E-Contents

NON CONVENTIONAL ENERGY SOURCES

3RD Semester
Electrical Engineering

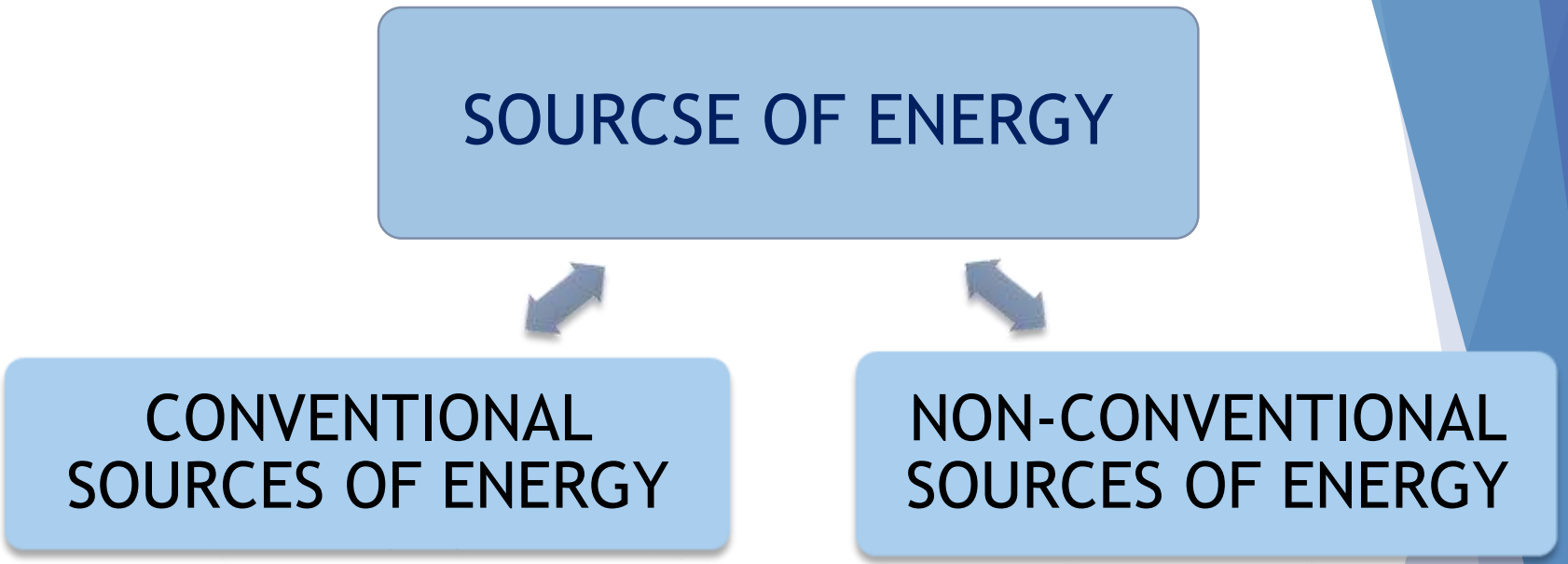
INTRODUCTION

ENERGY :-

Energy is defined as the or the capacity to do work. We use energy to do work Cars, planes, trolleys, boats, and machinery also transform one form of energy into another form of energy or work.

TYPES OF ENERGY :-

(1) Mechanical Energy
(2) Chemical Energy
(3) Electrical Energy
(4) Nuclear Energy
(5) Sound Energy
(6) Light Energy
(7) Heat Energy

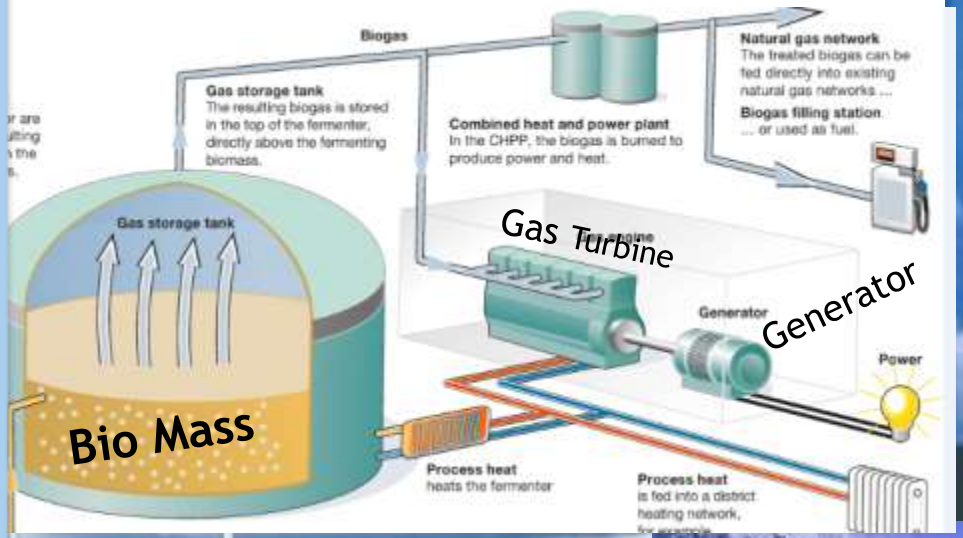

SOURCSE OF ENERGY
CONVENTIONAL SOURCES OF ENERGY
NON-CONVENTIONAL SOURCES OF ENERGY

CONVENTIONAL SOURCES OF ENERGY :-

Conventional energy directly mean the energy source which is fixed in nature like oil, gas and coal.

NON-CONVENTIONAL SOURCES OF ENERGY :-

These are also called renewable sources of energy. Examples are bio energy, solar energy, wind energy, tidal energy and geo-thermal energy.



Importance of non conventional energy sources:-

Non-conventional sources of energy are considered to be important as they are

Renewable,

Pollution-free,

Availability of them is in abundance, and they are

Environmentally friendly.

Present Scenario, Future Prospects and Energy Scenario in India:

In 1982 India was created, a separate Department of Non-Conventional Energy Sources (DNES) in the Ministry of Energy to look after all the aspects relating to New and Renewable Energy. The Department was upgraded into a separate Ministry of Non-Conventional Energy Sources (MNES) in 1992 and was rechristened as Ministry of New and Renewable Energy (MNRE), in October 2006.

In India, use of renewable energy is increasing day by day. Government of India announced in the year 2015, a target for 175 GW cumulative renewable power installed capacity by the year 2022. A capacity of 85.90GW has been set up by December 2019 constituting more than 23% of the total installed capacity. India has 4^{th} and 5^{th} global positions in the wind and solar power deployment respectively. Since 2013-14 till December 2019, the renewable power deployment has more than doubled.

Sector-wise energy consumption (domestic, industrial, agriculture etc.)

Consumption of Coal and Lignite:

- The estimated total consumption of raw coal by industry has increased from 549.57MT during 2008-09 to 896.34 MT during 2017-18
- Consumption of Lignite increased from 31.85 MT in 2008-09 to 45.82 MT in 2017-18.
- Consumption of Lignite in Electricity Generation sector is the highest, accounting for about 83.7% of the total lignite consumption.
- The maximum consumption of raw coal is in Electricity generation, followed by steel industry. Industry-wise estimates of consumption of coal shows that during 2017-18, electricity generating units consumed 576.19 MT of coal.

Consumption of Crude Oil and Natural Gas:

- The estimated consumption of crude oil has a steady increased from 160.77 MMT during 2008-09 to 251.93 MMT during 2017-18
- The maximum use of Natural Gas is in fertilizers industry (27.78%) followed by power generation (22.77%) and 16.25% natural gas was used for domestic fuel for transport sector.

Consumption of Petroleum Products:

- High speed diesel oil consumed 39.3% of total consumption (Excluding refinery fuel and loses) of all types of petroleum products in 2017-18.
- Sector-wise total consumption of different petroleum products contributes 54% in the total consumption followed by Domestic sector with contribution 18 %.

Consumption of Electricity:

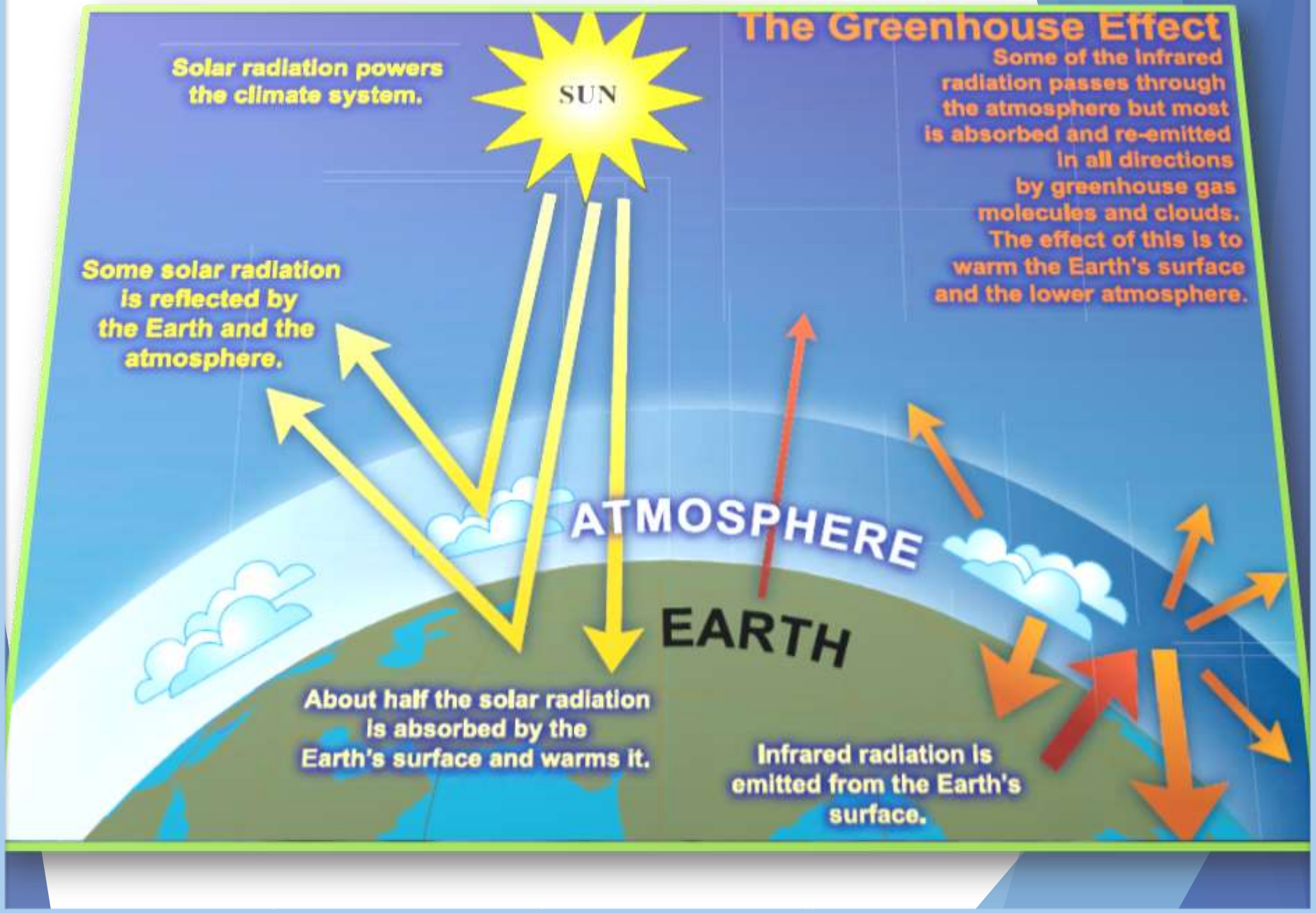
- The estimated electricity consumption increased from 553995 GWh during 2008-09 to 11, 30,244GWh during 2017-18. The percentage increase in electricity consumption is 6.51% from 2016-17 to 2017-18.
- The total consumption of electricity in 2017-18, industry sector (41.48%), followed by domestic (24.20%), agriculture (18.08%) and commercial sectors (8.51%).
- The electricity consumption in industry sector and domestic sector has increased at a much faster pace compared to other sectors during 2008-09 to 2017-18.

SOLAR ENERGY

Solar energy is the most readily available source of energy. It does not belong to anybody and therefore, it is free. It is also the most important of the non-conventional sources of energy because it is non-polluting and, therefore, helps in lessening the greenhouse effect.

Principle of conversion of solar radiation into heat (The Greenhouse Effect) :-

- Energy from the sun in the form of radiation passes through the atmosphere where most of it is absorbed by the Earth.
- Some infrared radiation (heat) is reflected back into space.
- Greenhouse gases act as heat trap also known as atmosphere glass, trapping some of this infrared radiation (heat) return back to the earth to forms more heat on earth's surface. This process is called the greenhouse effect.
- Without greenhouse gases or glass, the average temperature on Earth would be 60º F cooler and life on Earth would look very different than it does today
- Increased amounts of greenhouse gases, produced through human activities, act to strengthen the natural greenhouse gas effect. The enhanced greenhouse effect leads to increased average global surface temperatures and climate changes.


The Greenhouse Effect
Solar radiation powers the climate system.
SUN
Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.
Some solar radiation is reflected by the Earth and the atmosphere.
ATMOSPHERE
EARTH
About half the solar radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.

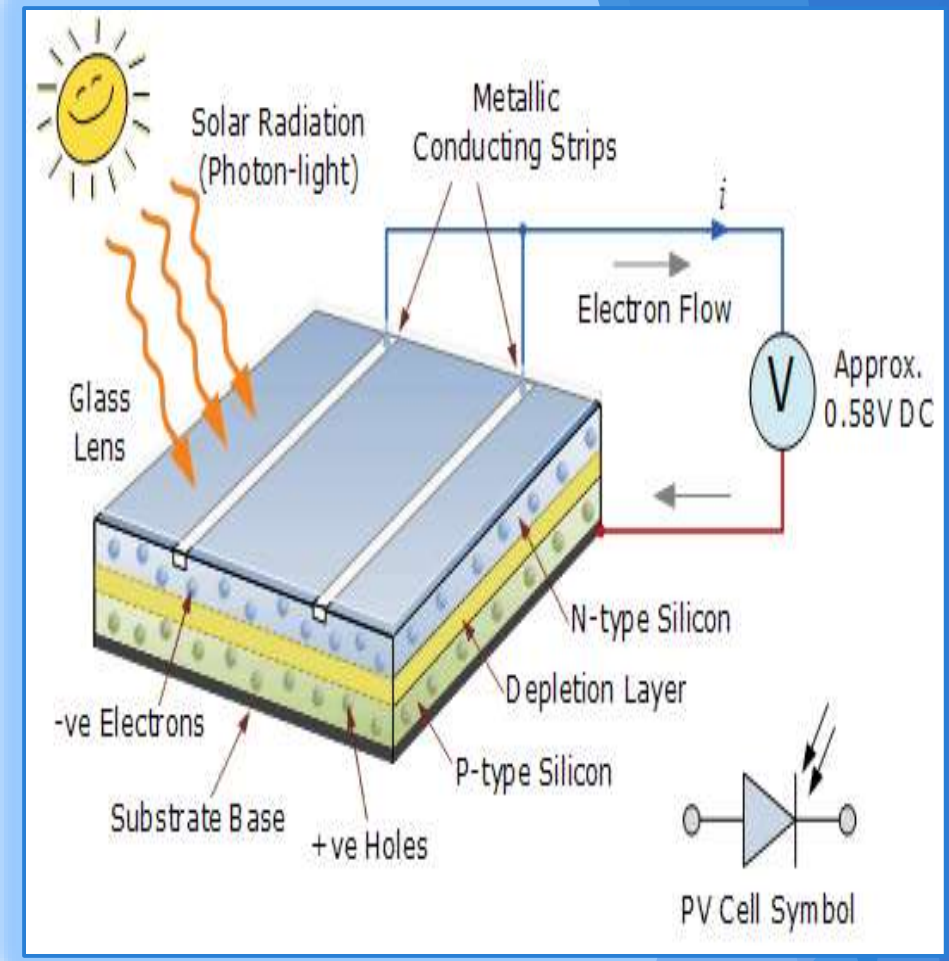
Applications of Solar Energy:-

Generally solar energy can be used in two ways as electricity and heat and Some of the major application of solar energy are as follows:

- Solar Electric Power Generation
- Solar Water Heating
- Solar Furnaces
- Solar Cooker
- Solar Lighting
- Solar Pumping

Solar Electric Power Generation (Photovoltaic cells) :-

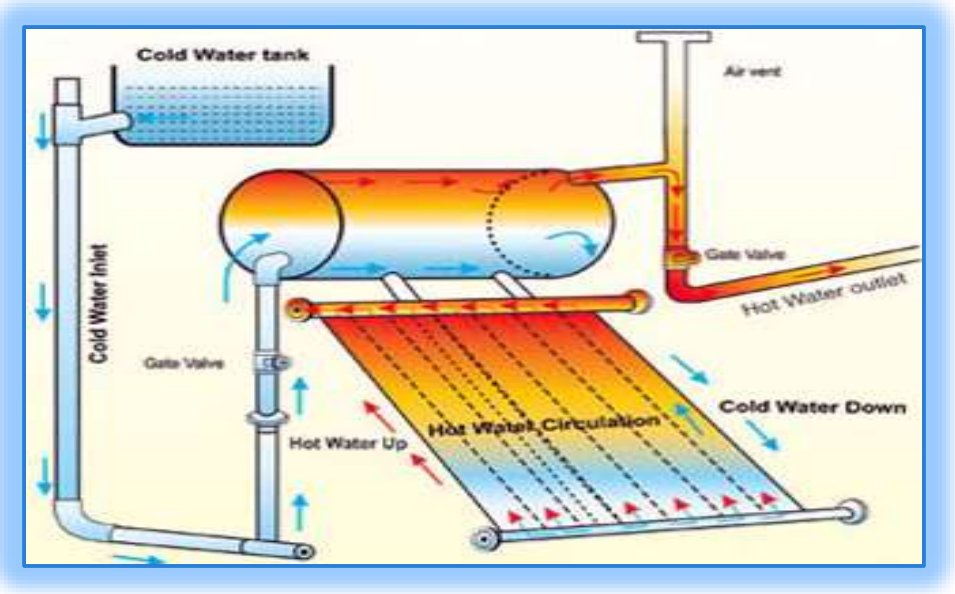
Electric energy can be produced directly from solar energy by means of photovoltaic cells. The photovoltaic cell is an energy conversion device which is used to convert photons of sunlight directly into electricity. It is made of semi conductors which absorb the photons received from the sun, creating free electrons with high energies. These high energy free electrons are induced by an electric field, to flow out of the semi- conductor to do useful work. This electric field in photovoltaic cells is usually provided by a p-n junction of materials which have different electrical properties.



APPLICATION OF SOLAR ENERGY

Solar Water Heating:-

A solar water heating unit consists a blackened flat plate metal collector with an associated metal tubing facing the general direction of the sun. The plate collector has a transparent glass cover above and a layer of thermal insulation beneath it. The metal tubing of the collector is connected by a pipe to an insulated tank that stores hot water during cloudy days

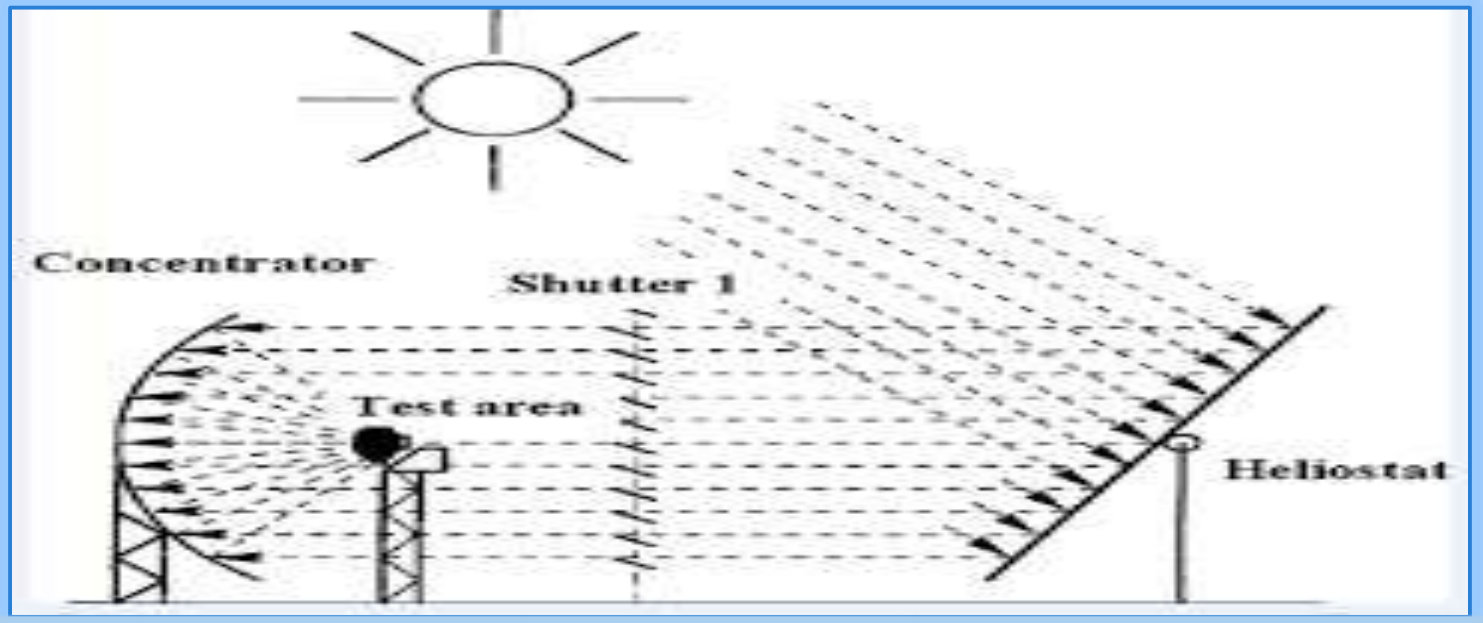


The collector absorbs solar radiations and transfers the heat to the water circulating through the tubing either by gravity or by a pump. This hot water is supplied to the storage tank via the associated metal tubing. This system of water heating is commonly used in hotels, guest houses, tourist bungalows, hospitals, canteens as well as domestic and industrial units.

Solar Furnaces:-

In a Solar furnace, high temperature is obtained by concentrating the solar radiations onto a specimen using a number of turn-able mirrors(Heliostats) arranged on a sloping surface.

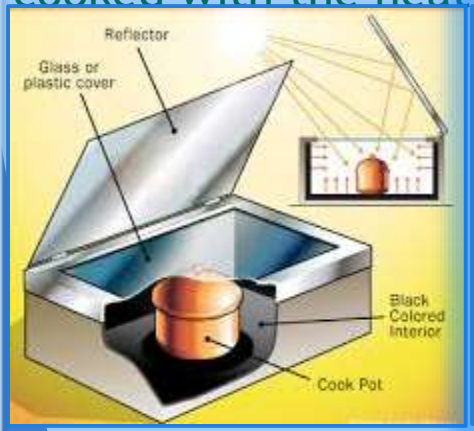
The solar furnace is used for studying the properties of ceramics at extremely high temperatures above the range measurable in laboratories with flames and electric currents. Temperature can be easily controlled by changing the position of the material or specimen in focus.



Solar Cooker :-

Fuel like coal, kerosene, cooking gas, fire wood, dung cakes and agricultural wastes are used for cooking purposes. Due to the energy crisis, supply of these fuels are either deteriorating or are too precious to be wasted for cooking purposes.

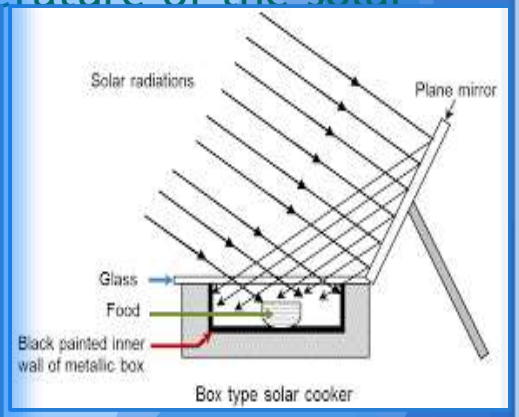
This necessitated the use of solar energy for cooking purposes and the development of solar cookers. A simple solar cooker is the flat plate box type solar cooker. It consists of a well insulated metal or wooden box which is blackened from the inner side and two glass covers are provided over the box. When solar cooker placed in sunlight, the solar rays penetrate the glass covers and are absorbed by the blackened surface thereby resulting in an increase in temp. inside the box. Cooking pots blackened from outside are placed in the solar box. The uncooked food gets cooked with the heat energy produced due to increased temperature of the solar



Box Type

Solar Panel Cooker

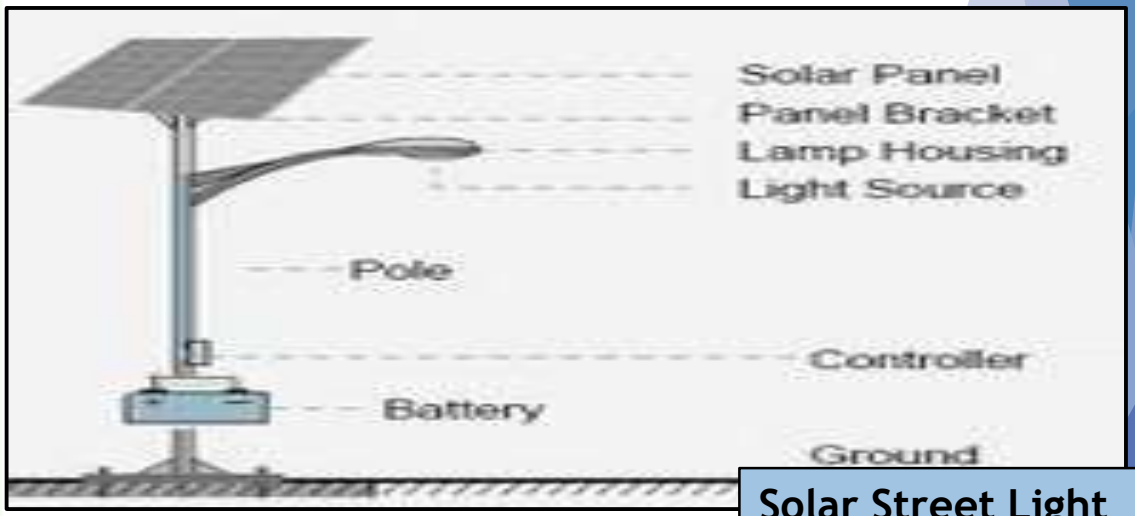
Parabolic Cooker



Single Line Box Type

Solar Lighting :-

Solar flood light The principle of how solar lighting works is actually quite simple. Because it is possible to collect the solar energy and transform it into lighting lies in the photovoltaic effect which is being used in a Solar panel or photovoltaic cell that is able to collect the solar energy which is produced by the Sun throughout the day-time. After being collected and converted in to electrical energy, the energy is usually stored in a battery. This stored energy used later in the evening when there is no sunlight to produce lighting. This type of solar lighting is mostly used in rural areas

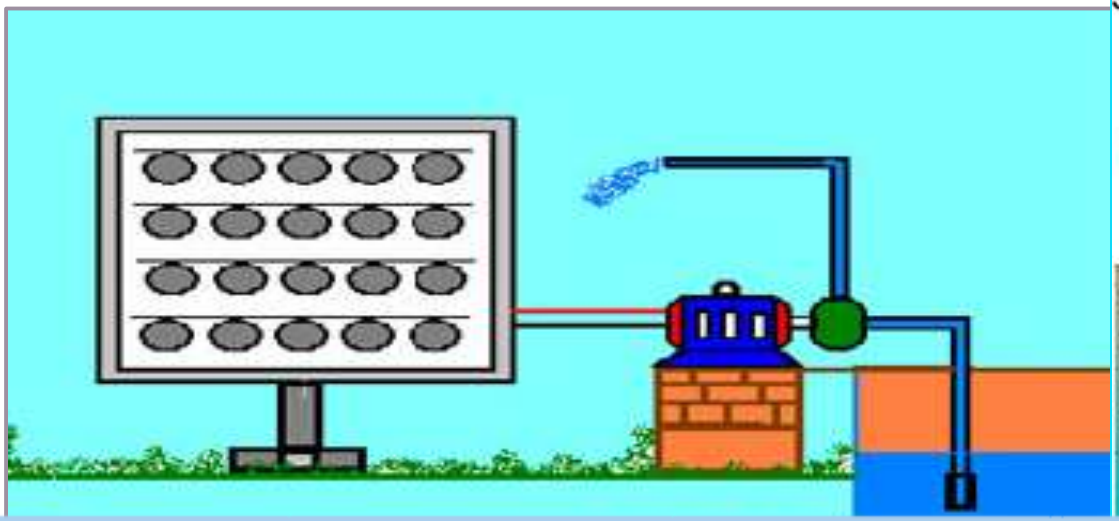


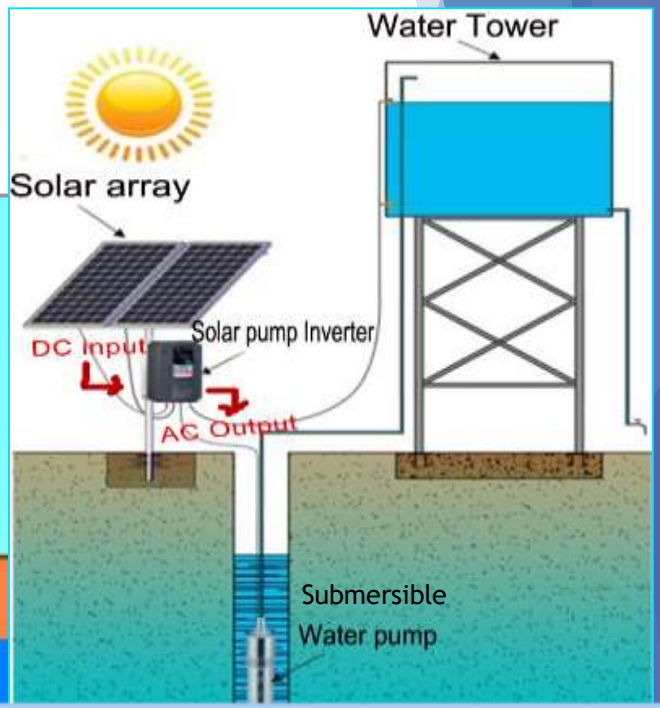
Solar Street Light

Solar Pumping :-

In the case of a solar pump, solar energy is converted into electricity and fed to a pump that circulates water. Solar pumps operate using three main components. Solar cells collect the sun's rays and convert them into usable electricity.. Wiring moves the electricity from the cells to the pump, and the pump does the work of moving the water.

Types of Solar Pumps :- There are two main types of solar pumps. Surface pumps sit above ground and move water through pipes. Surface pumps are commonly found on farms or large irrigation systems where water needs to be moved from a lake or other body to fields. There are also submersible solar water pumps. These units are installed underground, but the solar panels are connected above ground. Submersible pumps are used to move water from inside wells to the surface





BIO ENERGY

Bio energy is the energy which is stored in biological matter or “bio mass”. Biomass is organic material that comes from plants and animals, and it is a renewable source of energy. Biomass contains stored energy from the sun. Plants absorb the sun's energy in a process called photosynthesis. When biomass is burned, the chemical energy in biomass is released as heat. Biomass can be burned directly or converted to liquid bio fuels or biogas that can be burned as fuels.

Examples of biomass and their uses for energy :-

- Wood and wood processing wastes—burned to heat buildings, to produce process heat in industry, and to generate electricity
- Agricultural crops and waste materials—burned as a fuel or converted to liquid bio fuels
- Food, yard, and wood waste in garbage—burned to generate electricity in power plants or converted to biogas in landfills
- Animal manure and human sewage—converted to biogas, which can be burned as a fuel

BIO-MASS CONVERSION TECHNOLOGIES- WET AND DRY PROCESS

Conversion Process		Principal Product	Further Treatment	Product Fuel
Wet Process	Anaerobic Digestion	Methane and carbon dioxide	Carbon dioxide removal	Methane
	Fermentation	Ethane is produced oil	Distillation	Ethanol
	Chemical Reduction	Mixture of oil	Fractional distillation	Hydrocarbon liquids
	Liquid Faction	Char	Steam reforming and/or shift reaction	Methane
	Gasification	Char		Methanol
Dry Process	Steam Gasification	Char		Higher alcohols
	Hydrogenation	Mixture of oils	Fractional distillation	Hydrocarbon liquids

METHODS FOR OBTAING ENERGY FROM BIOMASS:-

1. Thermal Conversion is the use of heat, with or without the presence of oxygen, to convert biomass materials or feed stocks into other forms of energy. Thermal conversion technologies include direct combustion, pyrolysis.
2. Thermalchemical Conversion is the application of heat and chemical processes in the production of energy products from biomass. A key thermo chemical conversion process if Gasification.
3. Biochemical Conversion involves use of enzymes, bacteria or other microorganisms to break down biomass into liquid fuels, and includes anaerobic digestion, and fermentation.
4. Chemical Conversion involves use of chemical agents to convert biomass into liquid fuels.

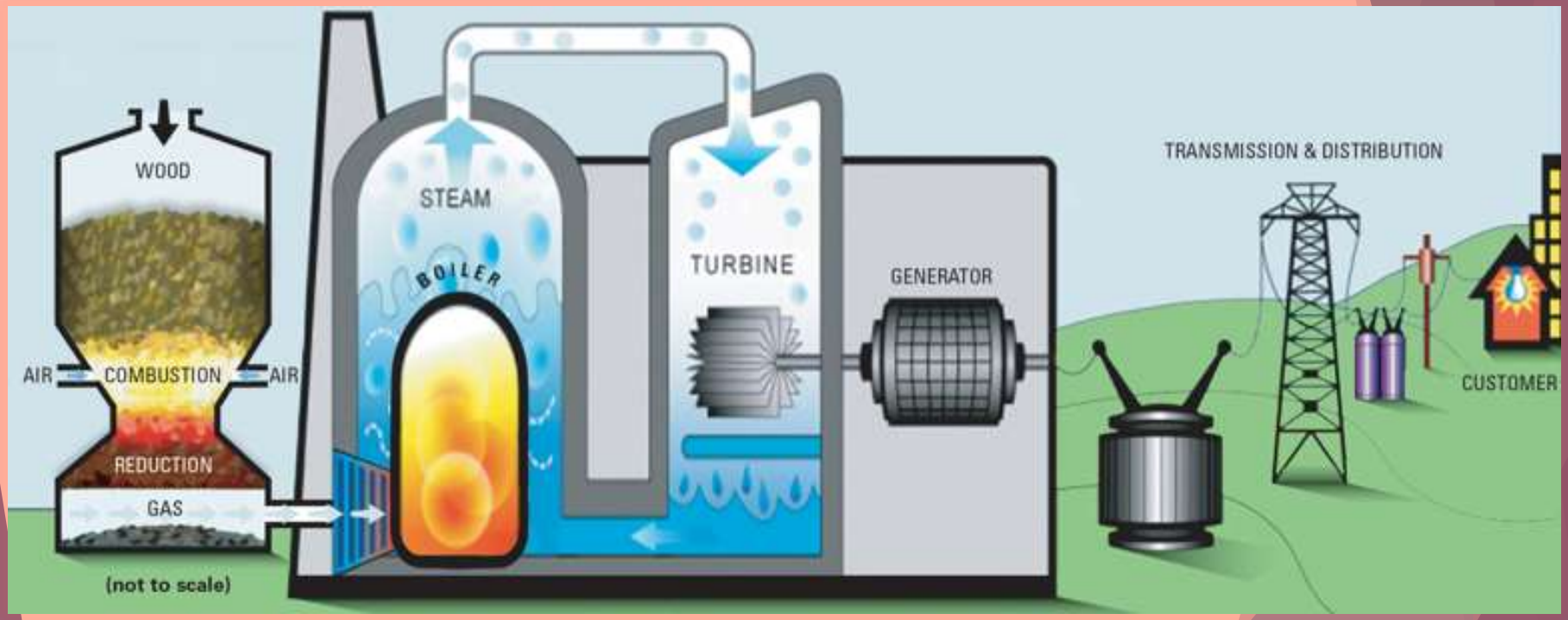
GASIFIER :-

A device is used for converting biomass into gas. Biomass is organic material that can be converted into fuel -- when you burn wood to heat your home, you're heating with biomass. However, burning plant material does not make full use of its potential energy. The process of gasification efficiently converts the biomass material into fuel for applications such as heating homes and power generation. The conversion of plant material or biomass into energy takes place inside a biomass gasifier device.

Gasifies equipments are generally classified as upward draft, downward draft and cross draft gasifies, based on the direction of air/oxygen and biomass flow in the equipment.

POWER GENERATION BY USING GASIFIERS:-

The biomass is burned in a gasifies to generate hot gas, which is fed into a boiler to generate steam, this high pressure steam rotate the steam turbine to produce mechanical energy and turbine connected with the generator which produced electrical energy or power.

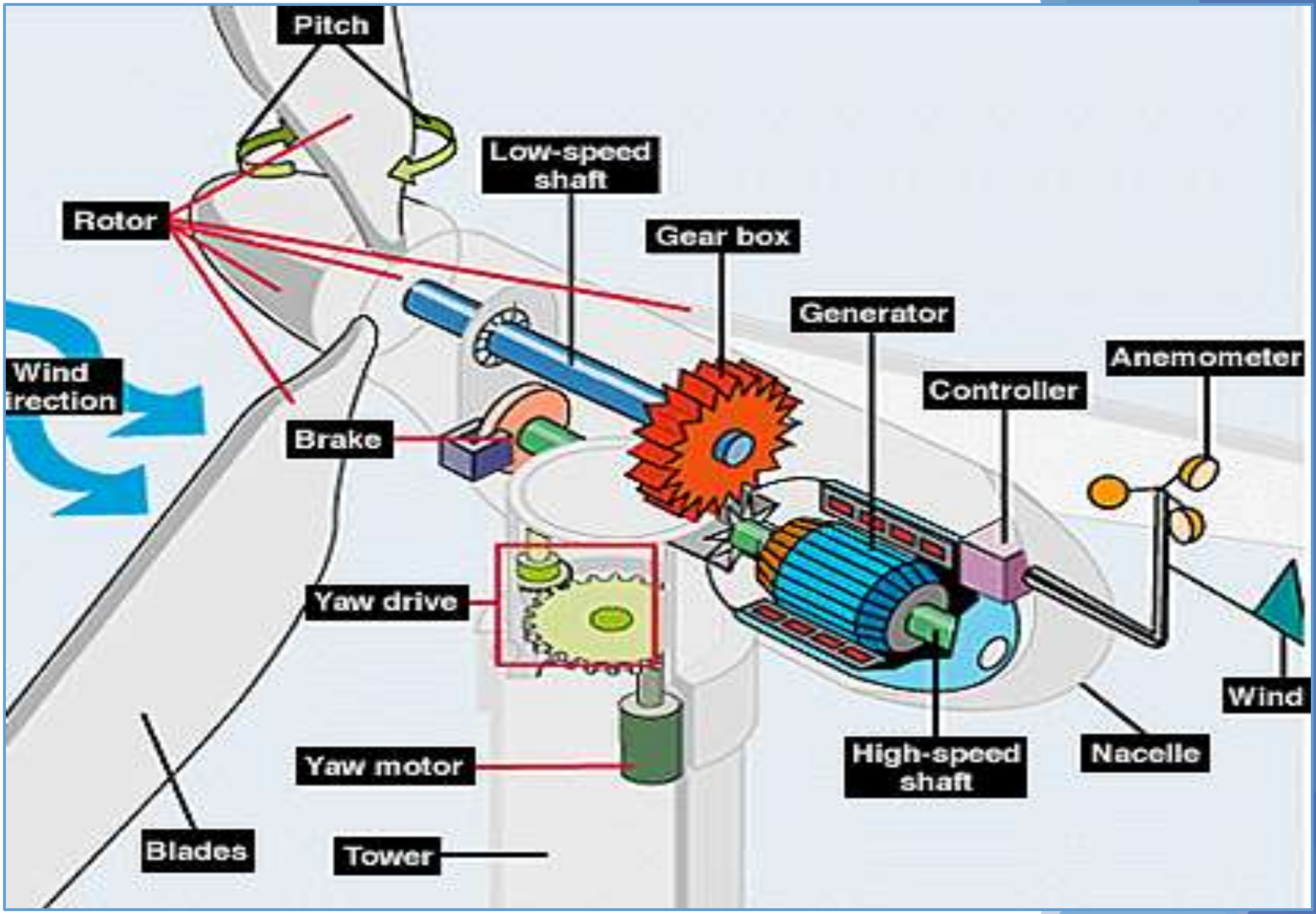


WIND ENERGY

Wind energy is a form of solar energy and is a result of the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and the rotation of the earth, The terms wind energy or wind power describe the process by which the wind is used to generate mechanical power or electricity

HOW WIND TURBINE WORKS :-

When the wind strikes the rotor blades, blades start rotating. The rotor is directly connected to a high-speed gearbox. Gearbox converts the rotor rotation into high speed which rotates the electrical generator. An exciter is needed to give the required excitation to the coil so that it can generate required voltage. The exciter current is controlled by a turbine controller which senses the wind speed based on that it calculates the power what we can achieve at that particular wind speed.



Construction Diagram of HAWT

TYPES OF WIND TURBINE :-

There are generally two types of wind turbines. The horizontal axis and vertical axis. The horizontal axis is divided as upwind and downwind whereas vertical axis is divided as a drag based and lift based as shown in below figure .

- Horizontal Axis Wind Turbine or HAWT - Up wind and Down wind
- Vertical Axis Wind Turbine or VAWT - Drag based and Lift based

HAWT

VAWT

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Etc.


THANKYOU