Welcome to my presentation on

Power Plant Engineering(27152)

About Subject

Subject: Power Plant Engineering

For the Students of 5th Semester Power Technology

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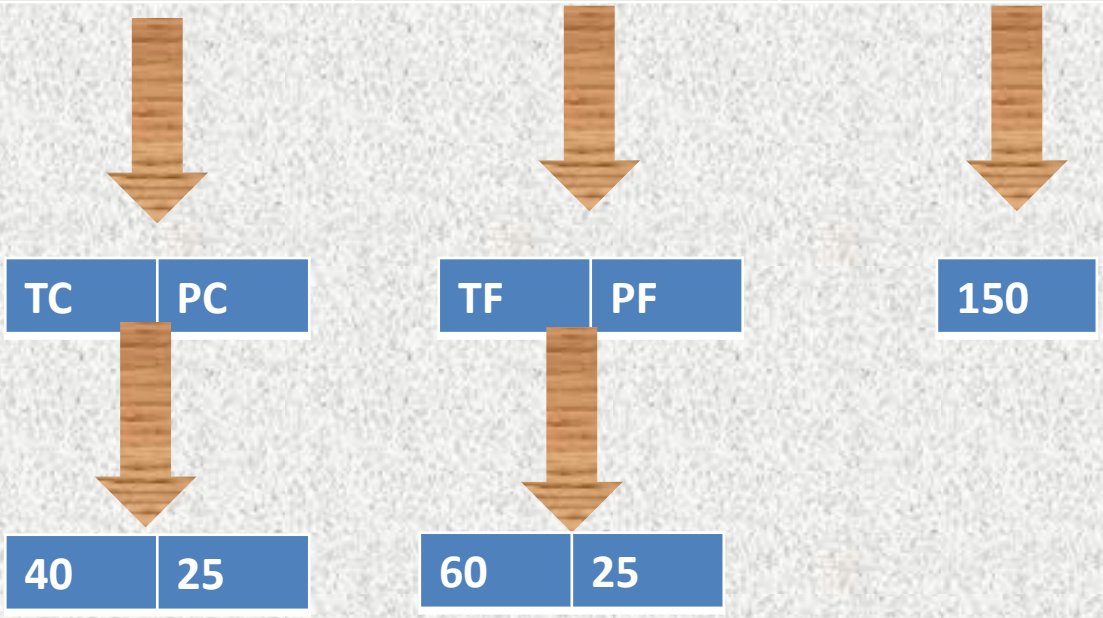

ডিপ্লোমা-ইন-ইঞ্জিনিয়ারিং পাওয়ার বিভাগের ৫ম পর্ব ছাত্র/ছাত্রীদের জন্য ডিজিটাল কন্টেনের মাধ্যমে ক্লাস

বিষয়ঃ- পাওয়ার প্ল্যান্ট ইঞ্জিনিয়ারিং

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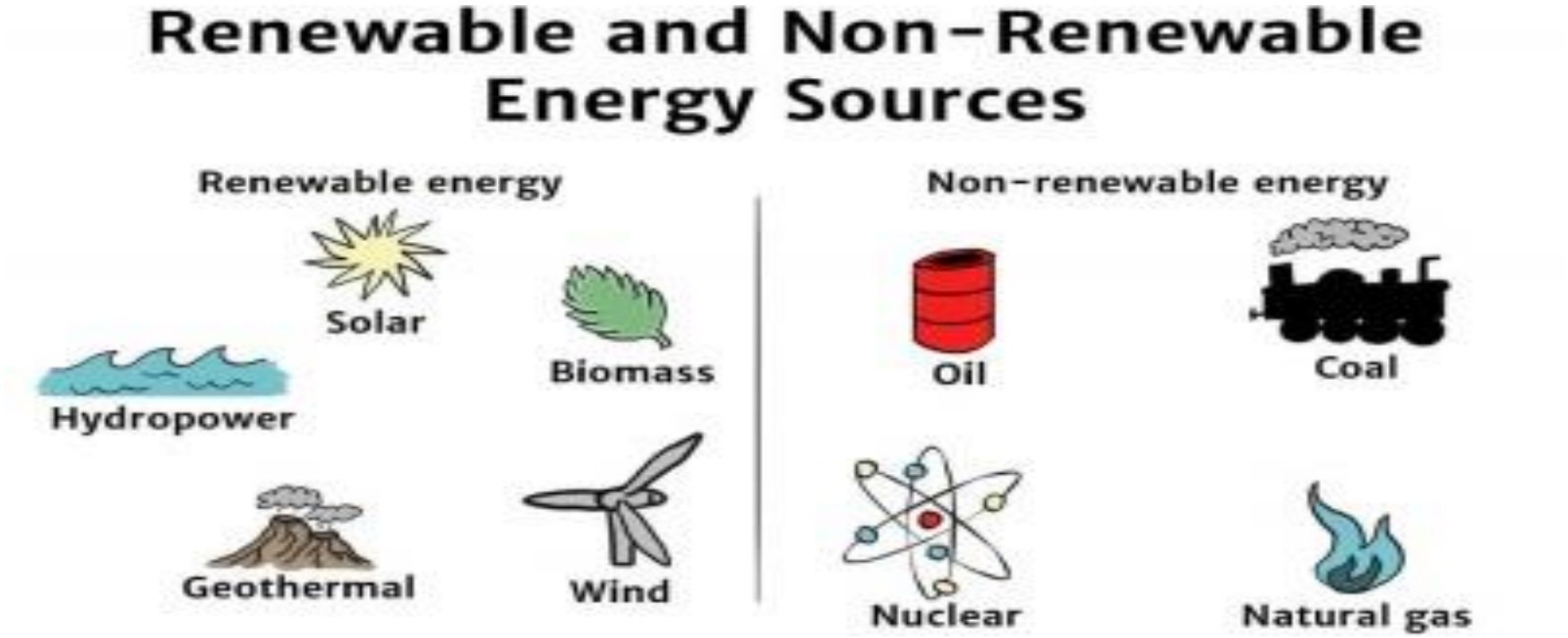
Chapter-1
Source of Energy and Concept Power plant

What is source of energy: A source from which useful energy can be extracted or recovered either directly or by means of a conversion or transformation process (e.g. solid fuels, liquid fuels, solar energy, biomass, etc.)



List the various source of Energy

- **Here is an overview of each of the different sources of energy that are in use, and what's the potential issue for each of them.**
- Solar Energy
- Wind Energy
- Geothermal Energy
- Hydrogen Energy
- Tidal Energy
- Wave Energy. ...
- Hydroelectric Energy
- Biomass Energy.

Mention the sources of energy available in Bangladesh

- Solar
- Wind Power
- Biomass Energy
- Biogas Energy
- Hydro Power
- Geothermal Energy
- Tidal Power
- Ocean Wave Energy

Concept Power plant

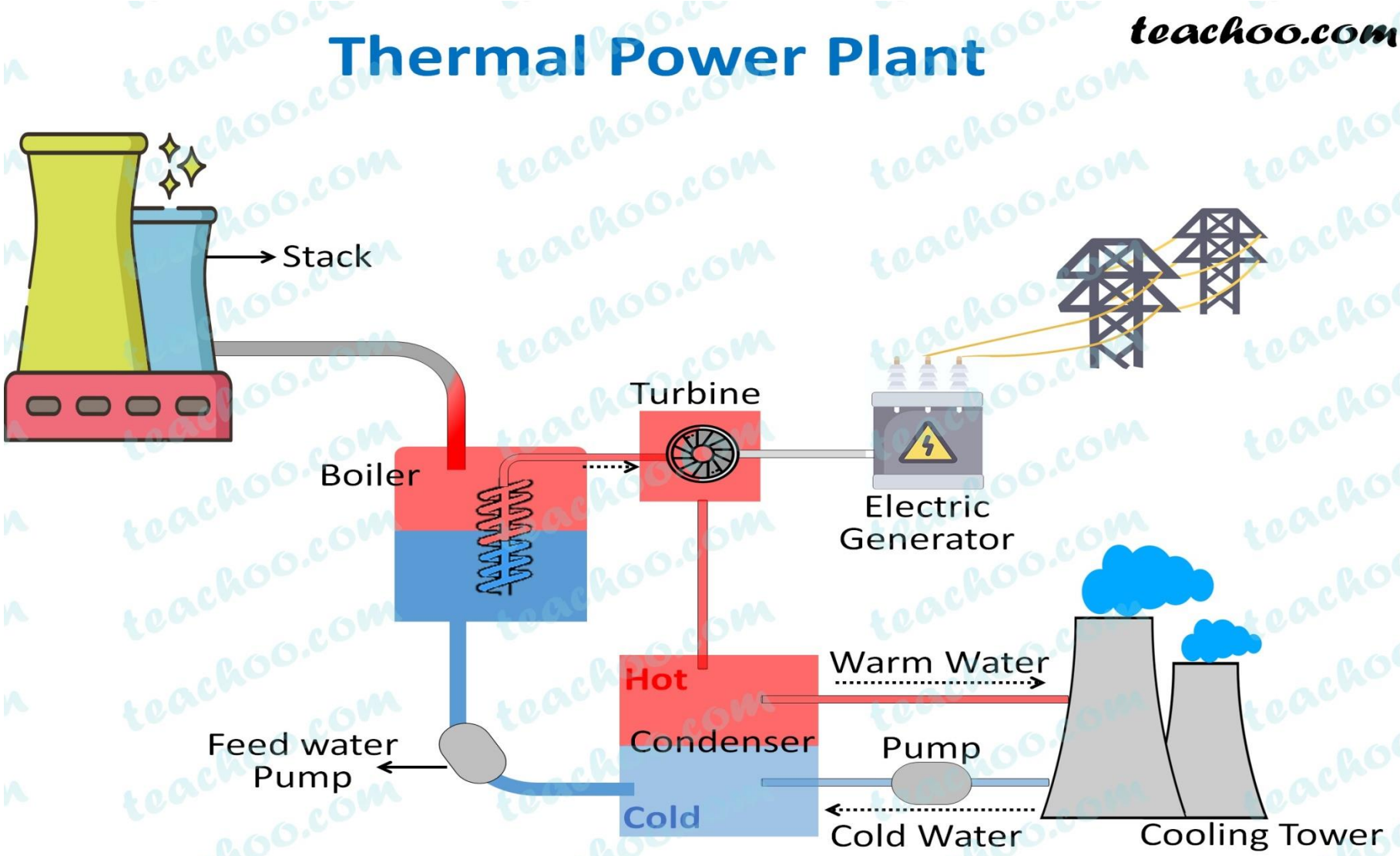
- **What is Power Plant**

A *power plant* is an industrial facility used to generate electric *power* with the help of one or more generators which converts different energy sources into electric *power*.All electricity produced in a *power plant* is alternating current (AC).

- **Importance of power Plant:**

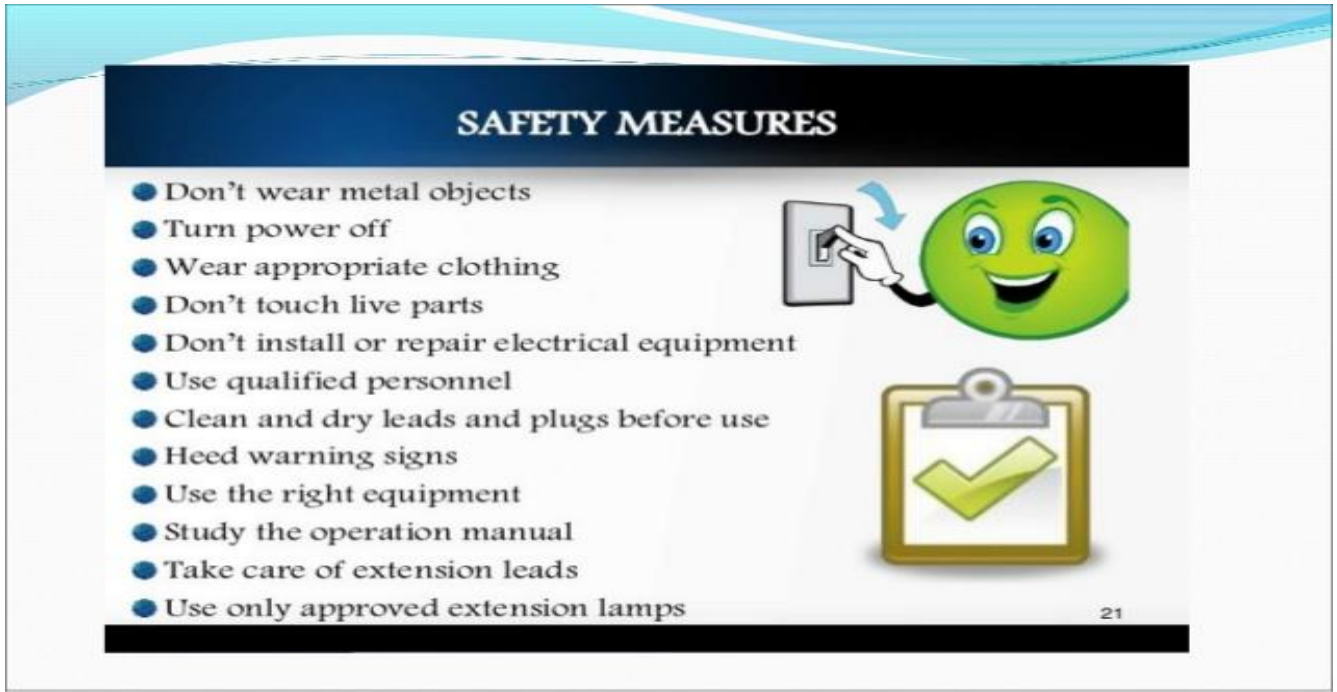
To provide the large amounts of steady power demanded by modern societies, large power plants have been built. Most power plants make electricity with a machine called a generator. Generators have two important parts: the rotor (which rotates) and the stator (which remains stationary).

Concept Power plant



Extract the safety rule of power plant

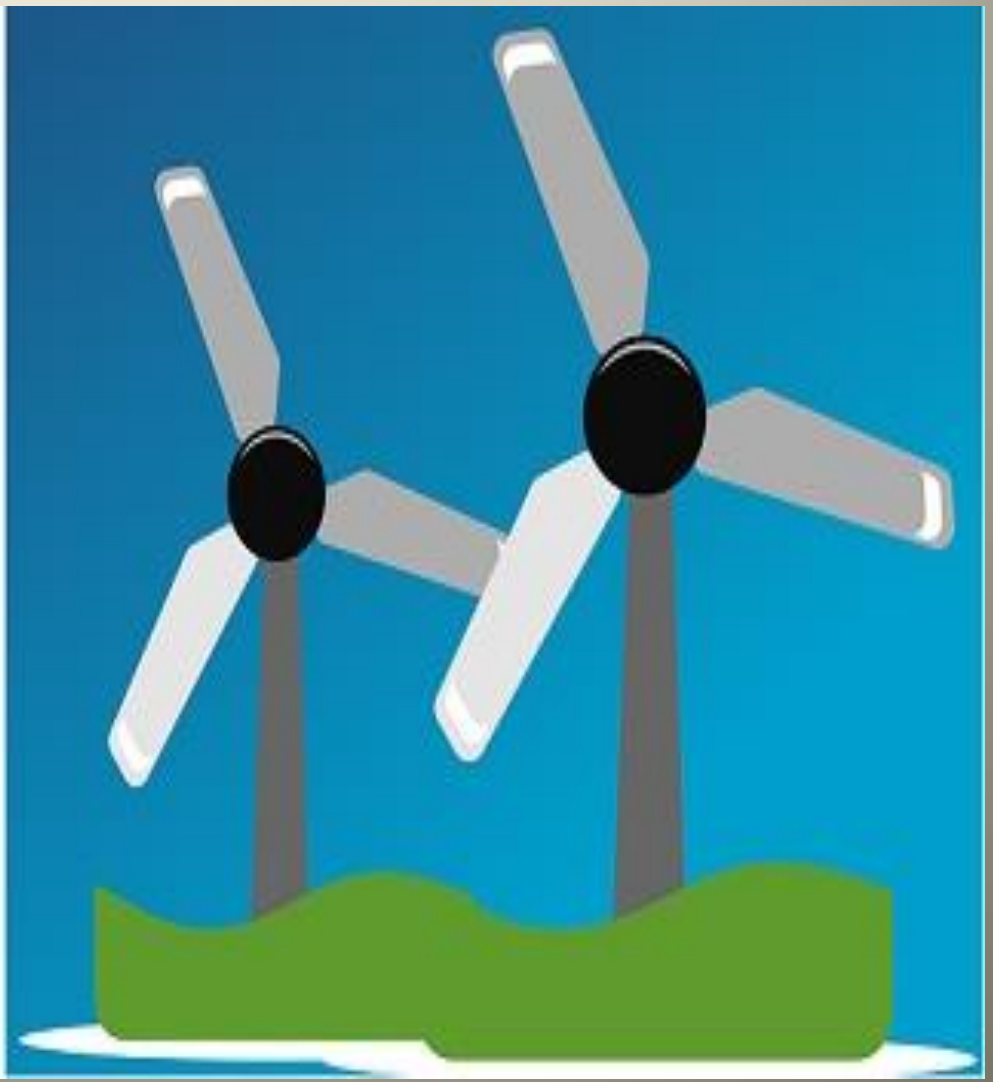
- Power plant safety: Among the most common hazards to power plant workers are electrical shocks and burns, boiler fires and explosions, and contact with hazardous chemicals. While these are most certainly not the only hazards encountered by power plant workers, they are definitely worth review.



Compare the conventional and non-conventional energy

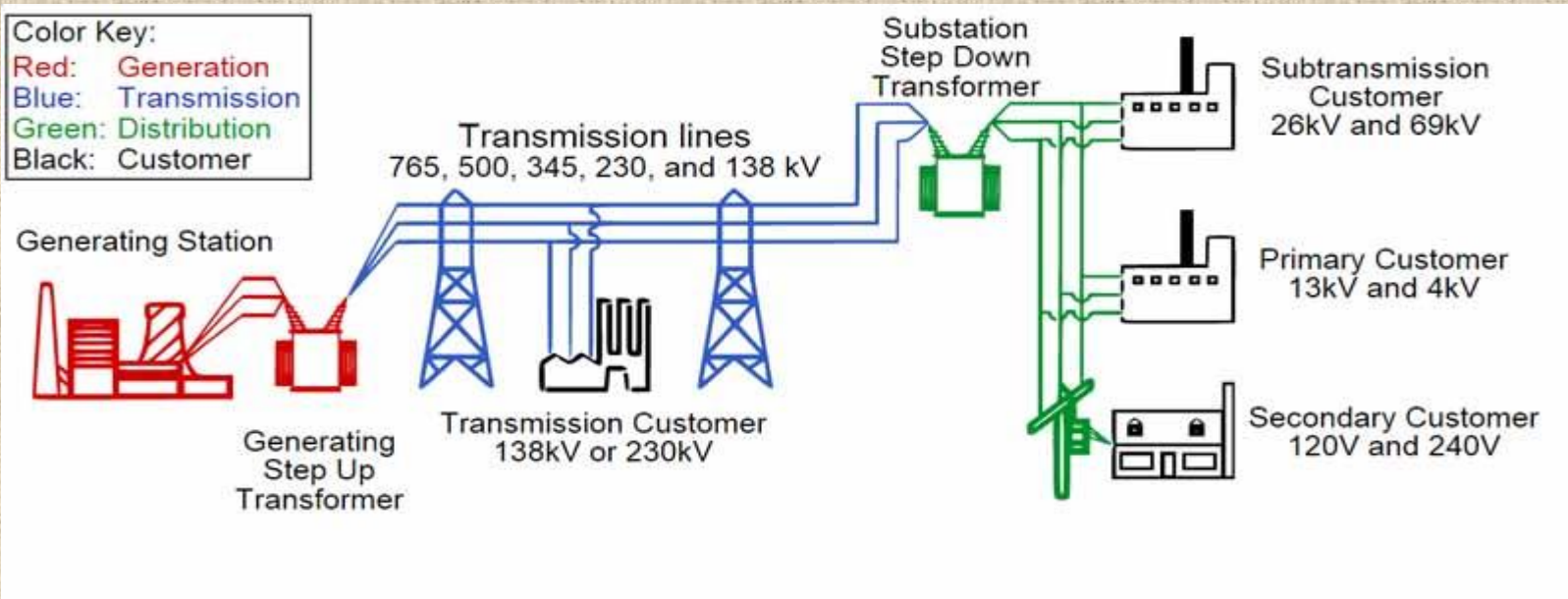
Conventional Sources	Non-Conventional Sources
Conventional energy, such as thermal powers (from coal, petroleum, and natural gas), hydel power (from high velocity of running water) are tapped and used abundantly at present.	non-conventional sources of energy (solar energy, tidal energy, geo-thermal energy, wind energy etc) are not used frequently and in large scale (commercially).
Their uses are practiced for a long time.	Their uses are comparatively more recent.
Except hydel power, the sources of thermal power i.e. other conventional energies are non renewable in nature.	But the sources of non-conventional energy are flow-resources. There is no anxiety for their exhaustion.
Except hydel power, the generation of other conventional energy produces air pollution.	But the generation of non-conventional energy does not produce air pollution.
Except hydel power, the other conventional energy is costly.	But comparatively, the non-conventional energy is much cheaper.

conventional and non-conventional energy



Grid System

- An electric grid is a network of synchronized power providers and consumers that are connected by transmission and distribution lines and operated by one or more control centers. When most people talk about the power "grid," they're referring to the transmission system for electricity



Chapter-2
Boiler

- **What is Boiler:**
- Boiler is a closed vessel in which water or other liquid is heated, steam or vapor is generated, steam is super-heated, or any combination thereof, under pressure or vacuum, for use external to itself, by the direct application of *energy from the combustion of fuels*, from electricity or nuclear energy. The boiler is a primary part of global heating system in power plants. ”

Boiler

Classification of Boilers

1. According to relative position of water and hot gases.

   a. Water tube boiler: A boiler in which the water flows through the tubes which are surrounded by hot combustion gases i.e. Babcock and Wilcox, Stirling, Benson boilers etc.

   b. Fire tube boiler: A boiler in which the hot combustion gases pass through the boiler tubes, which are surrounded by water i.e. Lancashire, Cochran, Locomotive boilers etc.

Classification of Boilers

According to water circulation arrangement

a. Natural circulation: Water circulates in the boiler due to density difference of hot and cold water e.g., Babcock and Wilcox boiler, Lancashire boiler, Locomotive boiler etc.

b. Forced circulation: A water pump forces the water along its path, therefore, the steam generation rate increases e.g.. Benson, La Mont, Velox boilers etc.

Classification of Boilers

According to position of furnaces:

Internally fired: The furnace is located inside the shell e.g., Cochran, Lancashire boilers etc.

b. Externally fired: The furnace is located outside the boiler shell i.e. Babcock and Wilcox, Stirling boilers etc.

c. According to the use: Stationary, Portable, Locomotive or marine boiler.

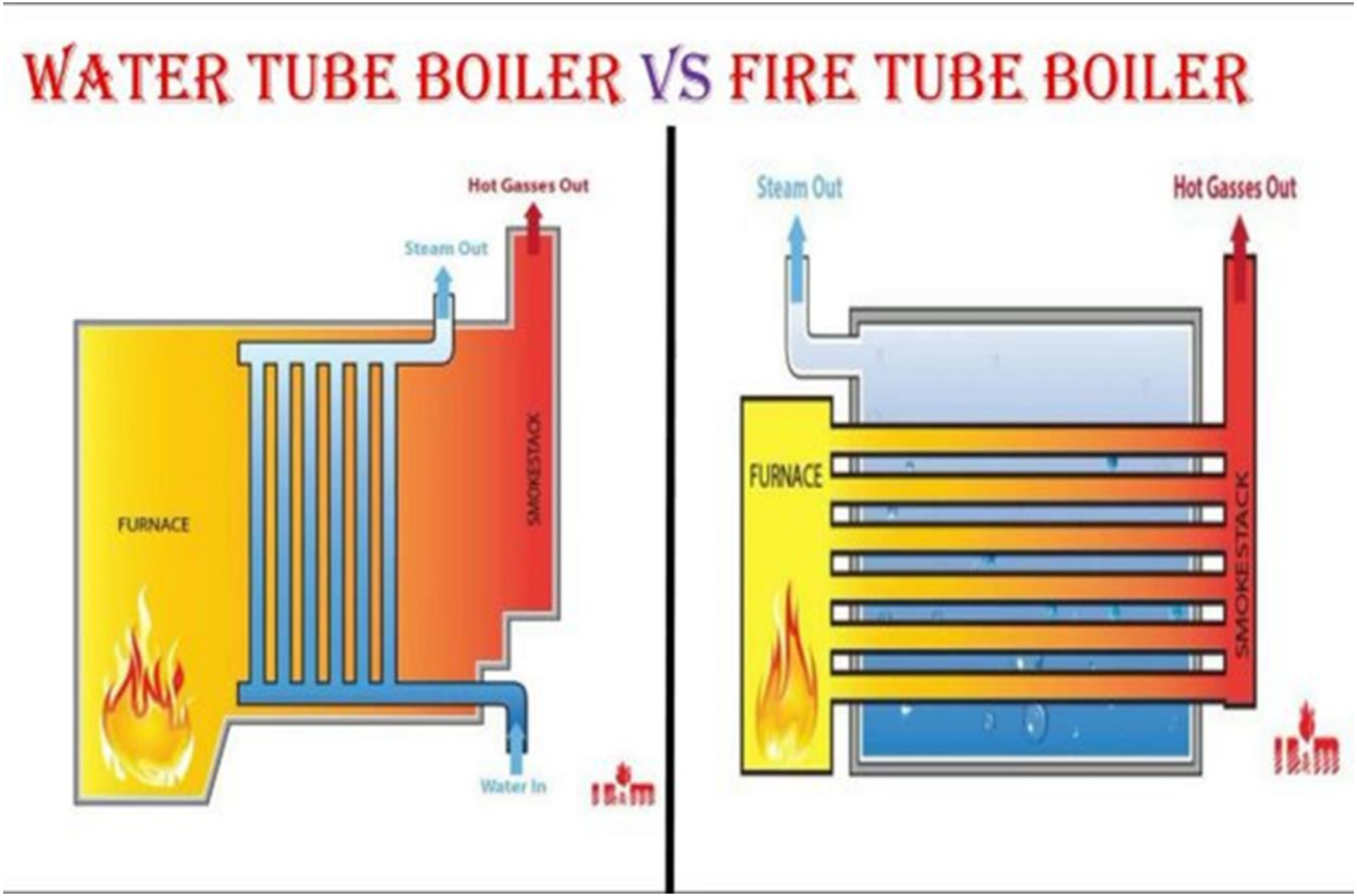
5. According to position of the boilers: horizontal, inclined or vertical boilers.

6. In order of increasing capacity:Fire-tube, water-tube and waterwall boilers.

Compare between Water & Fire Tube Boiler

Water Tube Boiler	Fire tube Boiler
i) The water circulates inside the tubes which are surrounded by the hot flue gases from the furnace.	i) The hot gases from furnace passes through the tubes which are surrounded by water.
ii) It generates steam at a higher pressure up to 165 bar.	ii) It can generate steam only up to 24.5 bar.
iii) The rate of generation of steam is high, up to 450 tons/hrs	iii) The rate of generation of steam is low, up to 9 tons/hrs
iv) Its overall efficiency 90%	iv) Its overall efficiency is only 75%
v) Its operating cost is high	v) Its operating cost is less
vi) The bursting chance of water tube boiler is more	vi) The bursting chance of fire tube boiler is less
vii) It is used for large power plant	vii) It is not suitable for large power plants
viii) Examples: • Babcock and Wilcox boiler • Stirling boiler • La-Mont boiler • Benson boiler • Loeffler boiler • Yarrow boiler	viii) Examples: • Simple vertical boiler • Cochran boiler • Lancashire boiler • Cornish boiler • Scotch boiler • Locomotive boiler • Velcon boiler

Compare between Water & Fire Tube Boiler



Utility of Boiler

- Power sector
- Textiles
- Sugar plant
- Thermal power plant
- Plywood
- Food processing industry
- FMCG
- Steam Power Plant

Boiler Efficiency

- Definition of Boiler Efficiency is “The percentage of the total absorption heating value of outlet

steam in the total supply heating value.”

In other word, it is a rate how the boiler runs efficiently. The actual calculation for the boiler

- efficiency is the followings;

(Steam value per hour :kg) × (h2－h1) × 100

Boiler Efficiency = (%)

(Fuel consumption per hour :kg) × (Fuel low calorific heating value : kJ/kg)

h2: The ratio enthalpy of feed water (kJ/kg)

h1: The ratio enthalpy of steam (kJ/kg)

Boiler Scaling

- Well, a scale is a deposit formed over the heat transfer surface when the solubility limits of the constituents of water are exceeded resulting in the precipitation of compounds over the surface. Scales are nothing but salts of Calcium and Magnesium (existing primarily in the form of sulphates or carbonates), which are highly insoluble in water.

Boiler blowdown

- **Boiler blowdown** is water intentionally wasted from a boiler to avoid concentration of impurities during continuing evaporation of steam. The water is blown out of the boiler with some force by steam pressure within the boiler. Bottom blowdown used with early boilers caused abrupt downward adjustment of boiler water level and was customarily expelled downward to avoid the safety hazard of showering hot water on nearby individuals.

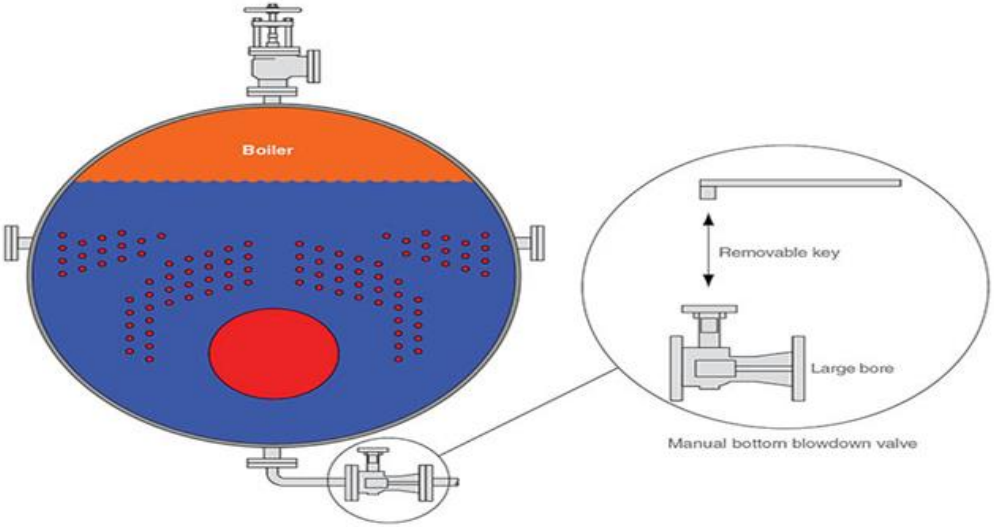


Fig. 3.14.2 Bottom blowdown valve with removable key

Boiler Capacity

- Since the amount of steam delivered varies with temperature and pressure, a common expression of the boiler capacity is the heat transferred over time expressed as British Thermal Units per hour. A boilers capacity is usually expressed as *kBtu/hour (1000 Btu/hour)* and can be calculated .

Minimum Relieving Capacity for Boiler Safety Valve

Minimum mass of steam per hour per heating surface area of oil-fired boilers, kg/h/m² (lb/h/ft²)

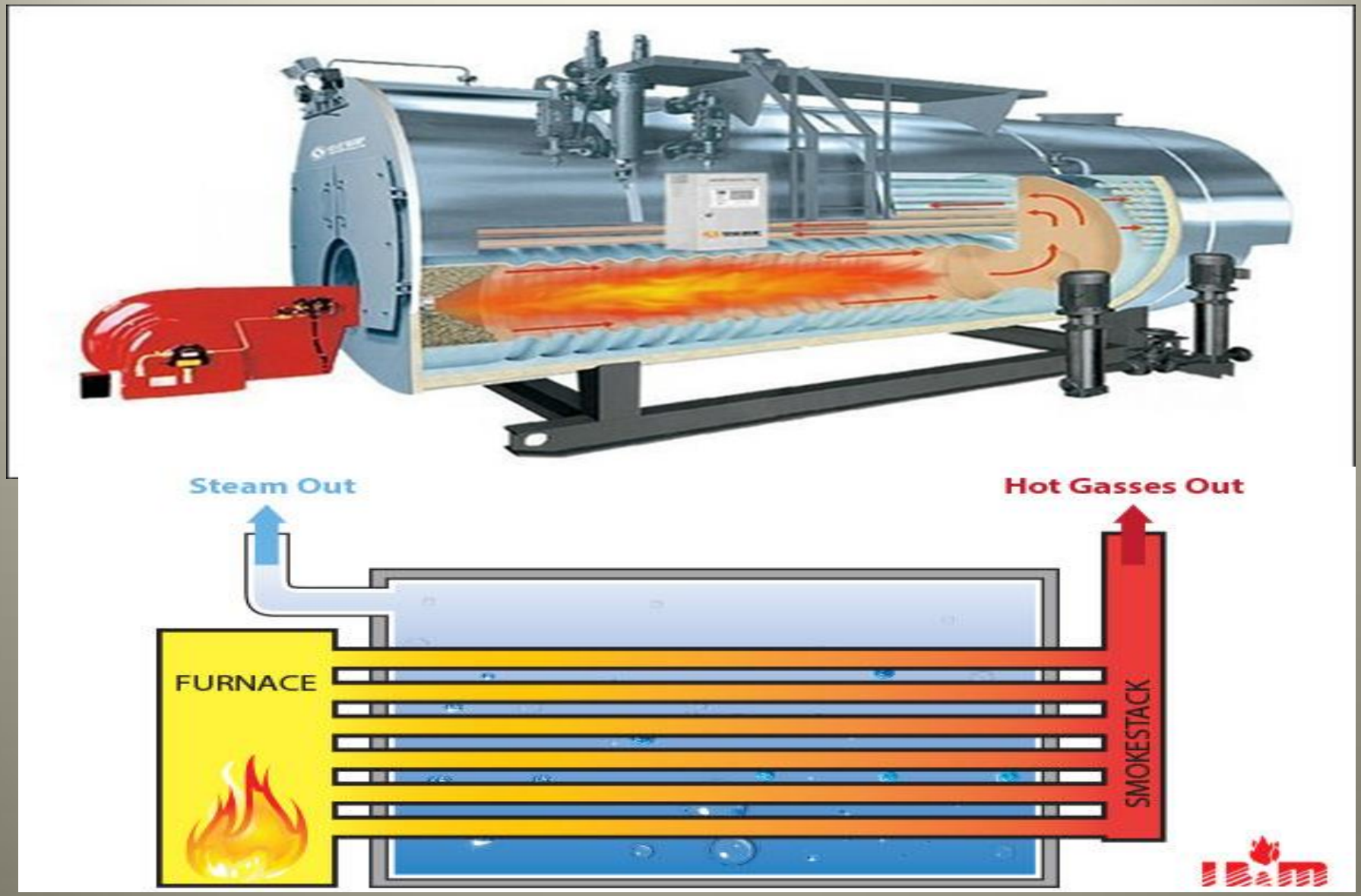
Boiler type	*Boiler heating surface*	*Waterwall surface*
Fire-tube	39.1 (8)	68.3 (14)
Water-tube	48.8 (10)	78.1 (16)

Fire Tube Boiler

- **Operation of fire tube boiler:** is as simple as its construction. In **fire tube boiler**, the fuel is burnt inside a furnace. The hot gases produced in the furnace then passes through the fire tubes. The fire tubes are immersed in water inside the main vessel of the boiler. As the hot gases are passed through these tubes, the heat energy of the gasses is transferred to the water surrounds them. As a result steam is generated in the water and naturally comes up and is stored upon the water in the same vessel of fire tube boiler.

- This steam is then taken out from the steam outlet for utilizing for required purpose. The water is fed into the boiler through the feed water inlet. As the steam and water is stored is the same vessel, it is quite difficult to produce very high pressure steam from. General maximum capacity of this type of boiler is 17.5 kg/cm^2 and with a capacity of 9 Metric Ton of steam per hour. In a fire tube boiler, the main boiler vessel is under pressure, so if this vessel is burst there will be a possibility of major accident due to this explosion.

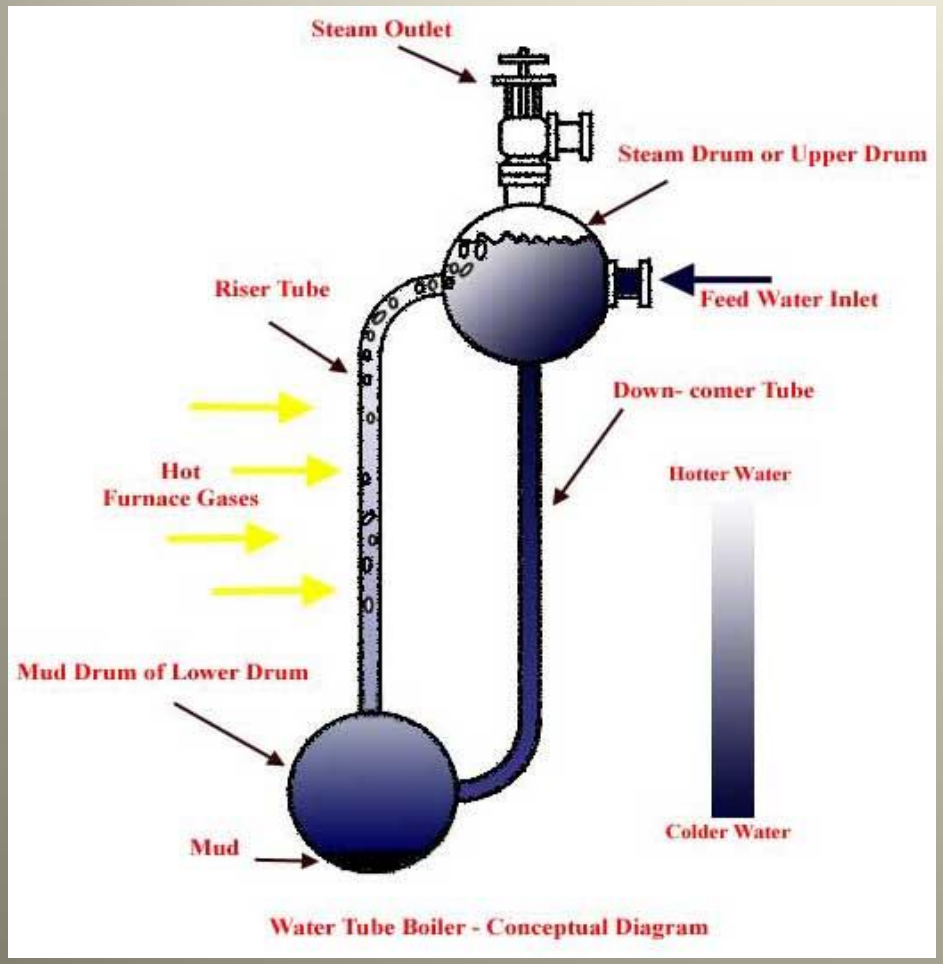
Fire Tube Boiler

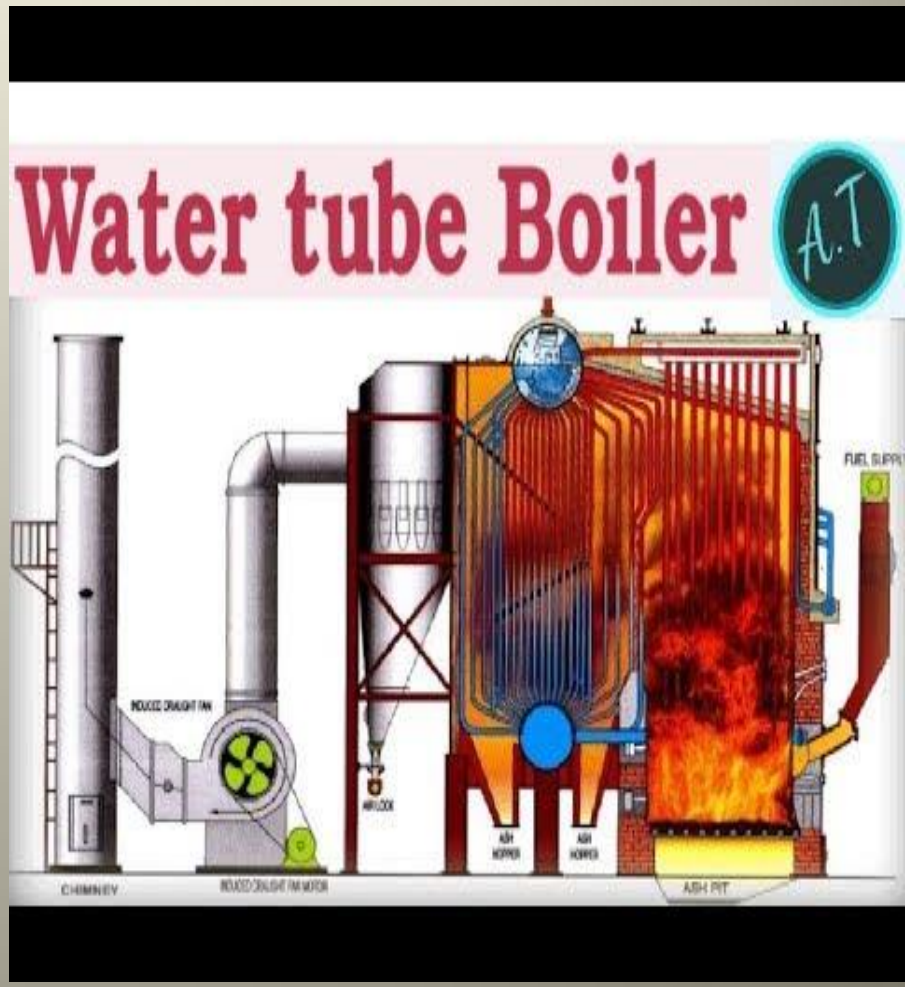


Water Tube Boiler

- It consists of mainly two drums, one is upper drum called steam drum other is lower drum called mud drum. These upper drum and lower drum are connected with two tubes namely down-comer and riser tubes as shown in the picture. Water in the lower drum and in the riser connected to it, is heated and steam is produced in them which comes to the upper drums naturally.
- In the upper drum the steam is separated from water naturally and stored above the water surface. The colder water is fed from feed water inlet at upper drum and as this water is heavier than the hotter water of lower drum and that in the riser, the colder water push the hotter water upwards through the riser. So there is one convectional flow of water in the boiler system.

Water Tube Boiler





Compare between Water & Fire Tube Boiler

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Boiler Mounting & Accessories:

- **Boiler Accessories:** **These are the devices which are used as integral parts of a boiler and help in running efficiently**

:Boilers Accessories:
:are as under:

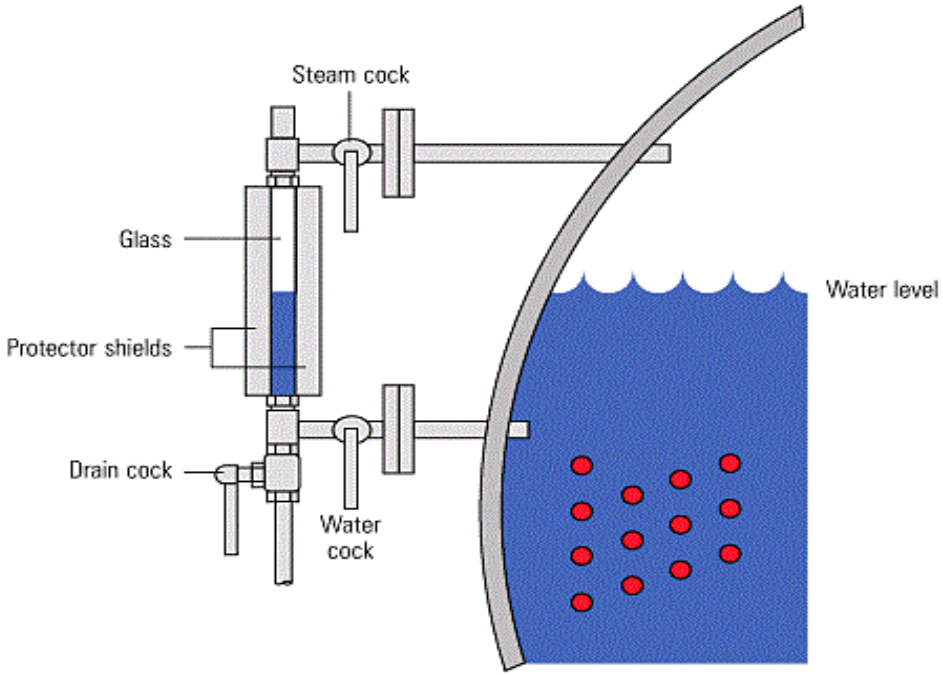
(1) Feed pump
(2) Injector
(3) Economiser
(4) Air preheater
(5) Superheater
(6) Steam separator
(7) Steam trap

Water Level indicator

1. It indicates the water level inside the boiler to an observer.
2. It is a safety device, upon which the correct working of the boiler depends.
3. It may be seen in front of the boiler, and are generally two in number.
4. It consists of steam cock , water cock and drain cock .

Water Level Indicator
how it works

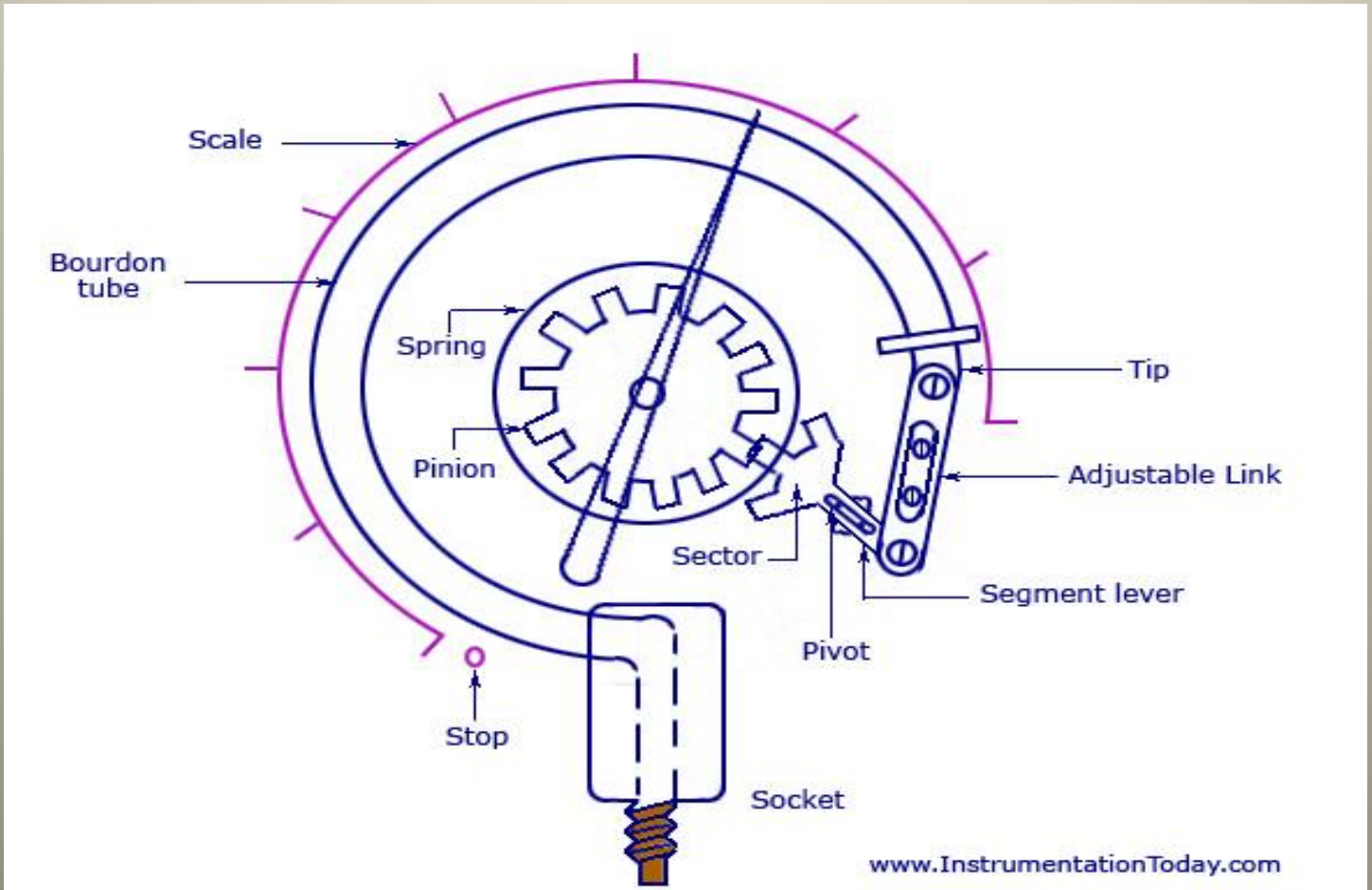
- When steam cock and water cock opened, steam rushes from upper passage and water rushed from lower from passage to the glass tube. This will indicate the level of water in the boiler. ... the ball are carrier along the passage to and of glass tube and



Pressure gauge

1. It is used to measure the pressure of the steam inside the steam boiler.
2. It is fixed in front of the steam boiler.
3. It consists of an elliptical elastic tube bent into an arc of a circle which is called Bourden's tube.
4. One end of the tube is fixed and connected to the steam space in the boiler and the other end is connected to a sector through a link.

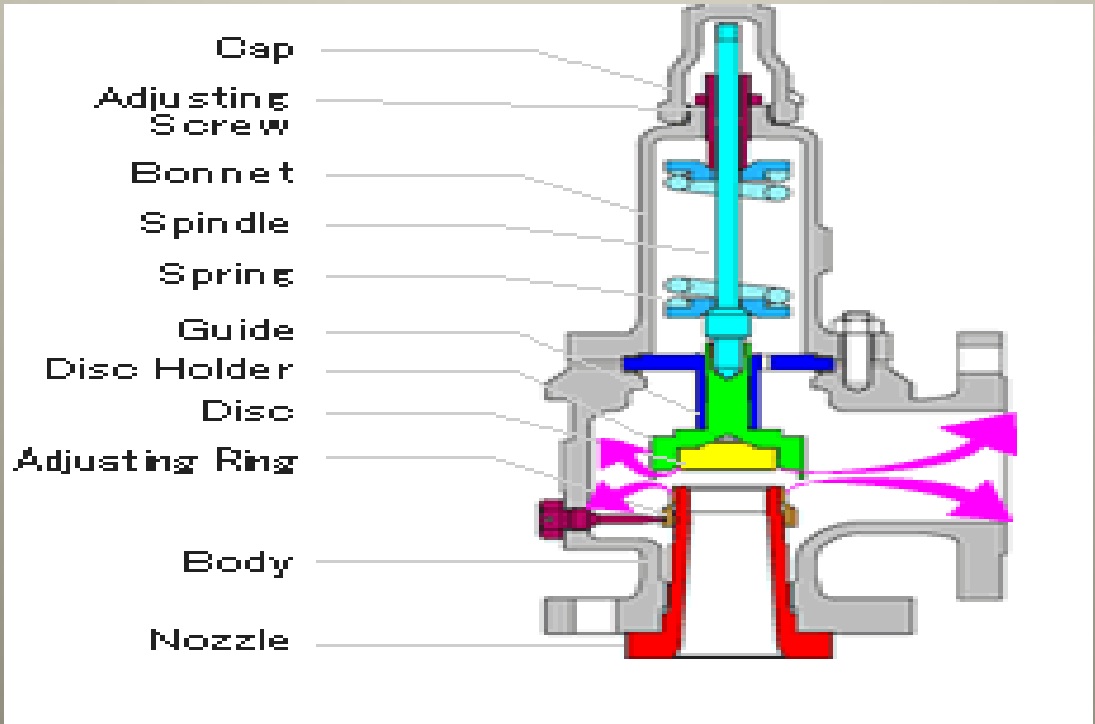
Pressure gauge



Bourdon Tube Pressure Gauge

Safety valve

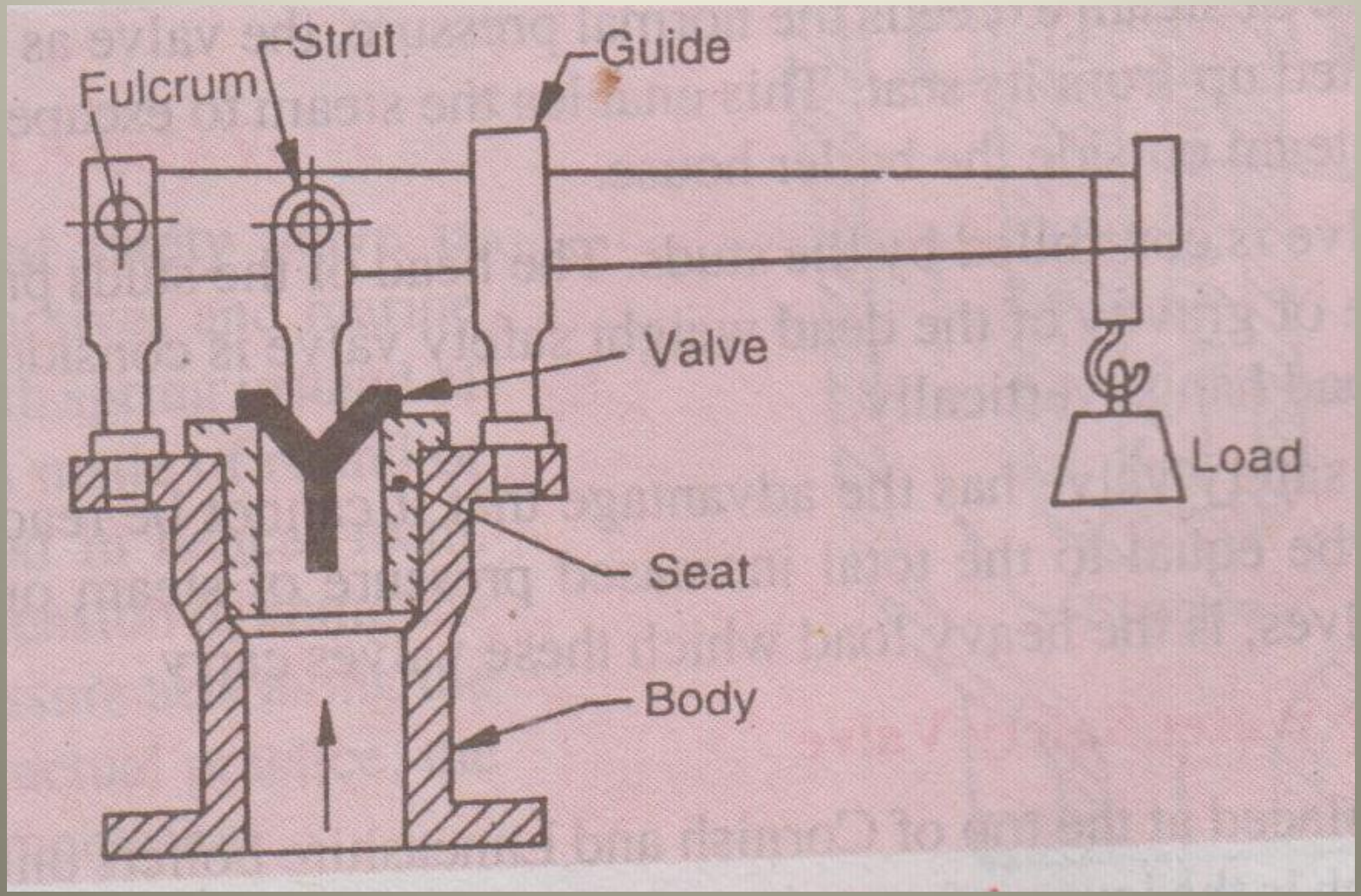
- **Safety Valve** is a type of **valve** that automatically actuates when the pressure of inlet side of the **valve** increases to a predetermined pressure, to open the **valve** disc and discharge the fluid (steam or gas) ; and when the pressure decreases to the prescribed value, to close the **valve** disc again.



Lever safety valve

1. It serves the purpose of maintaining constant safe pressure inside the steam boiler.
2. It consists of a valve body with a flange fixed to the steam boiler, a bronze valve seat screwed to the body and a bronze valve.
3. The thrust on the valve is transmitted by the strut.
4. When the pressure of steam exceeds the safe limit, the upward thrust of steam raises the valve from its seat and allows the steam to escape till the pressure falls back to its normal value.

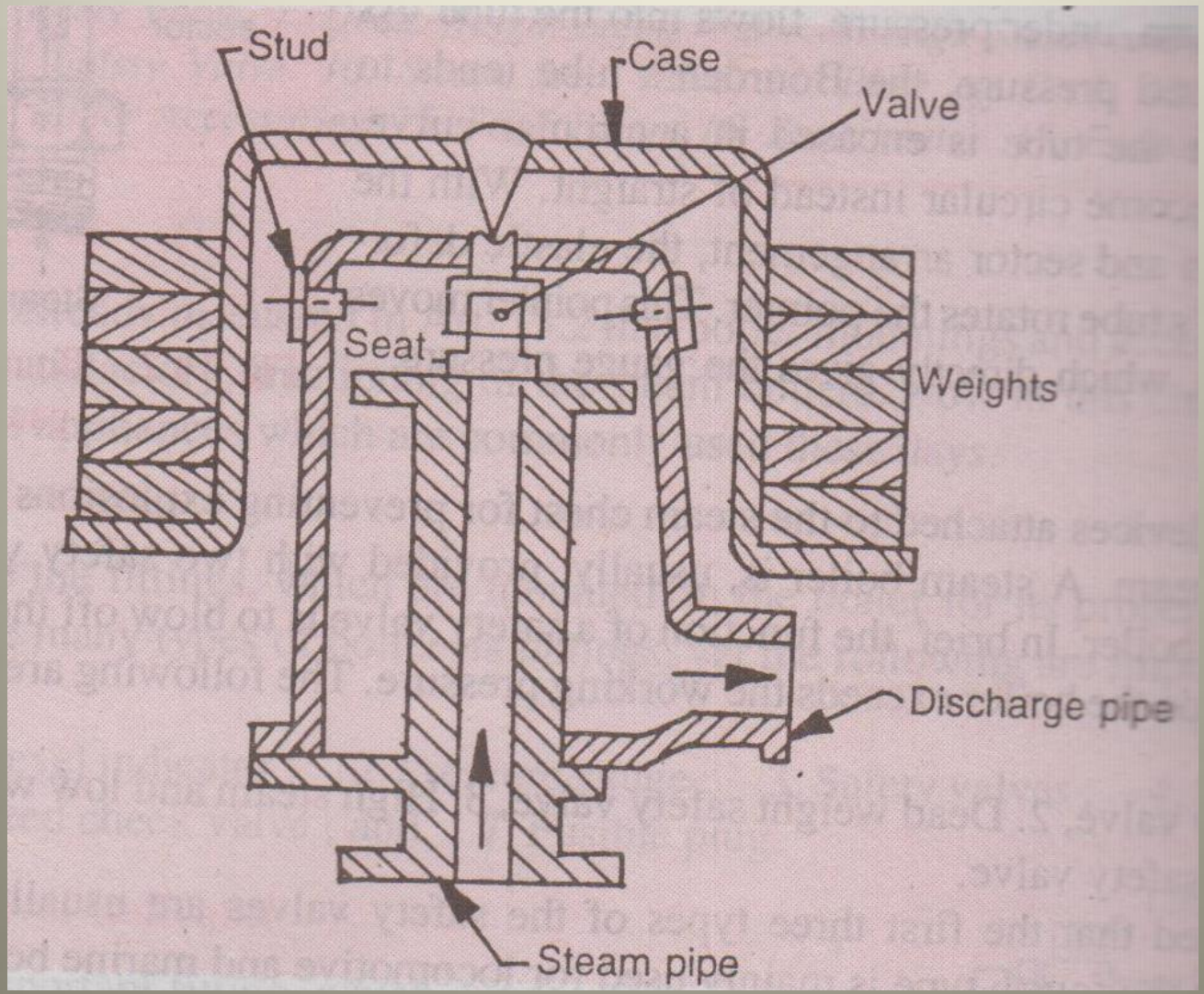
Lever safety valve



Dead weight safety valve

1. It consists of a gun metal valve rests on a gun metal seat.
2. It is fixed to the top of a steel pipe which is bolted to the mountings block and riveted to the top of the shell.
3. Both the valve and the pipe are covered by a case which contains weights.
4. The weights keep the valve on its seat under normal working pressure.
5. When the pressure of steam exceeds the normal pressure, the valve as well as the case are lifted up from its seat.
6. This enables the steam to escape through the discharge pipe.

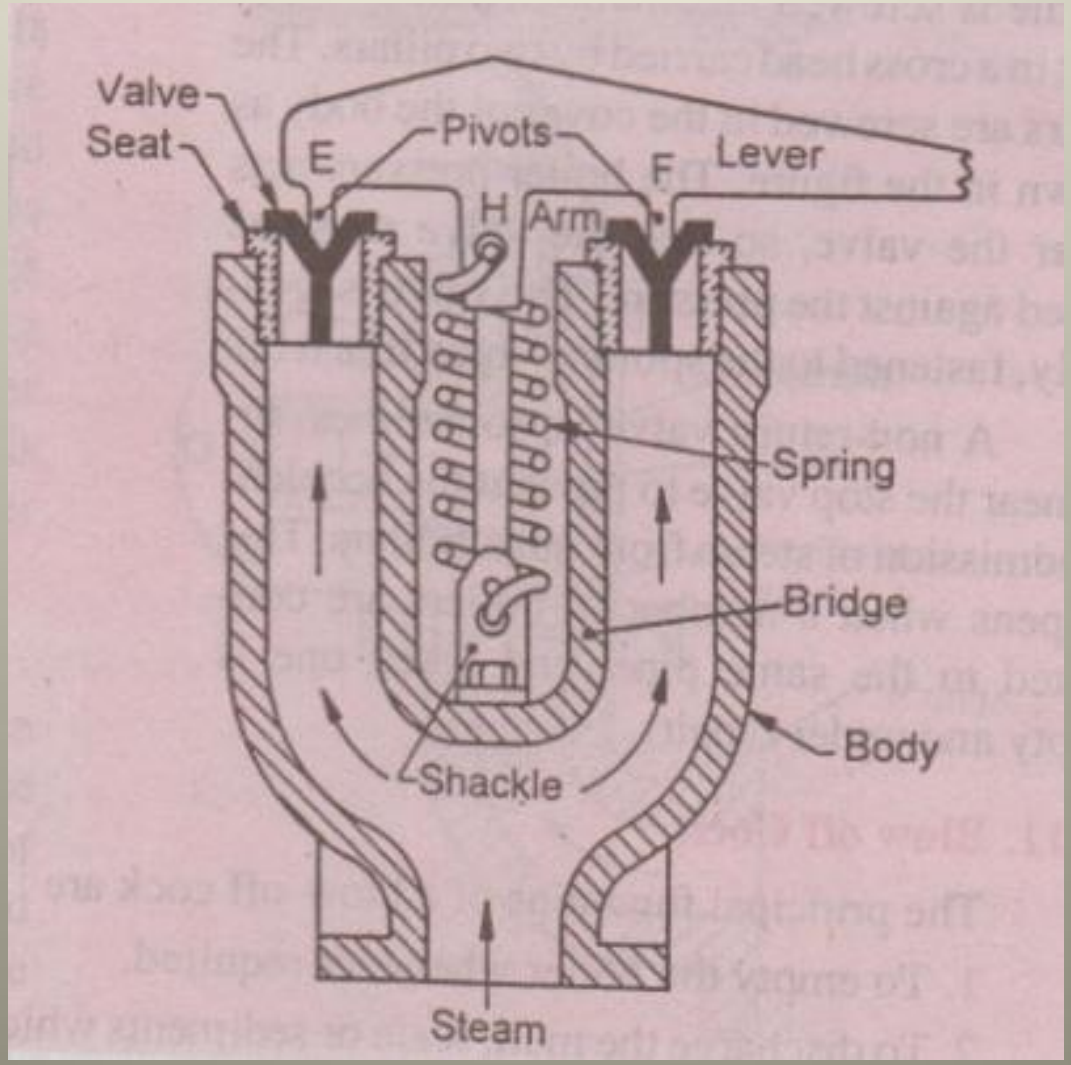
Dead weight safety valve



Spring loaded safety valve

1. It is used for locomotive and marine boilers.
2. The spring is made of round or square steel rod in helical form and placed in compression.
3. It consists of a cast iron body connected to the top of a boiler.
4. It has two separate valves of the same size having their seatings in the upper ends of two hollow valve chests.
5. These valve chests are united by a bridge and a base and is bolted to a mounting block on the top of a boiler over the fire box.

Spring loaded safety valve



Boiler Accessories

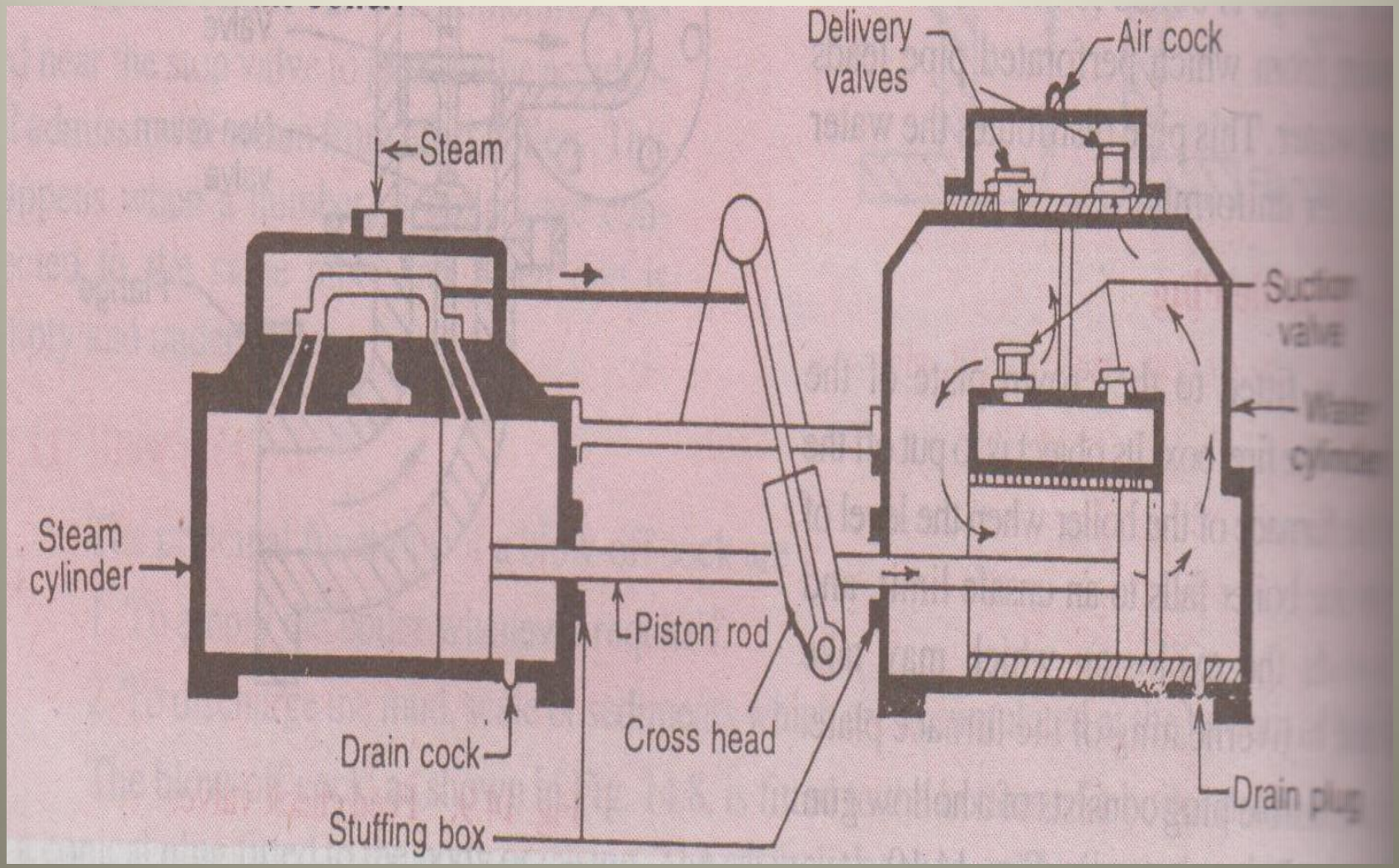
Economizer

- A common application of economizers in steam power plants is to capture the waste heat from boiler stack gases (flue gas) and transfer it to the boiler feedwater. This raises the temperature of the boiler feedwater, lowering the needed energy input, in turn reducing the firing rates needed for the rated boiler output.

Feed Pump

1. Water in a boiler is continuously converted into steam, so a feed pump is need to deliver water to the boiler.
2. The pressure of steam inside a boiler is high, so the pressure of feed water has to be increased proportionately before it is made to enter the boiler. Generally, the pressure of feed water is 20% more than that in the boiler.
3. The common type of pump used is a duplex feed pump as shown in figure.
4. This pump has two sets of suction and delivery valves for forward and backward stroke. The two pumps work alternately so as to ensure continuous supply of feed water.

Feed Pump

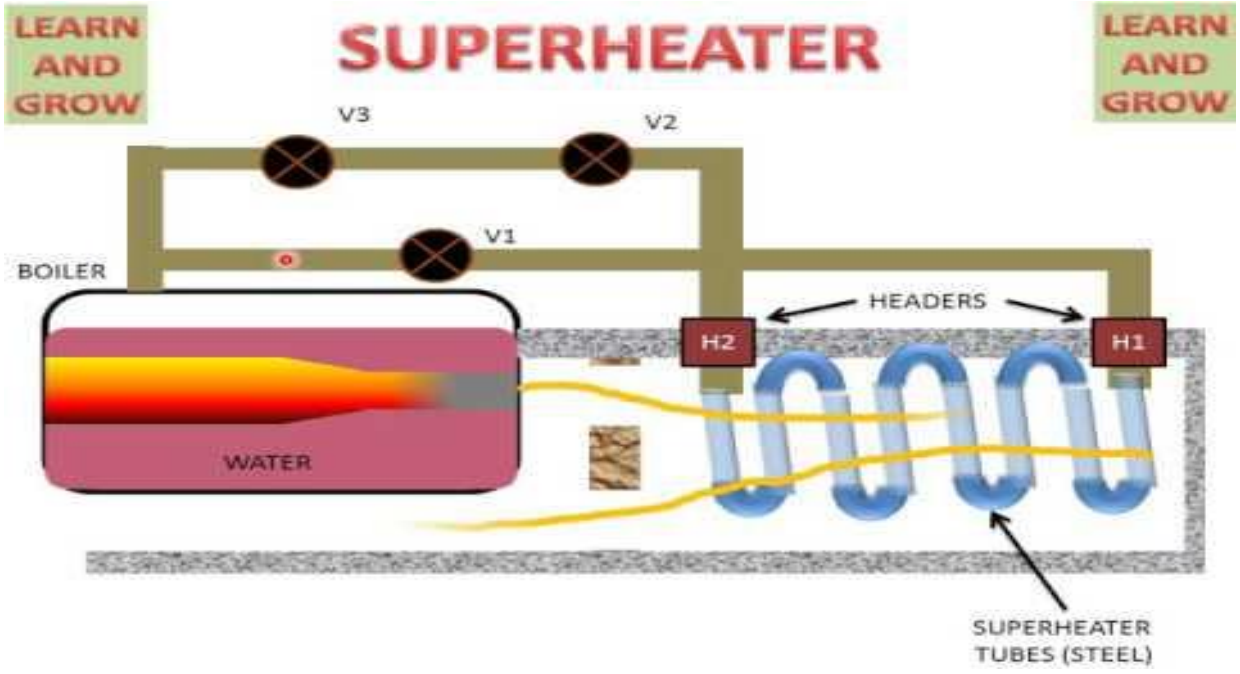

Delivery valves
Air cock
Steam
Steam cylinder
Piston rod
Cross head
Drain cock
Stuffing box
Drain plug

Super heater

1. A superheater is an important device of a steam generating unit.
2. Its purpose is to increase the temperature of saturated steam without raising its pressure.
3. It is generally an integral part of a boiler, and is placed in the path of hot flue gases from the furnace.
4. The heat, given up by these flue gases, is used in superheating the steam.

Super heater

- In a steam engine, the superheater re-heats the steam generated by the boiler, increasing its thermal energy and decreasing the likelihood that it will condense inside the engine. ... Steam which has been superheated is logically known as superheated steam; non-superheated steam is called saturated steam or wet steam.



Economiser Maintenance Procedure

1. An economiser is a device used to heat feed water by utilising the heat in the exhaust flue gases before leaving through the chimney.
2. As the name indicates, the economiser improves the economy of the steam boiler.
3. Following are the advantages of using an economiser:

a. There is about 15 to 20% of fuel saving.

b. It increases the steam raising capacity of a boiler because it shortens the time required to convert water into steam.

c. It prevents formation of scale in boiler water tubes, because the scale formed in the economiser tubes, can be cleaned easily.

d. Since the feed water entering the boiler is hot, therefore strains due to unequal expansion are minimised.

Chapter-3
Steam Power Plant.

- **What is Steam Power Plant:**
- Thermal power plants are power stations which convert heat energy into electric energy. Thermal power plant is a collective term which includes fossil fuels, geothermal, solar and nuclear power plants as well as waste incineration plants. The steam turbine spins and then drives the electric generator.

Selection of site for Steam power plant

- **Availability of coal:**
- A thermal plant of 400M, capacity requires nearly 6000 tons of coal every day.
- Power plant should be located near coal mines.

Ash Disposal Facilities:

- Ash comes out in hot condition and handling is difficult.

The ash can be disposed into sea or river.

Water Availability :

- Water consumption is more as feed water into boiler, condenser and for ash disposal.
- Water is required for drinking purpose.
- Hence plant should be located near water source.

Transport Facility :

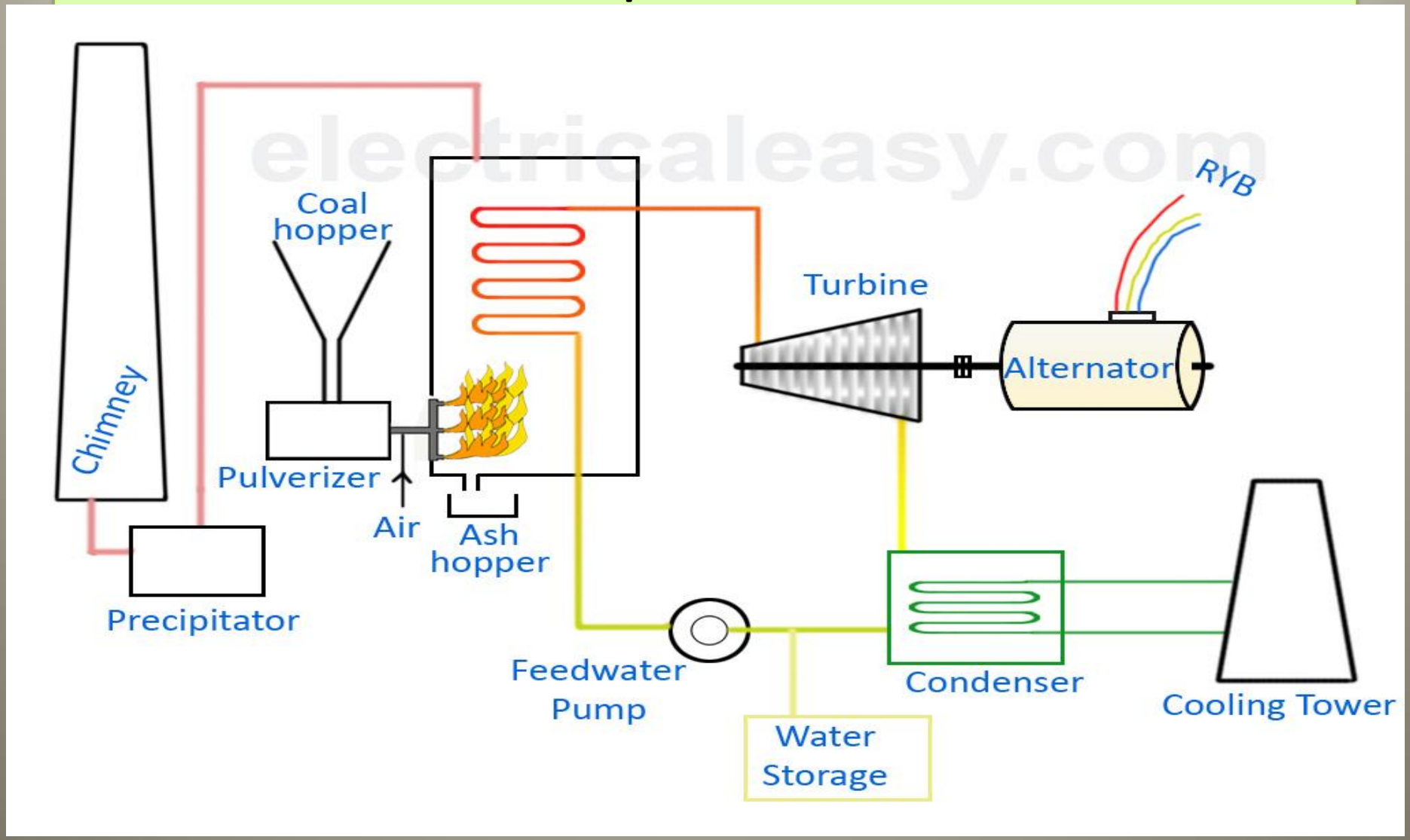
Public Problems:

- The plant should be far away from residential area to avoid nuisance from smoke, fly ash and noise.

Nature of Land :

- Many power plants have failed due to weak foundations.

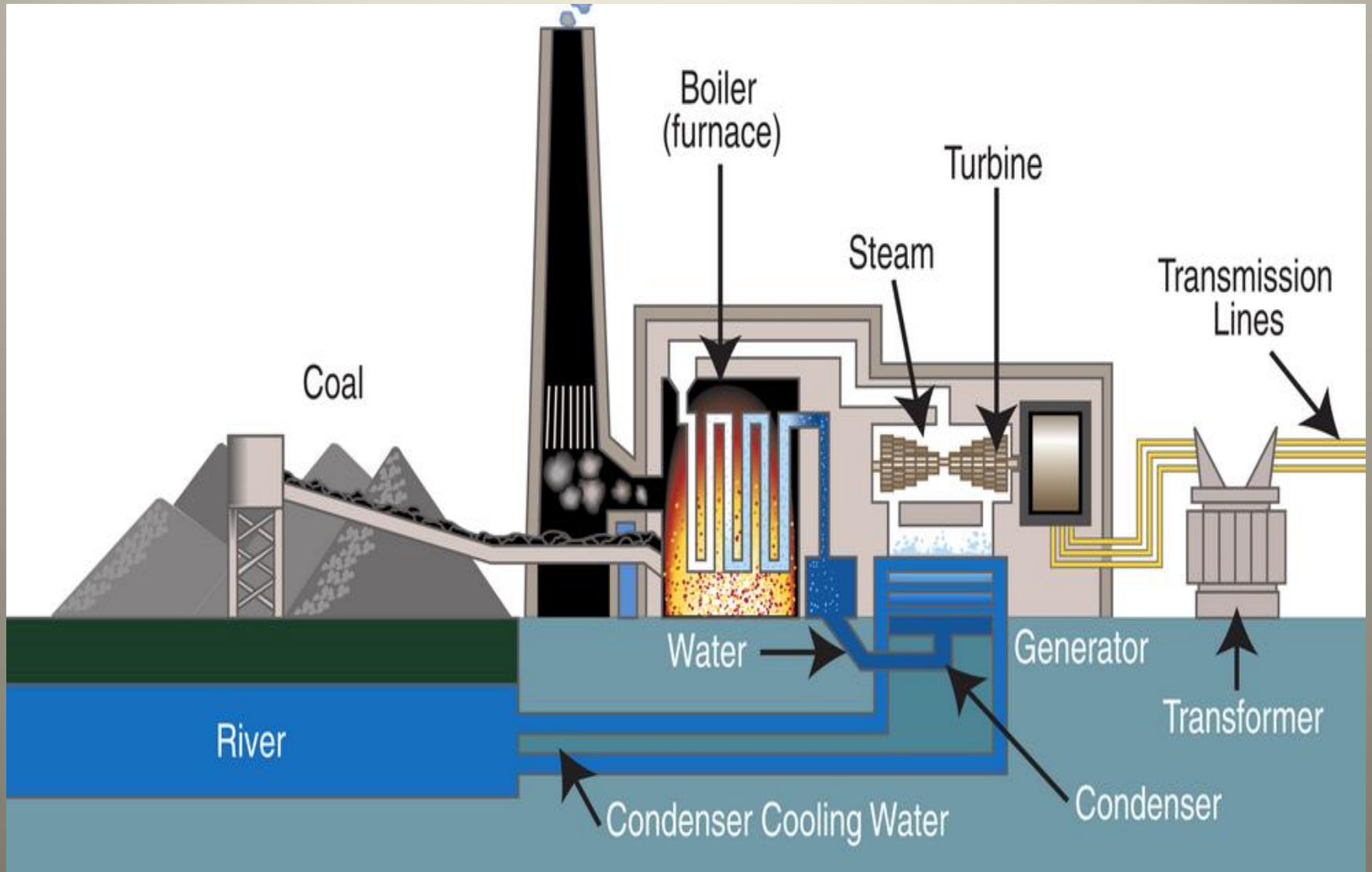
Schematic diagram of a Steam power plant.



Operation of a Steam power plant.

- A **thermal power station** is a power station in which heat energy is converted to electric power. In most places the turbine is steam-driven. Water is heated, turns into steam and spins a steam turbine which drives an electrical generator. After it passes through the turbine the steam is condensed in a condenser and recycled to where it was heated. This is known as a Rankine cycle. The greatest variation in the design of thermal power stations is due to the different heat sources; fossil fuel power generation, though nuclear heat energy, solar heat energy, biofuels, and waste incineration are also used. Some prefer to use the term *energy center* because such facilities convert forms of heat energy into electrical energy. Certain thermal power stations are also designed to produce heat for industrial purposes, for district heating, or desalination of water, in addition to generating electrical power.

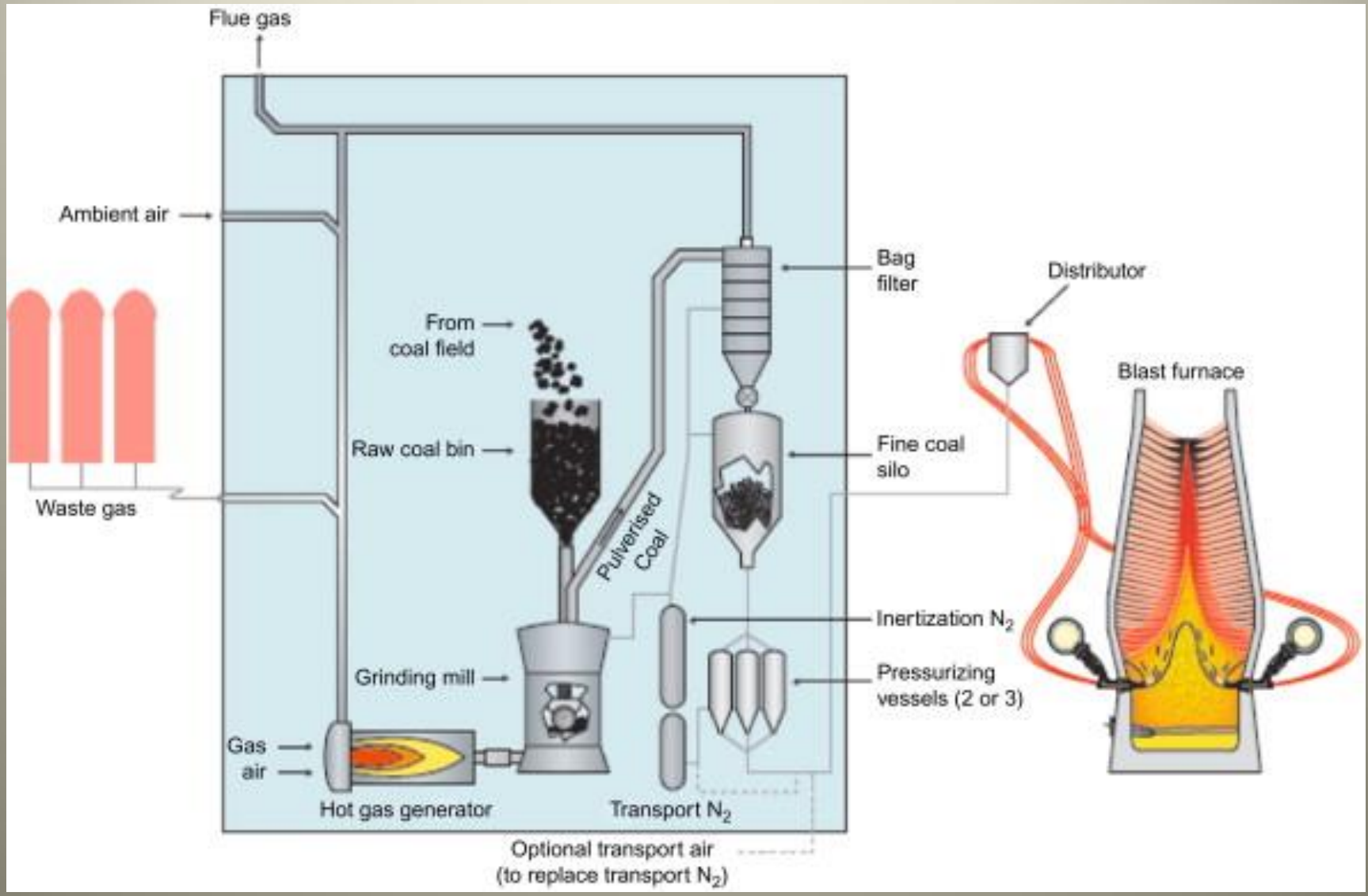
Steam power plant



Describe the operation of pulverized coal burner.

- A **pulverized coal-fired boiler** is an industrial or utility boiler that generates thermal energy by burning pulverized coal (also known as **powdered coal** or coal dust since it is as fine as face powder in cosmetic makeup) that is blown into the firebox.
- The basic idea of a firing system using pulverised fuel is to use the whole volume of the furnace for the combustion of solid fuels. Coal is ground to the size of a fine grain into the boiler, mixed with air and burned in the flue gas flow. Biomass and other materials can also be added to the mixture. Coal contains mineral matter which is converted to ash during combustion. The ash is removed as bottom ash and fly ash. The bottom ash is removed at the furnace bottom.
- This type of boiler dominates the electric power industry, providing steam to drive large turbines. Pulverized coal provides the thermal energy which produces about 50% of the world's electric supply.
- **Contents**

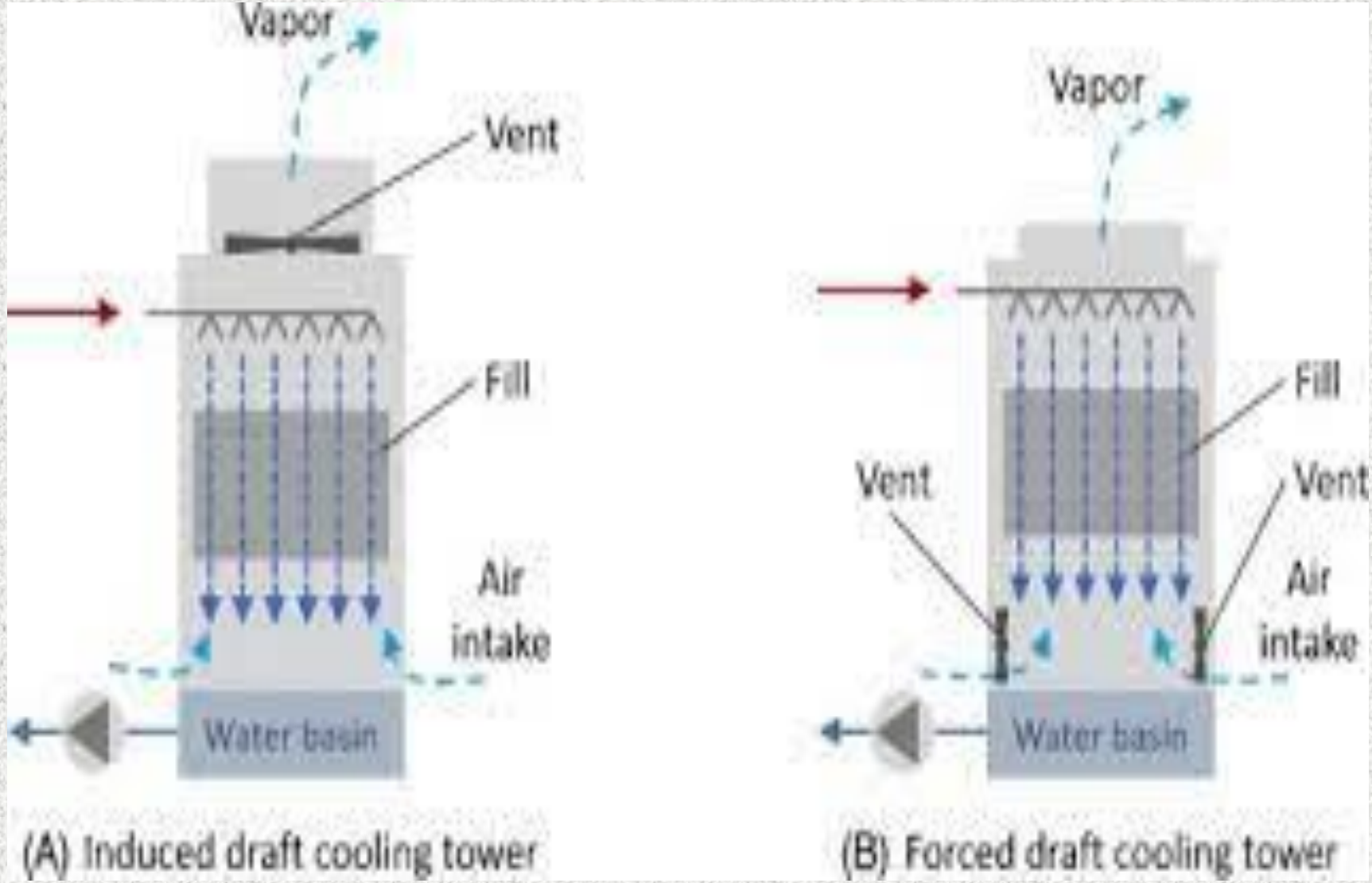
Pulverized coal burner.



Define draught and cooling tower.

- In natural draft cooling towers the airflow occurs due to the natural pressure difference caused by the difference in density between the cold outside air and the hot humid air inside. Simply speaking, the hot air inside the cooling tower tends to go up, while the cold air is sucked through the open bottom part.

Define draught and cooling tower.



CHAPTER-4

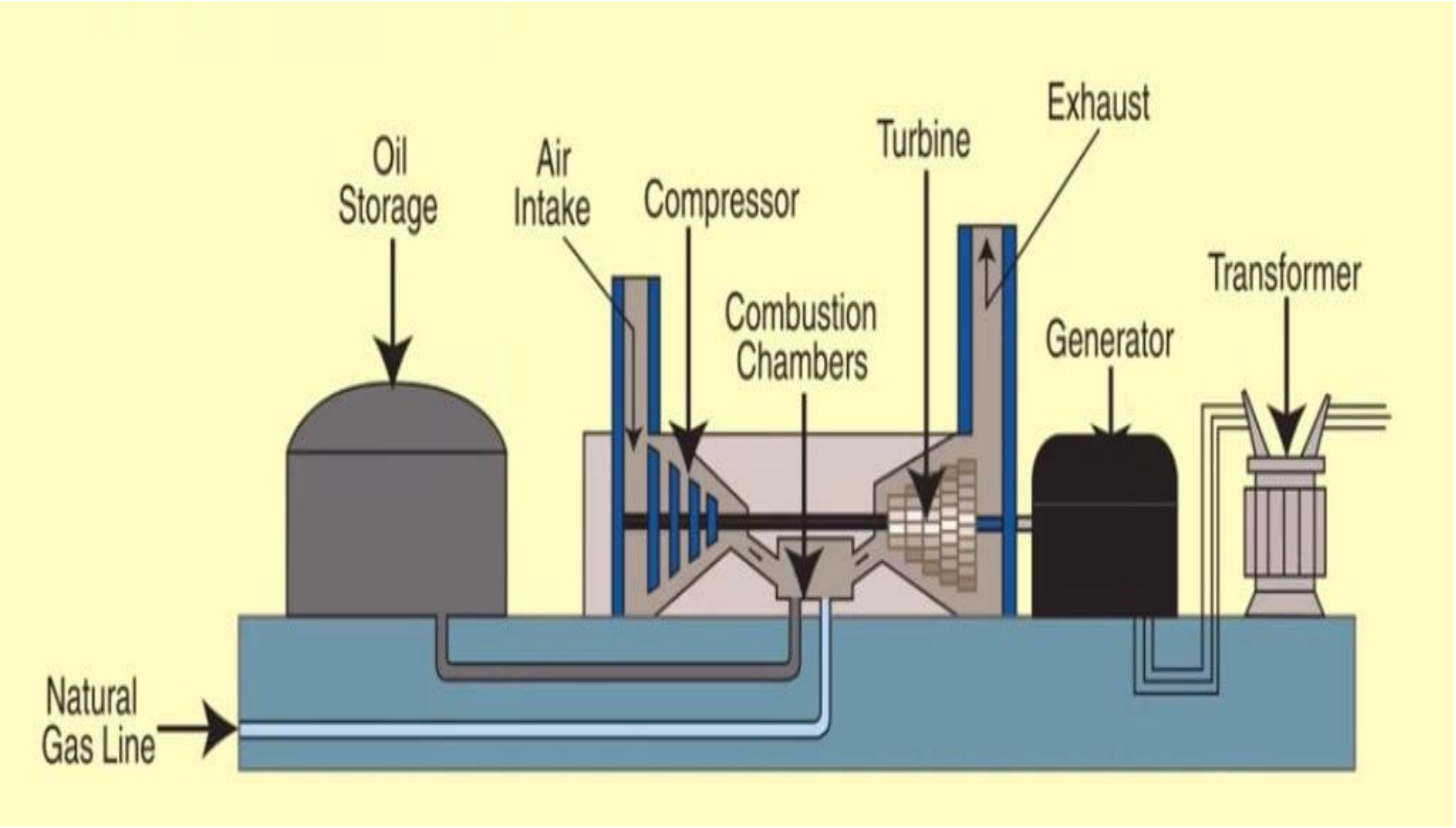
Gas turbine & Combined cycle Power Plant.

- In a gas turbine power plant the air is compressed by compressor and is led to the combustion chamber. In this chamber heat is added to the compressed air either by burning fuel in the chamber or by the use of air heaters and thus raising its temperature. The hot and high pressure air then passed to the gas turbine where it expands and converts to mechanical energy. The gas turbine drives the alternator which converts mechanical energy into electrical energy

Gas Turbine Power Plant:

- Gas turbines also called combustion turbines, a type of IC engine in which burning of an air-fuel mixture produces hot gases that spin a turbine to produce power.
- It is the production of hot gas during fuel combustion, not the fuel itself that the gives gas turbines the name.
- Combustion occurs continuously in gas turbines, as opposed to reciprocating IC engines, in which combustion occurs intermittently.

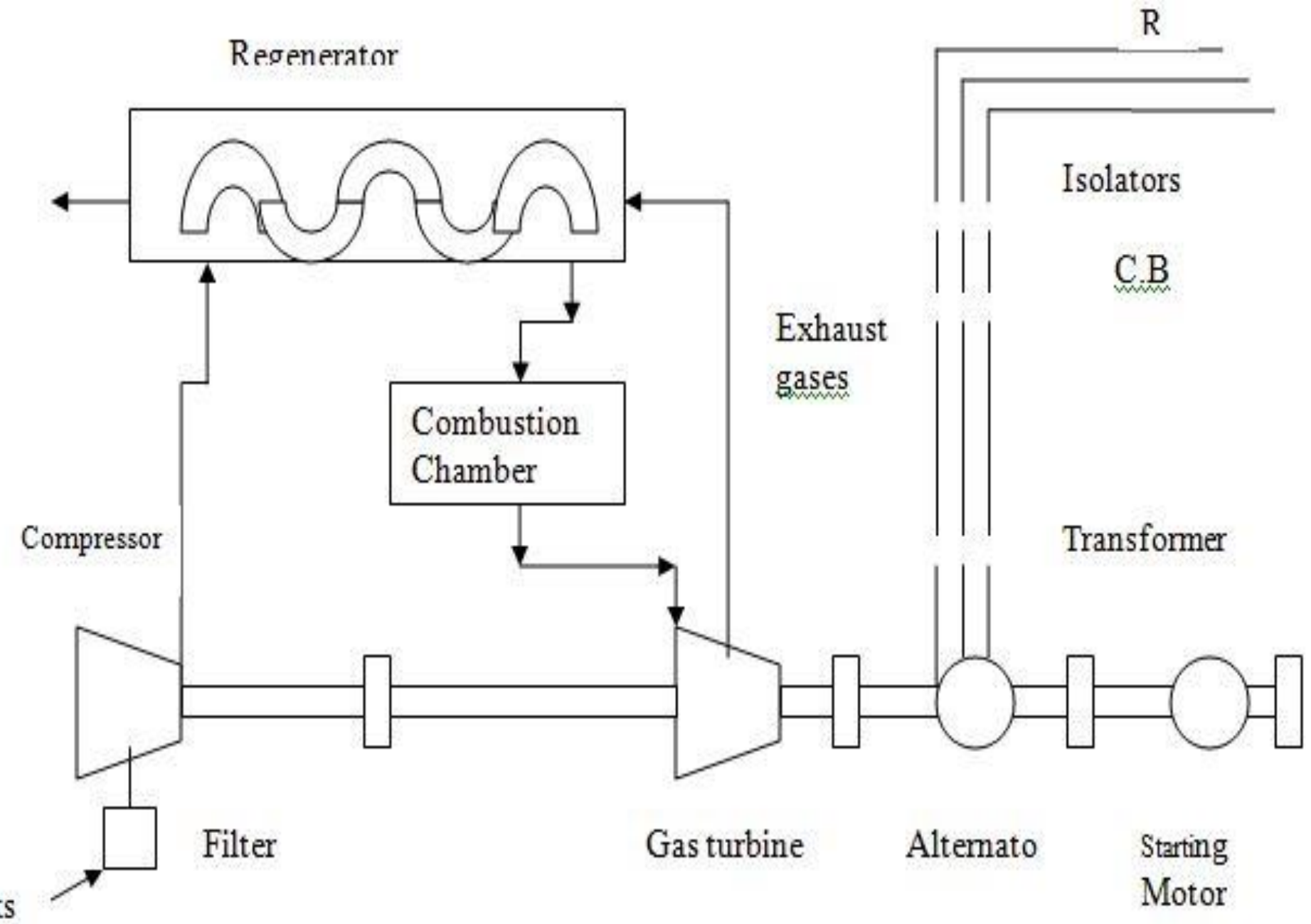
GAS TURBINE POWER STATION



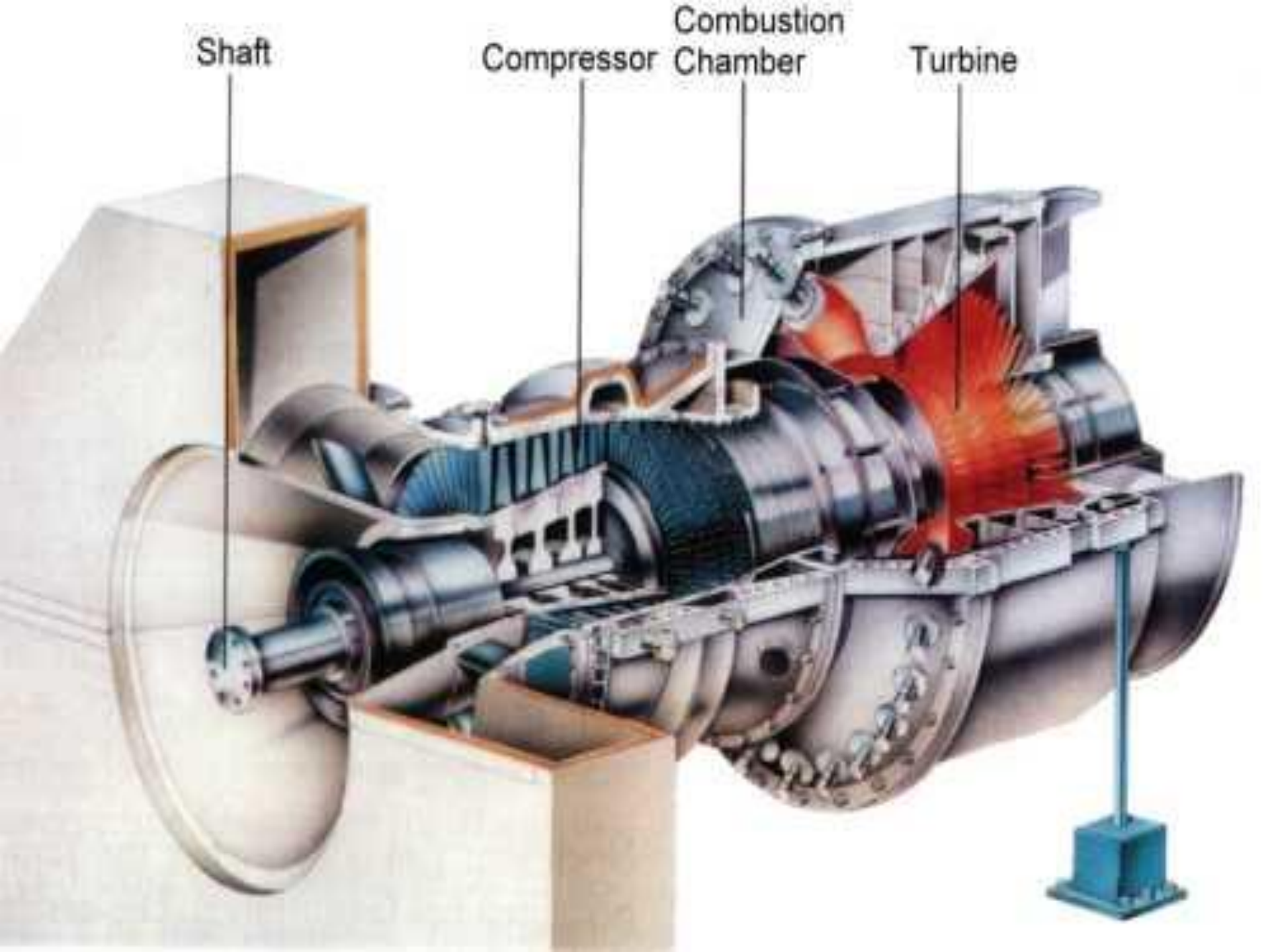
SCHEMATIC ARRANGEMENT OF GAS TURBINE POWER STATION

The schematic arrangement of a gas turbine power station can be divided into the following stages:

- Air inlet
- Compressor
- Regenerator
- Combustion chamber
- Gas turbine
- Exhaust
- Alternator
- Starting motor
- Electrical equipment



a Schematic arrangement of Gas Turbine Power Station


Shaft
Compressor
Combustion Chamber
Turbine

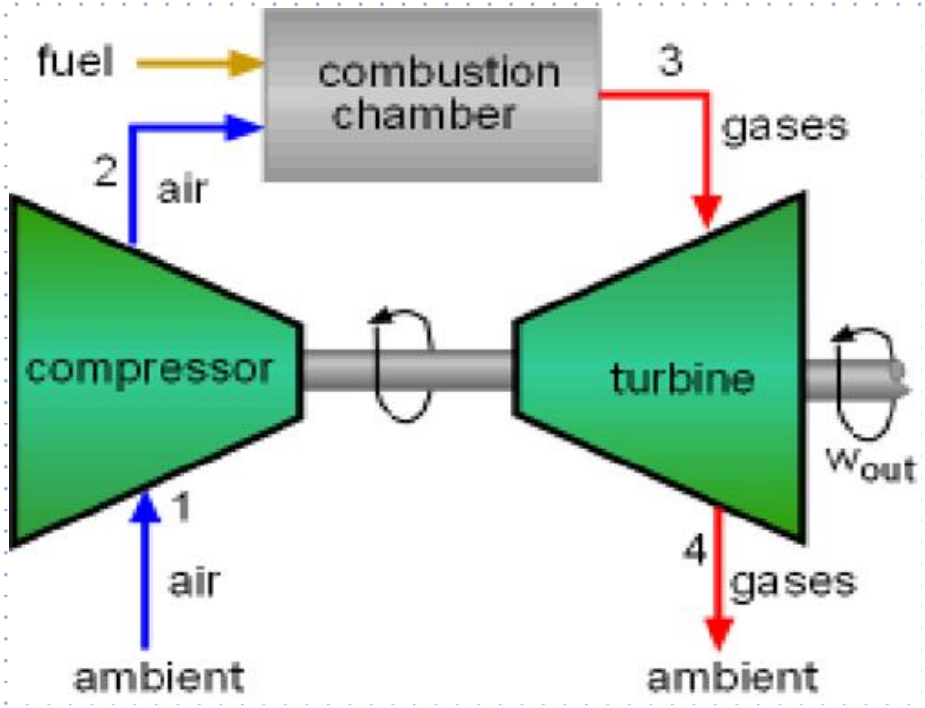
DESCRIBE THE OPERATION OF OPEN CYCLE TYPE GAS TURBINE PLANT

- **Working Principal**
- Fresh air enters the compressor at ambient temperature where its pressure and temperature are increased.

The high pressure air enters the combustion chamber where the fuel is burned at constant pressure.

The high temperature (and pressure) gas enters the turbine where it expands to ambient

pressure and produces work.



AIR COMPRESSOR

- The air compressor and turbine are mounted at either end on a common shaft, with the combustion chamber between them.
- Gas turbines are not self starting. A starting motor is used.
- The air compressor sucks in air and compresses it, thereby increasing its pressure.

Advantages and disadvantages of open and closed cycle of gas turbine power plant.

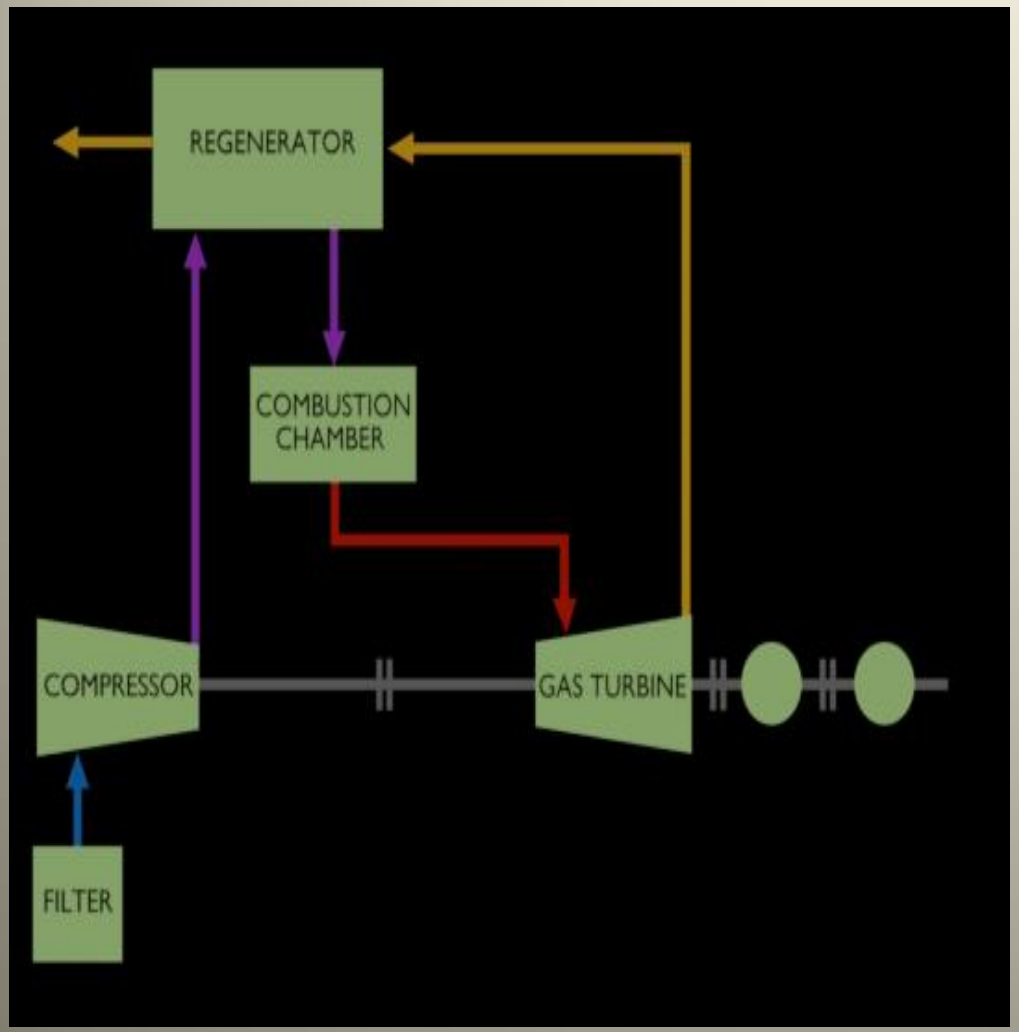
Closed Cycle Gas Turbine	Open Cycle Gas Turbine
1. The compressed air is heated in heating chamber.	1. The compressed air is heated in combustion chamber.
2. As the gas is heated by an external source, hence the amount of gas remains same thought the cycle	2. The products of combustion are get mixed up in the heated air hence same gas doesn't remain in cycle.
3. The gas after turbine is passed into the cooling chamber.	3. The gas after turbine is exhausted into the atmosphere.
4. The working fluid is circulated continuously.	4.The working fluid is replaced continuously.
5. Any fluid with better thermodynamic properties can be used.	5. Only air is used as the working fluid.
6. The turbine blades do not wear away earlier, as the enclosed gas does not get contaminated while flowing through heating chamber.	6. The turbine blades wear away earlier, as the air from atmosphere get contaminated while flowing through combustion chamber.
7.The mass of installation per Kwatt is more	7.The mass of installation per Kwatt is less
8. High maintenance cost	8. Maintenance cost is low

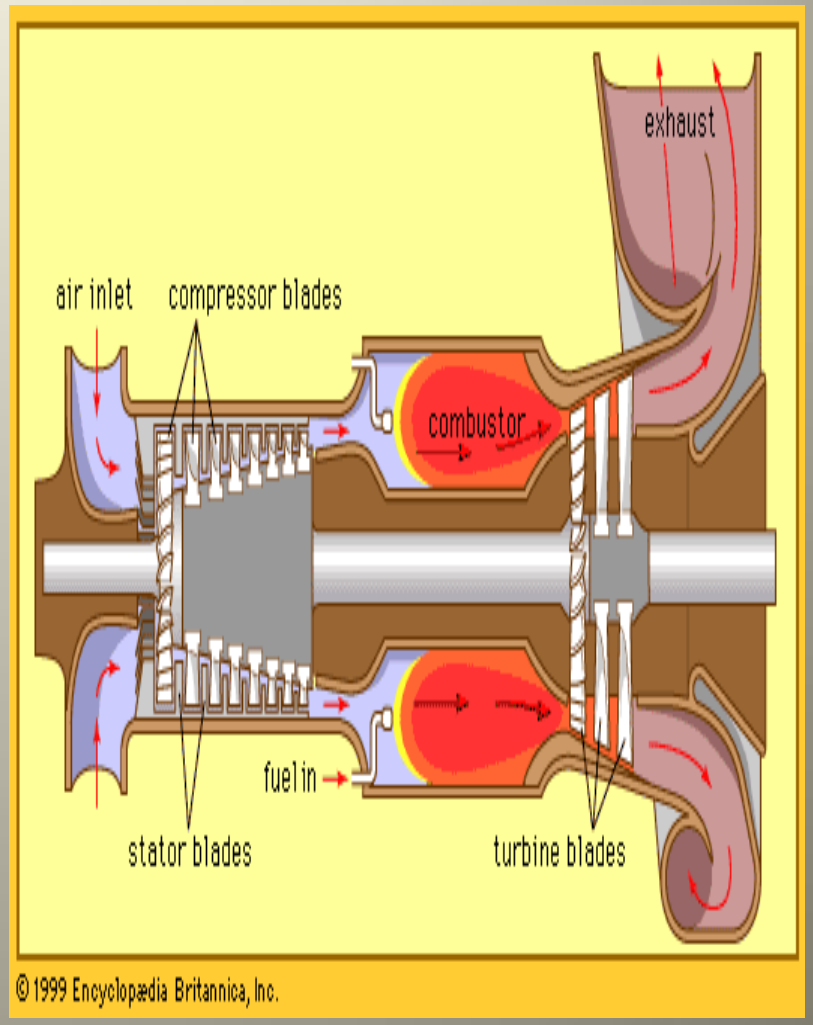
Describe the construction and operation gas engine power plant

- The basic operation of the gas turbine is a Brayton cycle with air as the working fluid. Atmospheric air flows through the compressor that brings it to higher pressure. Energy is then added by spraying fuel into the air and igniting it so the combustion generates a high-temperature flow. This high-temperature high-pressure gas enters a turbine, where it expands down to the exhaust pressure, producing a shaft work output in the process.

- The turbine shaft work is used to drive the compressor; the energy that is not used for compressing the working fluid comes out in the exhaust gases that can be used to do external work, such as directly producing thrust in a turbojet engine, or rotating a second, independent turbine (known as a power turbine) which can be connected to a fan, propeller, or electrical generator. The purpose of the gas turbine determines the design so that the most desirable split of energy between the thrust and the shaft work is achieved. The fourth step of the Brayton cycle (cooling of the working fluid) is omitted, as gas turbines are open systems that do not use the same air again.

Gas engine power plant





Advantage & Disadvantage of Gas Power Plant

Advantages of gas turbine power plant

- Storage of fuel requires less area and handling is easy.
- The cost of maintenance is less.
- It is simple in construction. There is no need for boiler, condenser and other accessories as in the case of steam power plants.
- Cheaper fuel such as kerosene , paraffin, benzene and powdered coal can be used which are cheaper than petrol and diesel.
- Gas turbine plants can be used in water scarcity areas.
- Less pollution and less water is required.

Disadvantages of gas turbine power plant

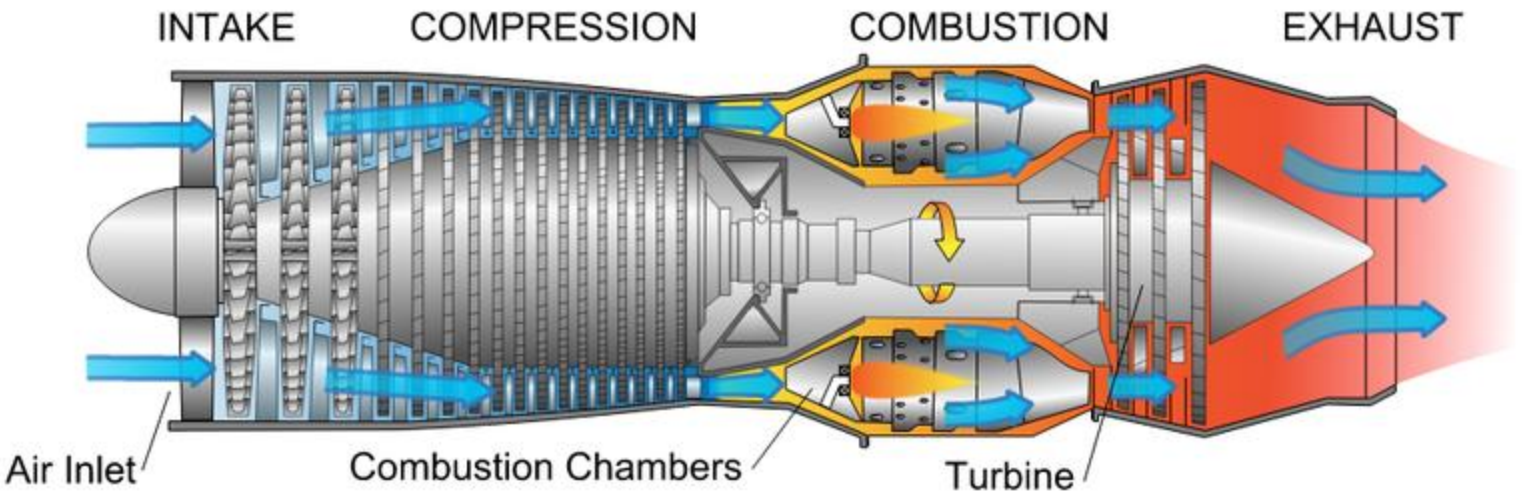
- 66% of the power developed is used to drive the compressor. Therefore the gas turbine unit has a low thermal efficiency.
- The running speed of gas turbine is in the range of (40,000 to 100,000 rpm) and the operating temperature is as high as 1100 – 1260^{0}C. For this reason special metals and alloys have to be used for the various parts of the turbine.
- High frequency noise from the compressor is objectionable.

❑ COMBUSTION CHAMBER

- ✓ **In the combustion chamber, the compressed air combines with fuel and the resulting mixture is burnt.**
- ✓ **The greater the pressure of air, the better the fuel air mixture burns.**
- ✓ **Modern gas turbines usually use liquid fuel, but they may also use gaseous fuel, natural gas or gas produced artificially by gasification of a solid fuel.**

❑ TURBINE

- Hot gases move through a multistage gas turbine.
- Like in steam turbine, the gas turbine also has stationary and moving blades.
- The stationary blades
  - ✓guide the moving gases to the rotor blades
  - ✓adjust its velocity.
- The shaft of the turbine is coupled to a generator.



❑ APPLICATIONS OF GAS TURBINE

- drive pumps, compressors and high speed cars.
- aircraft and ships.
- Power generation (used for peak load and as stand-by unit).

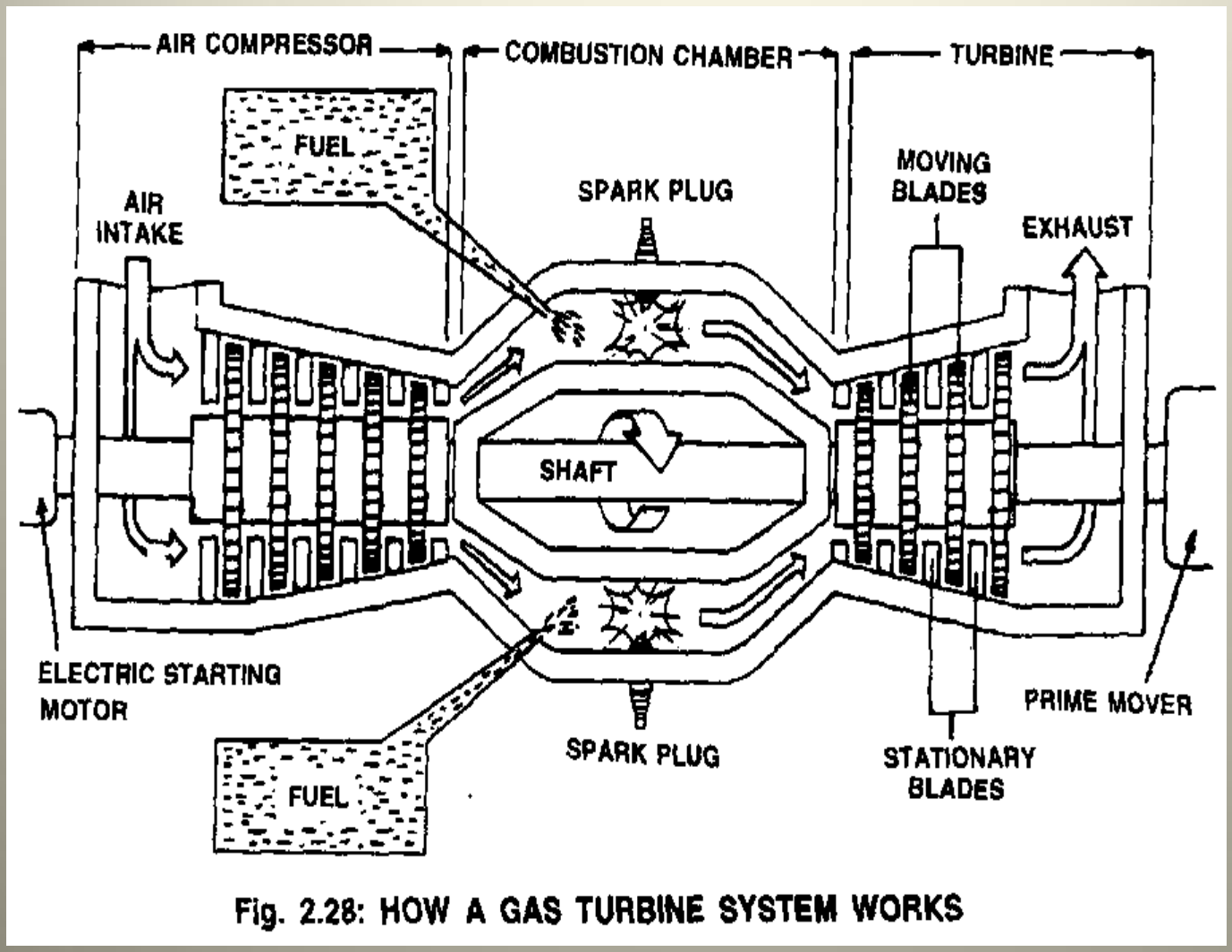
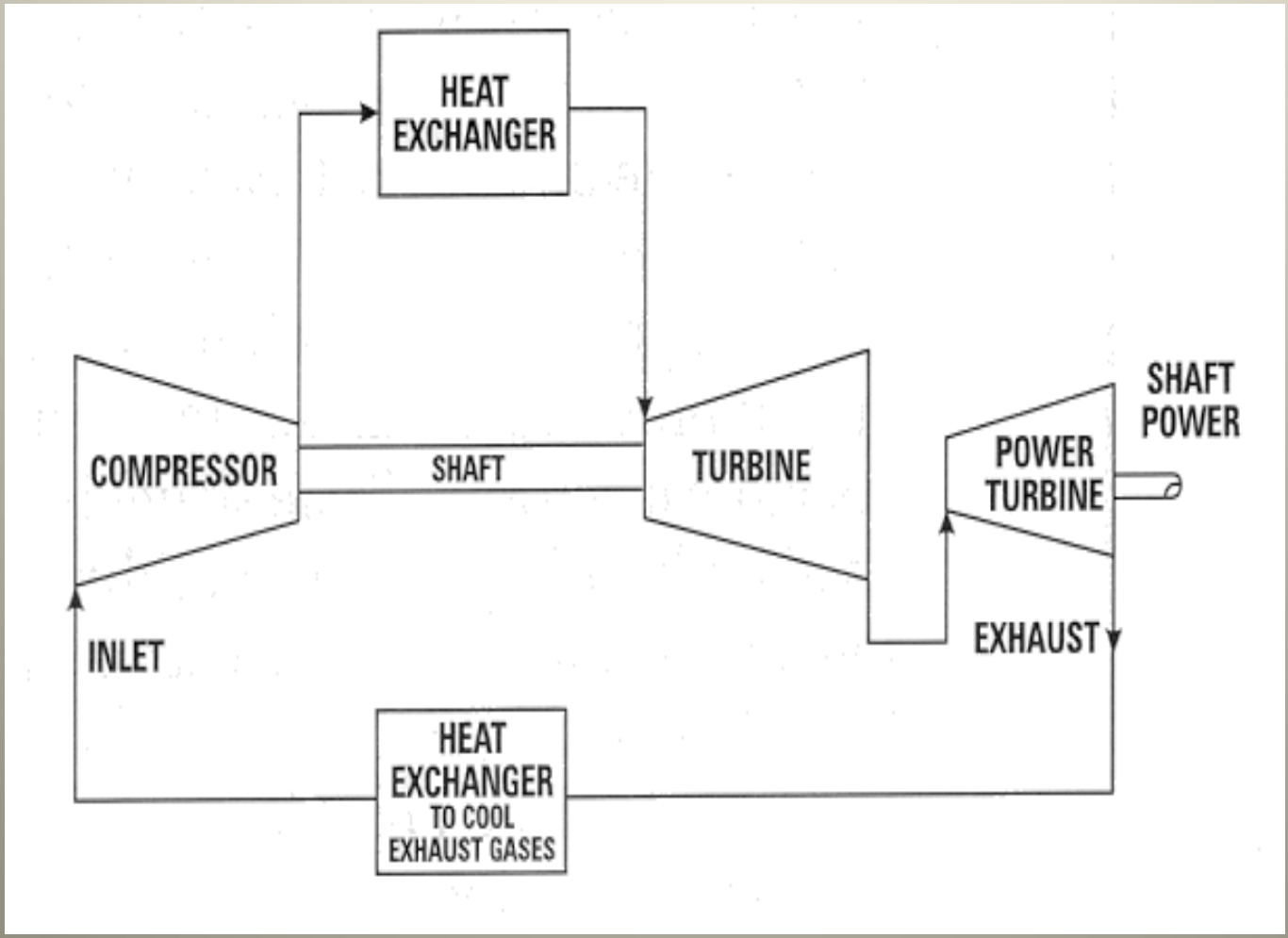


Fig. 2.28: HOW A GAS TURBINE SYSTEM WORKS

❑ CLOSED CYCLE GAS TURBINE POWER PLANT

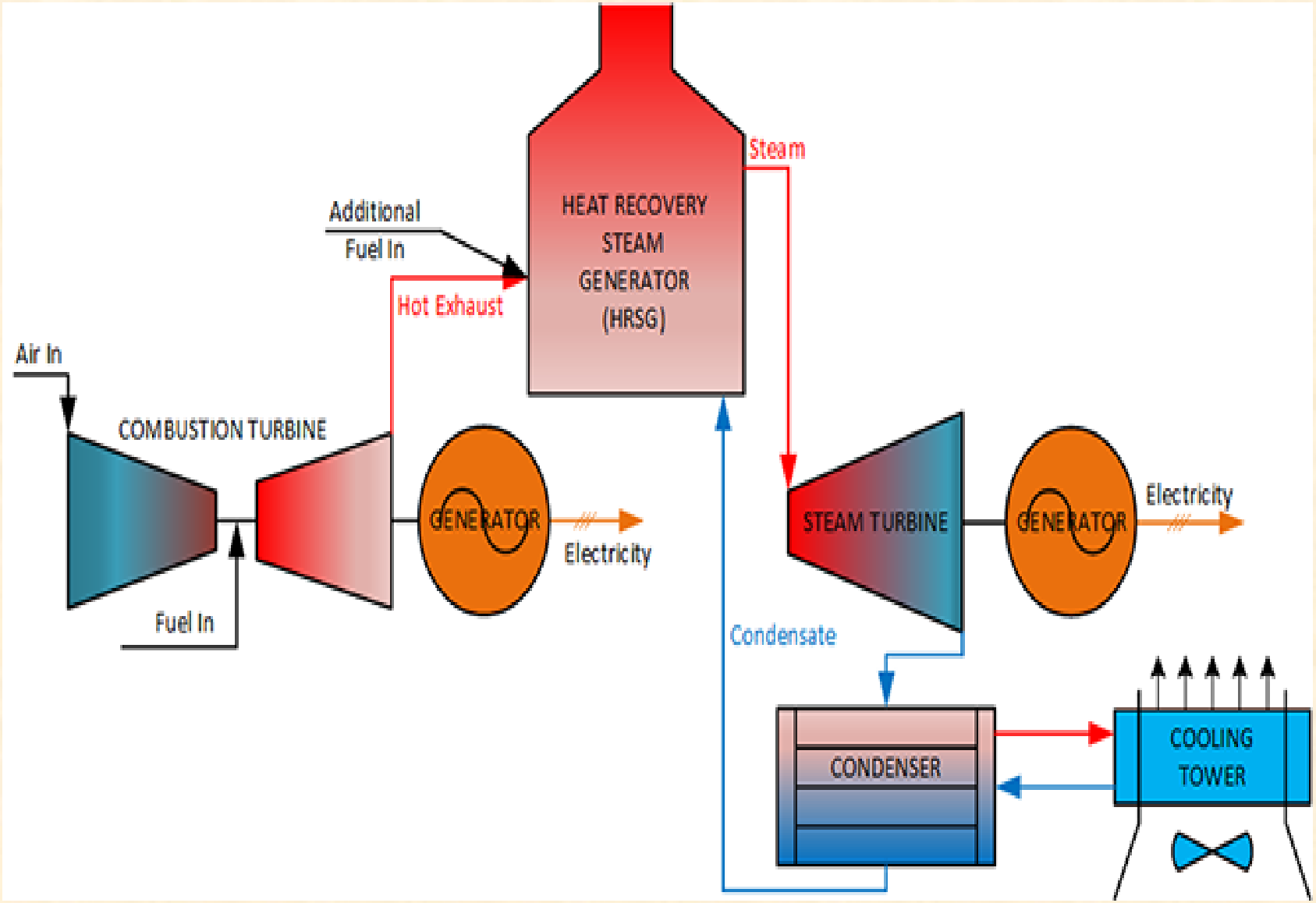


Closed cycle gas turbine

COMBINED CYCLE POWER PLANT

- What is a combined cycle power plant?
- A combined-cycle power plant uses both a gas and a steam turbine together to produce up to 50% more electricity from the same fuel than a traditional simple-cycle plant. The waste heat from the gas turbine is routed to the nearby steam turbine, which generates extra power.

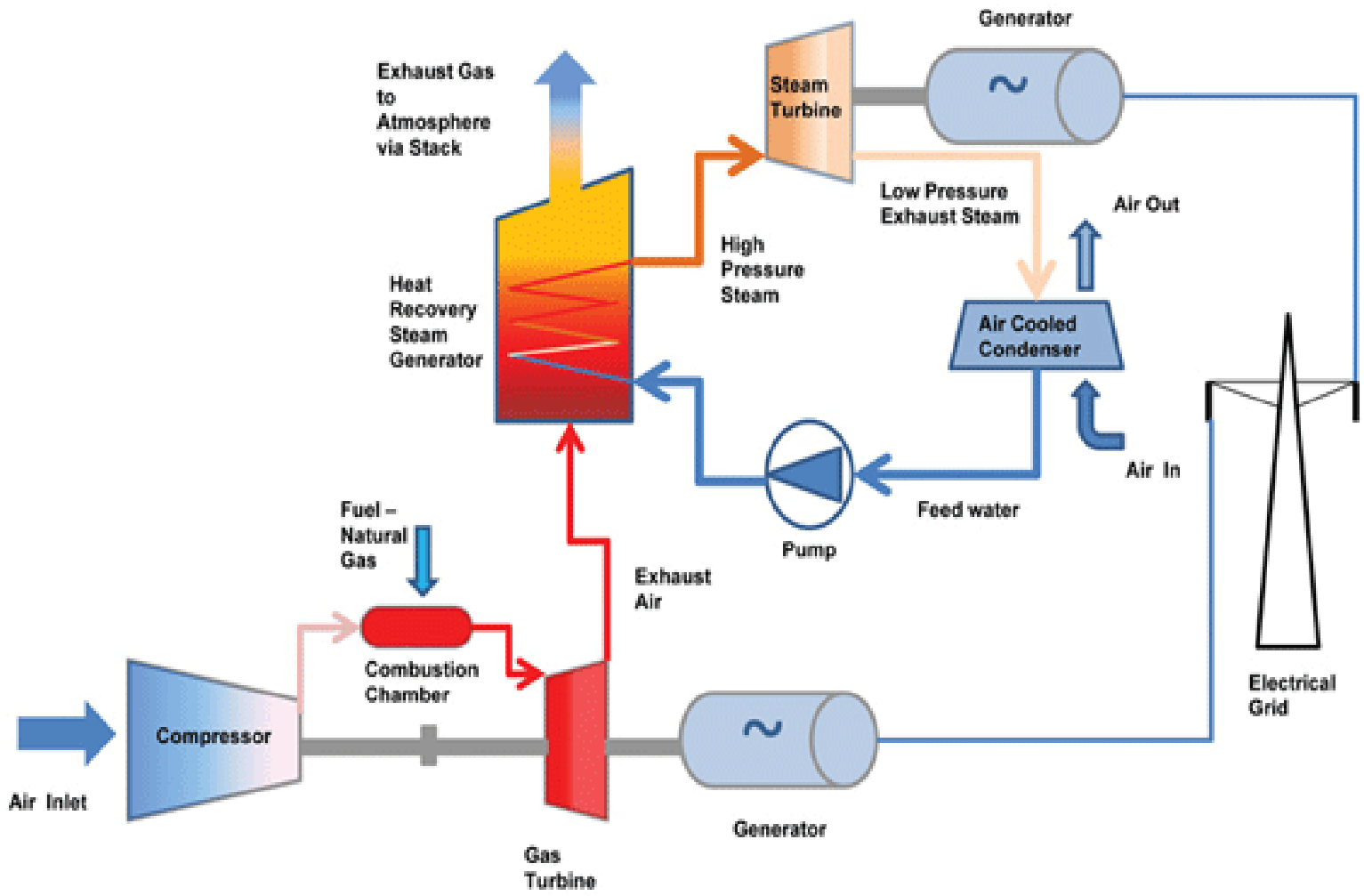
COMBINED CYCLE POWER PLANT



COMBINED CYCLE POWER PLANT OPERATION

- This is how a combined-cycle plant works to produce electricity and captures waste heat from the gas turbine to increase efficiency and electrical output.
- 1) Gas turbine burns fuel:
- The gas turbine compresses air and mixes it with fuel that is heated to a very high temperature. The hot air-fuel mixture moves through the gas turbine blades making them spin.
- The fast-spinning turbine drives a generator that converts a portion of the spinning energy into electricity.
- 2) Heat recovery system captures exhaust:
- A heat recovery steam generator (HRSG) captures exhaust heat from the gas turbine that would otherwise escape through the exhaust stack.
- The HRSG creates steam from the gas turbine exhaust heat and delivers it to the steam turbine.
- 3) Steam turbine delivers additional electricity:
- The steam turbine sends its energy to the generator drive shaft, where it is converted into additional electricity.

COMBINED CYCLE POWER PLANT OPERATION



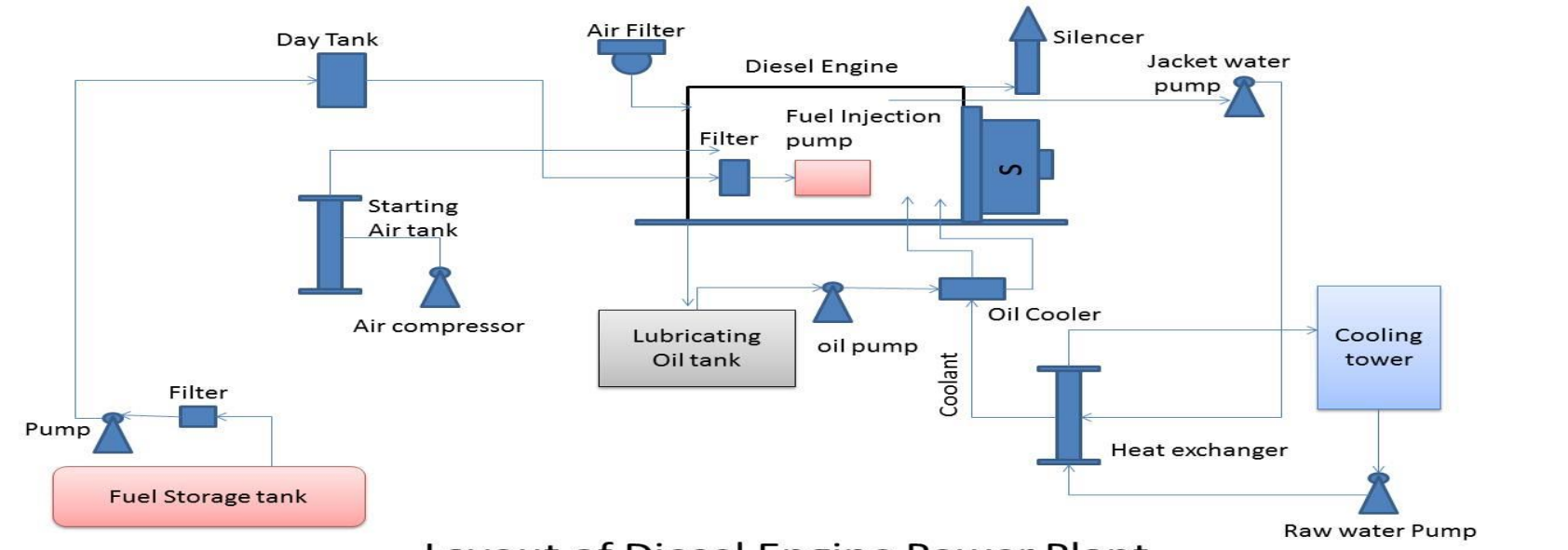
Mention the advantages of a combined cycle power plant

Advantages of Combined Cycle Power plant:

- Saving in exhaust heat of the gas turbine and, therefore increases in its heat rate.
- Reduction of stack emissions.
- Reduction in space requirement in comparison with conventional generating units of a given capacity.
- Reduction in requirements of condensing water by 60% as compared to fossil fueled plant of given capacity.
- Reduction in starting time.

Chapter-5
Understand the features of Diesel power plant.

- operation of a diesel power plant:
- The working principle of the diesel power station is very simple; as we compress the air in a cylinder to raise the temperature, then we burn the diesel inside the engine and the combustion produces the working fluid at high_temperature and high_pressure to convert the heat energy into mechanical energy.



Layout of Diesel Engine Power Plant

Various methods used for starting of diesel plant

- 1) 30K air supply from air bottle reaches the automatic valve and turning gear interlock.
  2) Hand cranking for small engines such as lifeboat engine, emergency air compressor engine, emergency fire pump engine.
  3) Electric batteries for emergency generator engine, main and supplementary engine for small craft, lifeboat engine. Uses series wound DC motor which have high starting torque, applied voltage 12~24 V.
  4) If reversing has been finished as per engine telegraph and engine is ready for starting then the starting handle interlock will be released and starting can be initiated.
  5) Air motor for urgent situation generator engine or emergency fire pump engine. Uses vane type motor and drives through gearing at 7 bar.

Considered in selecting the site of a diesel power plant

Site selection of diesel power plant

- Ideal choice for the diesel electric power plants is as near the load centre as possible in order to avoid transmission costs and losses
- The factors to be considered for site selection of diesel power plants are availability of water supply
- availability of fuel,
- availability of transportation facilities,
- distance from populated area
- availability of land at reasonable rate and of high bearing capacity to withstand the load of the plant and also vibrations transmitted to the foundation from compressors and diesel engines.

Mention the advantages of a diesel power plant.

- The design and layout of the plant are quite simple.
- It occupies less space, as the number and size of the auxiliaries are small.
- It can be placed at any position.
- It can be started quickly and can pick upload in a short time.
- There are no standby losses.
- It requires less quantity of water for chilling.
- The overall price is much less than that of the steam power station of the same content.
- The thermal efficiency of the plant is more eminent than that of a steam power station.
- It requires less operating staff.

Mention the Disadvantages of a diesel power plant.

- The plant has high running charges as the fuel (i.e., diesel) used is costly.
- The plant does not operate satisfactorily under overload conditions for a longer period.
- The plant can only generate small power.
- The cost of lubrication is generally high.
- The maintenance charges are generally high.

Describe the starting and shut down procedure of a diesel power plant.

- Starting Procedure:
- Turn the key to the start position without turning the engine on. ...
- Wait for the glow plugs to heat up before attempting to start the truck.
- Start the engine, but allow it to crank for no more than 30 seconds. ...
- Attempt to start the vehicle again by heating the glow plugs.

- Stoping Prpcedure:
- Disconnect Load.
- The first thing to do is to isolate generator from the load. ...
- Turn Off Engine Switch. You turn of the engine by simply switching the engine to the off position using the switch on the generator.
- Turn off Fuel Valve. This can also be step two if you prefer.

Chapter-6
Understand the features of hydro-electric power plant.

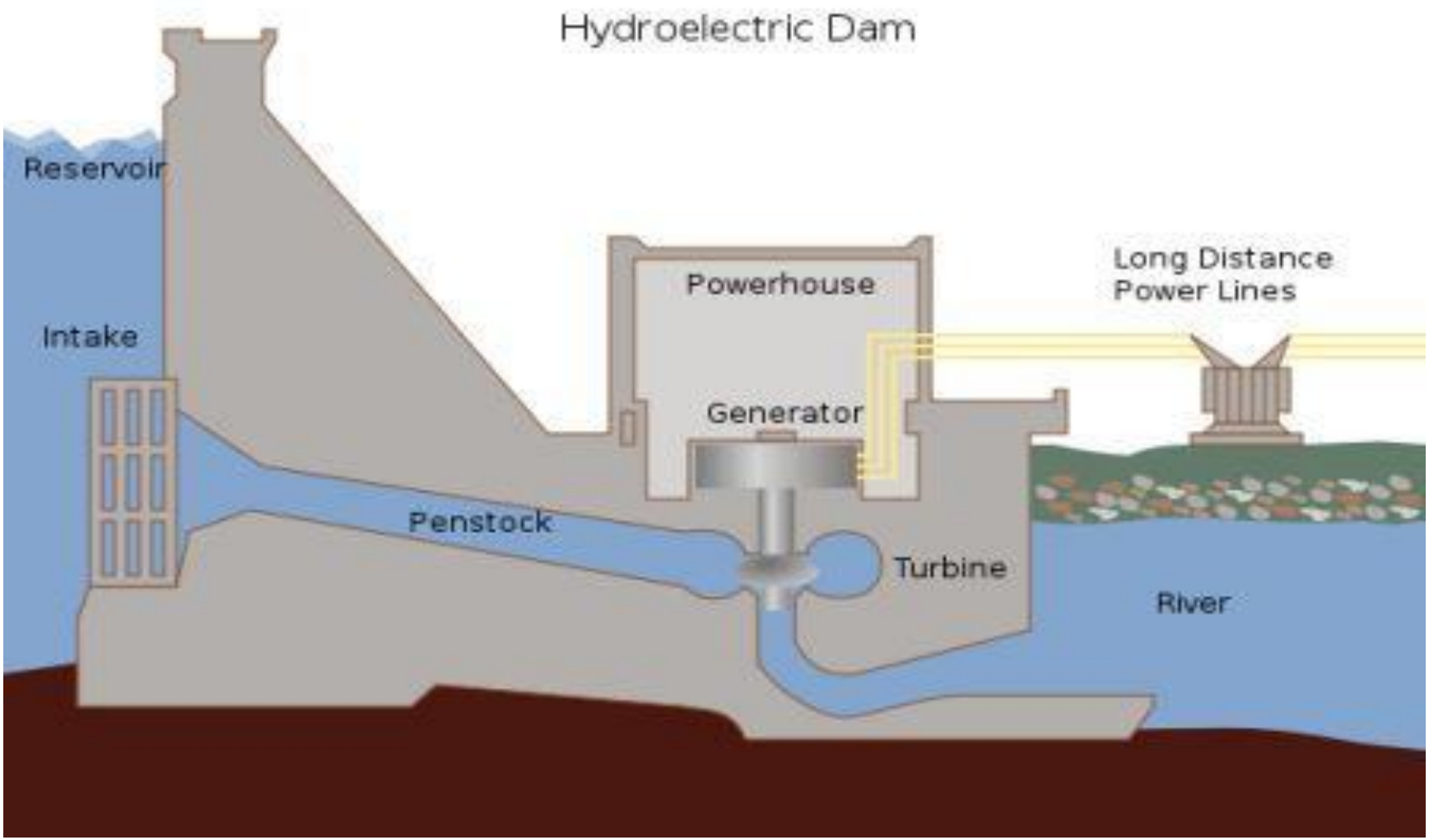
- State the meaning of hydro-electric power plant:Hydroelectric power, electricity produced from generators driven by turbines that convert the potential energy of falling or fast-flowing water into mechanical energy.

Describe the operating principle of hydro-electric power plant.

- The principle of hydropower is that the potential energy of the water stored at great heights in the dam is converted in to kinetic energy by allowing the water to flow at high speed. Then the kinetic energy of flowing water used to generate electricity. ... These turbines are connected to electric generators.

When water from the dam passes through, the turbines spin. This creates electricity. Hydroelectric power is produced as water passes through a dam, and into a river below. The more water that passes through a dam, the more energy is produced.

Hydro-electric power plant



Varies Types of Hydraulic Turbine

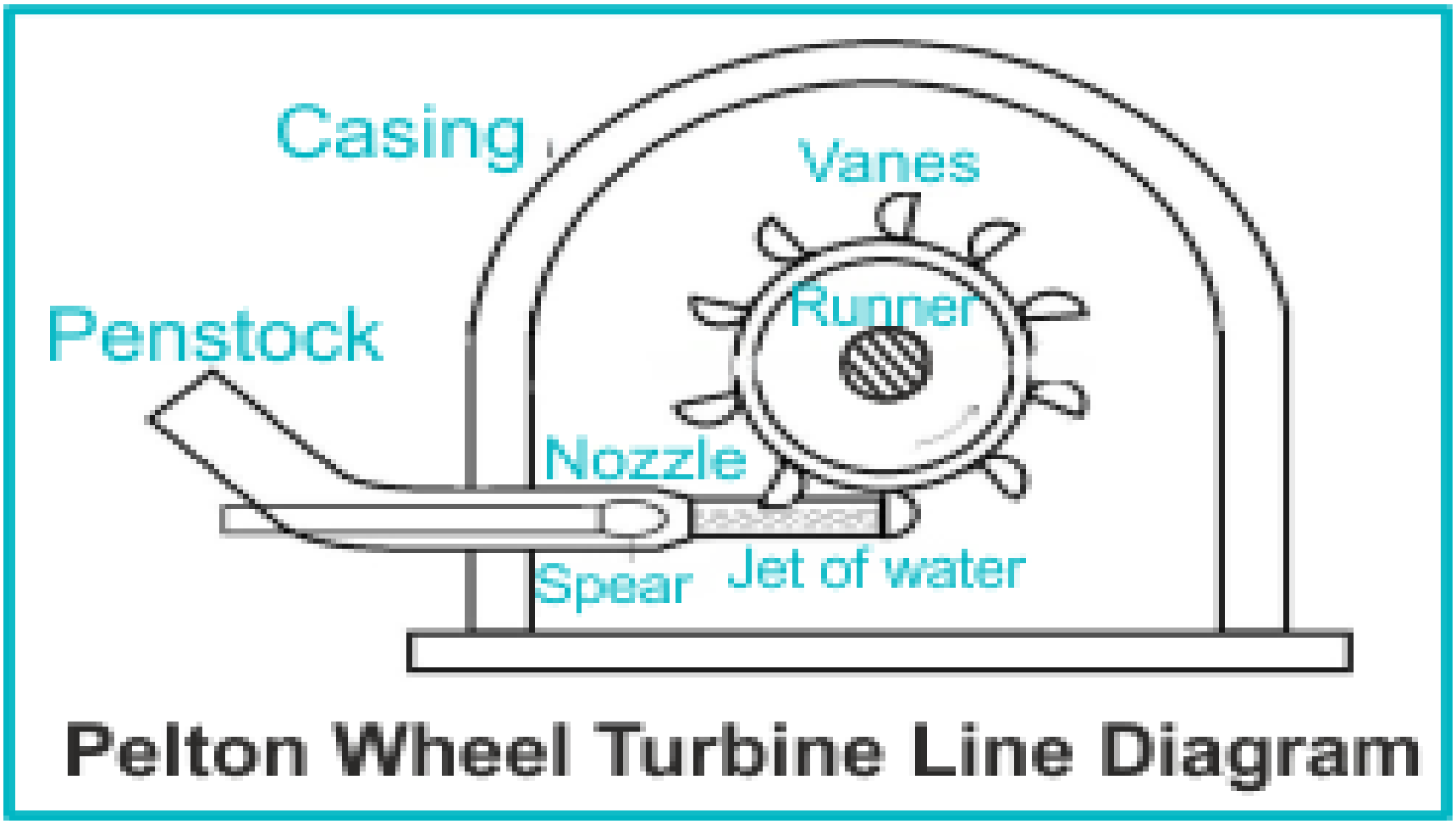
- Pelton turbine
- Francis turbine
- Kaplan turbine
- Axial flow
- Bulb turbine
- Impulse turbine
- Radial flow
- Types of turbine
- Centrifugal pumps

Operation of Pelton Turbine

- Pelton Wheel Turbine is an impulse turbine designed to harness water energy in high head applications for power generation. In this turbine, a high-velocity jet of water exits the nozzle and strikes the open air, subsequently impacting the specially designed buckets or vanes. This transfer of kinetic energy propels the turbine into rotation, generating mechanical power that can be converted into electricity. The Pelton Wheel Turbine's ability to efficiently capture the energy of fast-moving water jets makes it a valuable choice for hydroelectric power plants.

Operation of Pelton Turbine

testbook



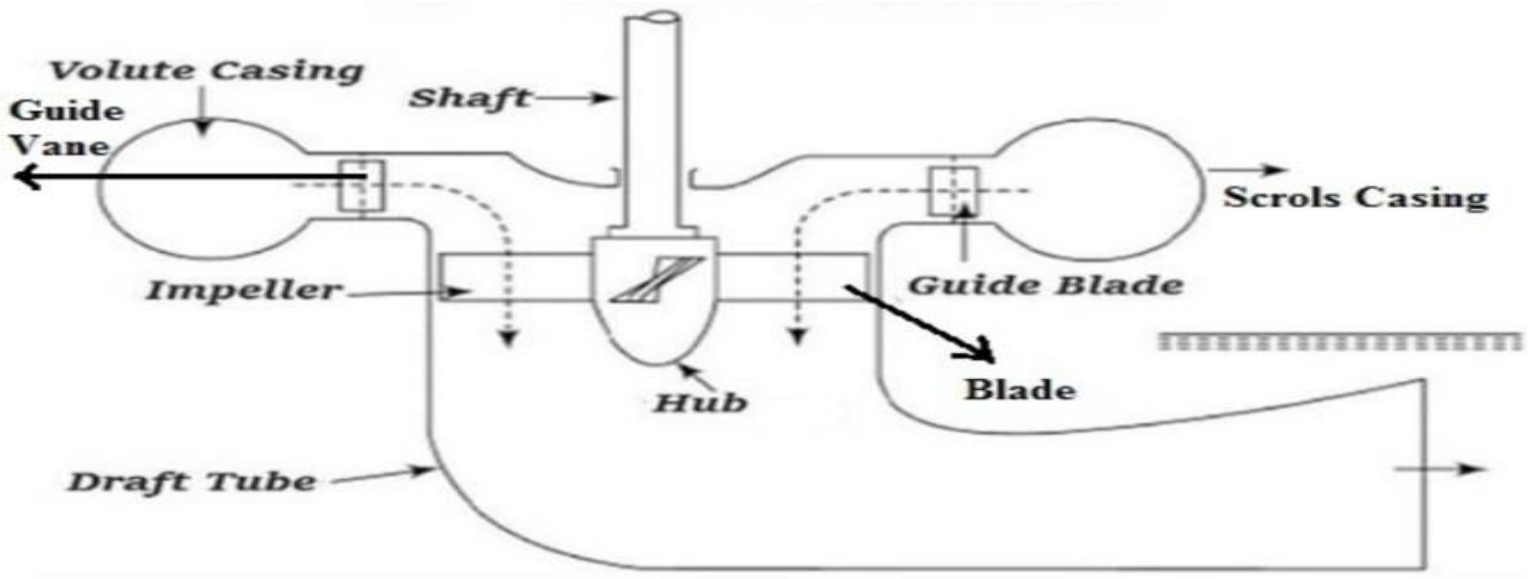
Pelton Wheel Turbine Line Diagram

Operation of kaplan Turbine

- The **Kaplan Turbine** is an adjustable-bladed axial reaction flow turbine. The axial flow turbine is defined as one in which the water flows parallel to the shaft's rotating axis. The turbine is known as a reaction turbine if the head of the inlet of the turbine is the sum of pressure energy and kinetic energy during the flow of water via a runner, and a portion of the pressure energy is converted into kinetic energy. The turbine shaft is vertical in an axial flow reaction turbine. The bottom end of the shaft is thickened, forming a hub or boss.

Operation of kaplan Turbine

- The hub functions as the axial flow reaction turbine's runner because the vanes are attached to it. The Francis turbine evolved into the Kaplan turbine. Its invention enabled efficient power generation in low-head applications, which the Francis turbine could not do.



Describe the elements of hydro-electric power plant

- **Dam and Reservoir:** The dam is constructed on a large river in hilly areas to ensure sufficient water storage at height. The dam forms a large reservoir behind it. The height of water level (called as water head) in the reservoir determines how much of potential energy is stored in it.
- **Control Gate:** Water from the reservoir is allowed to flow through the penstock to the turbine. The amount of water which is to be released in the penstock can be controlled by a control gate. When the control gate is fully opened, maximum amount of water is released through the penstock.
- **Penstock:** A penstock is a huge steel pipe which carries water from the reservoir to the turbine. Potential energy of the water is converted into kinetic energy as it flows down through the penstock due to gravity.
-

Describe the elements of hydro-electric power plant

- **Water Turbine:** Water from the penstock is taken into the water turbine. The turbine is mechanically coupled to an electric generator. Kinetic energy of the water drives the turbine and consequently the generator gets driven. There are two main types of water turbine; (i) Impulse turbine and (ii) Reaction turbine. Impulse turbines are used for large heads and reaction turbines are used for low and medium heads.
- **Generator:** A generator is mounted in the power house and it is mechanically coupled to the turbine shaft. When the turbine blades are rotated, it drives the generator and electricity is generated which is then stepped up with the help of a transformer for the transmission purpose

Describe the elements of hydro-electric power plant

Surge Tank:

- Surge tanks are usually provided in high or medium head power plants when considerably long penstock is required. A surge tank is a small reservoir or tank which is open at the top. It is fitted between the reservoir and the power house. The water level in the surge tank rises or falls to reduce the pressure swings in the penstock. When there is sudden reduction in load on the turbine, the governor closes the gates of the turbine to reduce the water flow. This causes pressure to increase abnormally in the penstock. This is prevented by using a surge tank, in which the water level rises to reduce the pressure. On the other hand, the **surge tank** provides excess water needed when the gates are suddenly opened to meet the increased load demand.

Compare the hydro electric power plant with steam power plant.

Thermal power plant	Hydro power plant
A thermal power plant produces electricity by burning fossil fuels.	Hydro power plant produces electricity by the flowing water.
In this, chemical energy of the fossil fuels is transformed into electrical energy.	In this, potential energy of water stored is transformed into electric energy.
In this, burning of fossil fuels pollute the air.	In this, blocking of water affects fish and other organisms in the river.
It is easier to build where fossil fuels are available.	It is expensive to build .

The two dam projects, that were opposed due to rehabilitation are Tehri dam and Sardar Sarovar projects. (2 + 1)

Mention the factors to be considered in selecting the site of a hydro-electric power plant.

- 1 Water Availability and Quality.
- 2 Topography and Geology.
- 3 Energy Demand and Grid Connection.
- 4 Environmental and Social Impact.
- 5 Technical and Regulatory Requirements.
- 6 Innovation and Optimization.

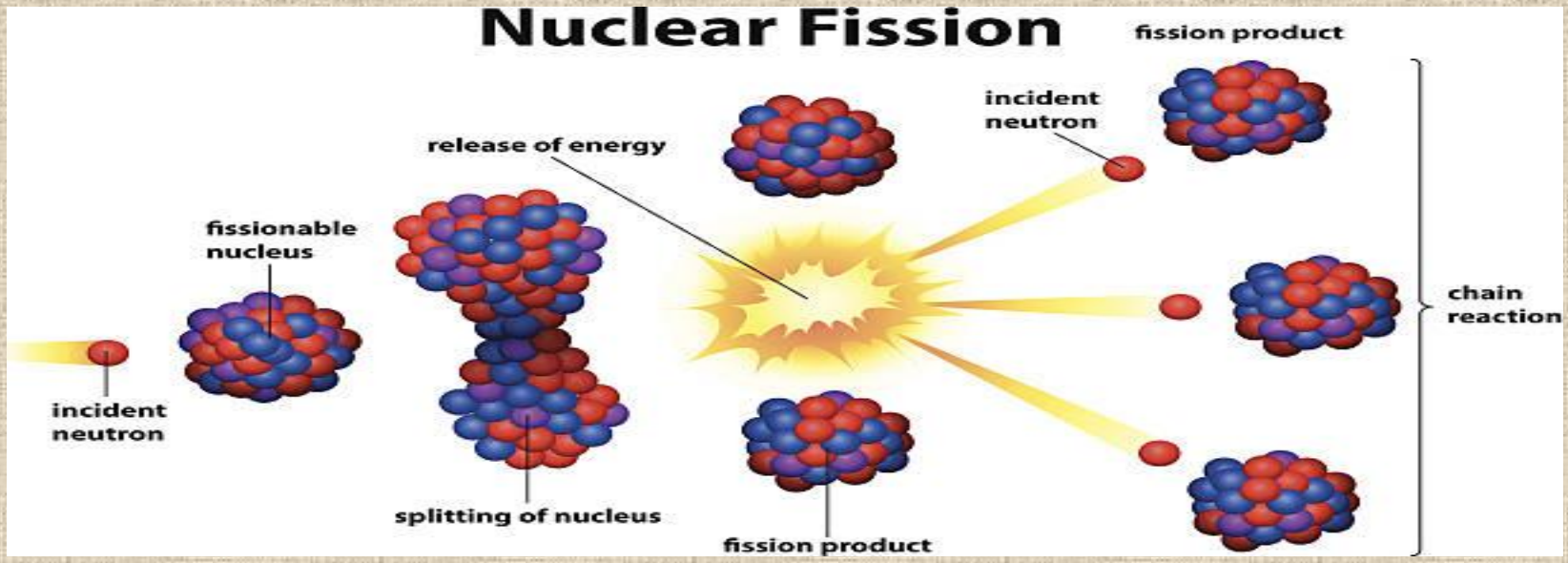
Chapter-7
Understand the features of nuclear power plant.

- Explain fission, fusion & chain reaction
- Fission: Nuclear fission is a process in nuclear physics in which the nucleus of an atom splits into two or more smaller nuclei as fission products, and usually some by-product particles. Hence, fission is a form of elemental transmutation.

- Fusion :is the process of combining two or more things together into one. ... The noun fusion comes from the Latin word fundere, meaning melt, so fusion is the act of melting things together. In science, fusion is the process of merging atoms together to create energy.

- chain reaction: In chemistry and physics, a self-sustaining series of reactions. In a chain reaction in a uranium-based nuclear reactor, for example, a single neutron causes the nucleus of a uranium atom to undergo fission. In the process, two or three more neutrons are released.

Fission, Fusion & Chain reaction



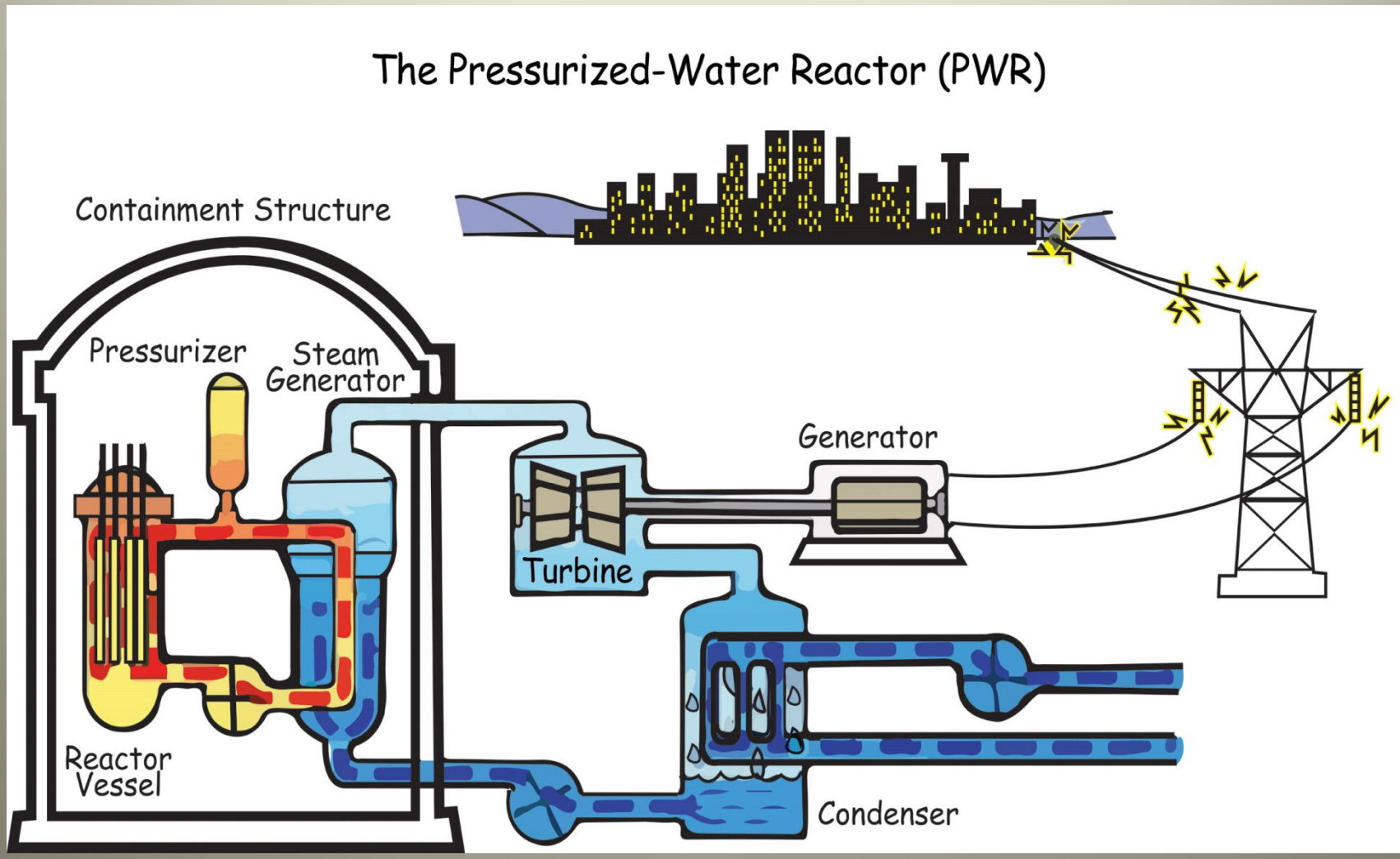
Nuclear Power Plant Working

- The main use currently given to nuclear energy is that of electric power generation. Nuclear power plants are the facilities responsible for this process.

  From the outset, we wonder what is nuclear energy According to its definition, nuclear energy is the internal energy contained in the nucleus of an atom. This energy can be released in the form of heat energy through fission or fusion reactions. Virtually all nuclear power plants in production use nuclear fission since nuclear fusion is currently unfeasible despite being in the process of development.

  The operation of a nuclear power plant is identical to the operation of a thermoelectric power plant working with fossil fuels like coal, oil or gas, except in the way of providing heat to the water for converting this one into steam. In nuclear reactors this process of producing heat is made by the fission reactions of the fuel atoms.

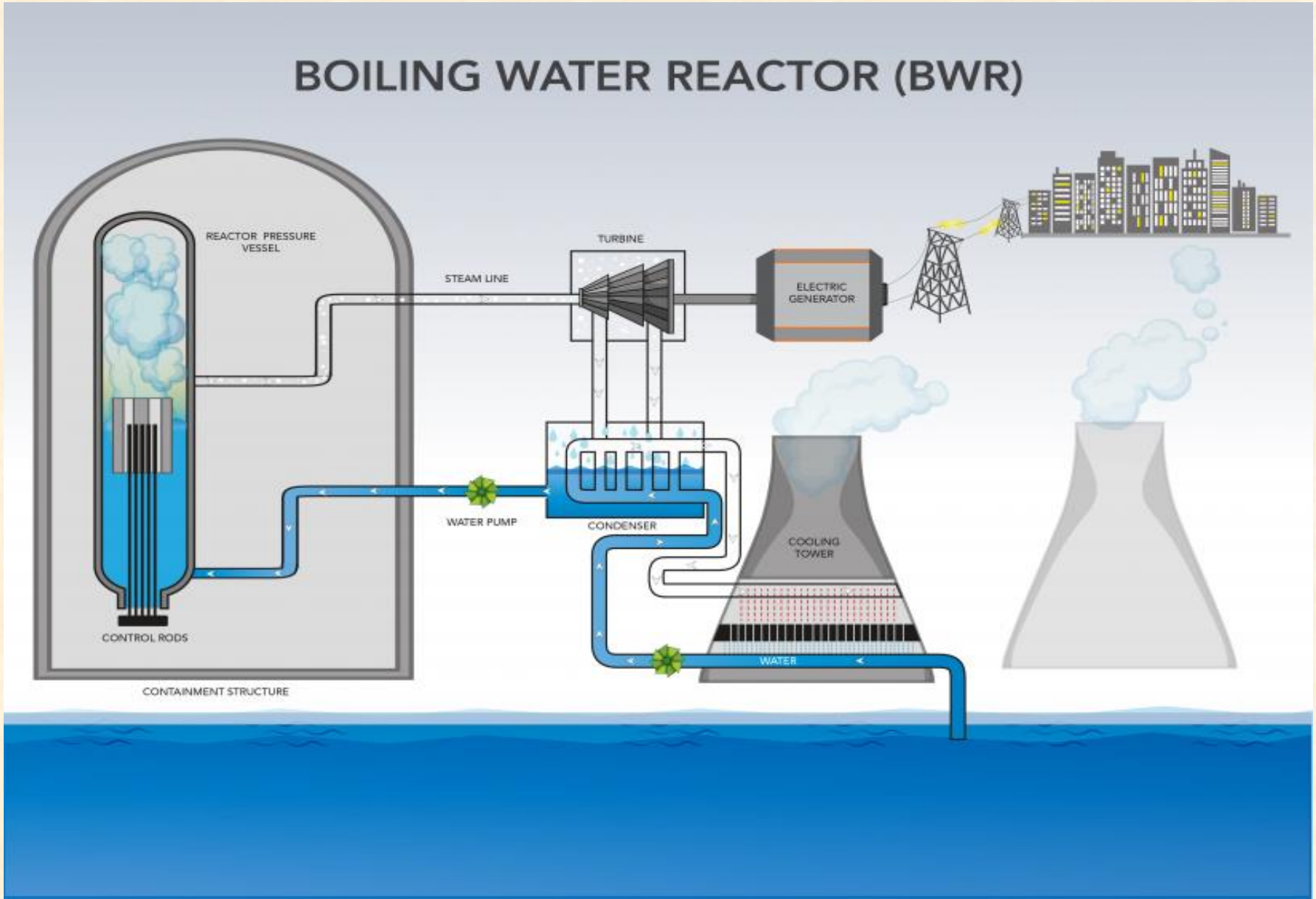
Nuclear Power Plant



BOILING WATER REACTORS

- Roughly a third of the reactors operating in the United States are boiling water reactors (BWRs).
- BWRs heat water and produce steam directly inside the reactor vessel. Water is pumped up through the reactor core and heated by fission. Pipes then feed the steam directly to a turbine to produce electricity.
- The unused steam is then condensed back to water and reused in the heating process.

BOILING WATER REACTORS



Various Nuclear Waste Disposal Methods

- **Various Nuclear Waste Disposal Methods**
- One of the most recent goals with nuclear waste is to try and reduce the overall amount produced. Mostly, these recommendations take the form of being careful where and how radioactive materials are handled, and using the least amount of nuclear materials possible to do the job needed.

- **Incineration:** Burning radioactive waste is largely done through commercially-operated incinerators developed for this purpose, although certain large companies have the means to do this on their own. Incineration is common with low-level waste, as this material usually consists of clothing or other common items that have simply been contaminated.

Various Nuclear Waste Disposal Methods

Storage: Over time, the radioactivity of nuclear material does decay, so storing this material until it is no longer radioactive is another way to deal with proper nuclear waste disposal. This process, called radioactive decay, depends on the amount of materials and the radioactivity level. Therefore, storage is typically only done with radioactive waste that has a shorter half-life, or the amount of time it takes for the material's radioactivity to be reduced by half. There are commercial storage facilities for this waste, while some approved companies have their own means of storage.

- Recycling: Recycling refers to both the direct reuse of used products (e.g. used clothing and functioning parts removed from used vehicles) and material recycling, that is the recovery of raw materials from waste (e.g. production of new glass from fragments, the melting of scrap iron and the production of recycled building materials from construction waste).

Mention the advantages and disadvantages of nuclear plant

What are the Advantages of Nuclear Energy?

- **Clean Energy**
  Nuclear energy has the ability to produce electricity without greenhouse gas emissions. It produces electricity without pollution. It is cleaner than many other forms of energy production. Essentially, nuclear power would be "carbon-zero" if the uranium were mined and transported in a more efficient way.
- **High Quantities**
  Nuclear reaction releases a million times more energy, as compared to hydro or wind energy. Large quantity of energy is generated from a single nuclear power plant.

Disadvantages of Nuclear Power

- Nuclear power stations may be unpopular with people who are concerned about how safe they are. People are worried about a radiation leak such as what happened at **Chernobyl** in the Ukraine and at Fukushima in Japan.
- Nuclear energy is not renewable. When uranium supplies runs out they cannot be replaced.
- Nuclear energy produces radioactive waste which must be buried in sealed containers for thousands of years.
- http://www.twigonglow.com/films/nuclear-waste-1344/

Mention the advantages and disadvantages of nuclear plant

Aseismic Measures Taken by Nuclear Power Plants

【8 key safety points】

Stages	Measures	Details
Assuring safety at the design stage	① Thorough investigation	Perform a detailed survey of active faults and past earthquakes at the site and its surrounding areas as well as the geology and geological structure of the site.
	② Seismic design considering even an extremely rare earthquake	Assure the seismic design to prevent safety-significant components and systems from losing their functions against ground motions both in the horizontal and vertical direction which are assumed to occur during the plant service life, even though the possibility is extremely low.
	③ Detailed analytical evaluation	Perform detailed analyses of possible complicated jolts to important buildings and components when a postulated earthquake hits the site using reliable computational codes to verify the seismic safety.
	④ Confirmation of safety of bearing ground and surrounding slopes	Perform tests and analyses to verify if the ground, on which the facilities important for seismic safety are to be built, has sufficient bearing resistance against earthquakes and confirm that assumed events accompanying an earthquake, such as the collapse of surrounding slopes, would not significantly influence the safety of reactor facilities.
	⑤ Confirmation of safety against tsunami	Performing detailed numerical simulations of a tsunami which is assumed to accompany an earthquake to confirm that it would not significantly influence the safety of the facilities.
Assuring safety at the construction and operation stages	⑥ Construction of a nuclear power plant on ground with sufficient bearing resistance	Build a nuclear power plant on ground that has a low amplitude of earthquake ground motion, sufficient bearing resistance, and no possibility of sliding or adverse subsidence.
	⑦ Automatic shutdown function	Install a system which can automatically shut the reactor immediately after jolts exceeding a certain level are detected.
	⑧ Demonstration of earthquake resistance and understanding of seismic limits using a shaking table and exciter	Demonstrate the earthquake resistance of nuclear facilities, understand the design margin and verify the validity of computational codes used in the maintenance and analysis of equipment functions by applying earthquake loads exceeding the design limit to the actual unit or a specimen equivalent to the actual unit by using a shaking table or exciter.

Nuclear Power in Bangladesh

- **Nuclear Power in Bangladesh**
- Bangladesh started construction of its first nuclear power reactor, Rooppur 1, in November 2017. The unit is scheduled to be commissioned in 2023.
- Construction of the second unit at Rooppur commenced in July 2018.
- The country has a rapidly increasing power demand and is aiming to reduce its dependence on natural gas.
- Bangladesh produced 64 TWh gross of electricity in 2016. Some 53 TWh (82%) was from natural gas and 10 TWh from oil Electricity demand is rising rapidly (7% per year) and capacity was 18.8 GWe as of 2018

- About 10% of the population remains without electricity either from grid or local solar installations, and those relying on the grid experience frequent power cuts. Some 5% of government expenditure is being allocated to 'power and energy'. The government plans for the whole country to be accessible to the grid by 2021, and the Rural Electrification Board has drawn up ambitious plans to connect 2.7 million more households by then (see figures published by the Bangladesh government's Power Division).

- A long-term plan was made in the the Power System Master Plan (PSMP) 2016 an updated version of the PSMP 2010. The plan aims for generation capacity of 23 GWe in 2020, 40 GWe in 2030, and 60 GWe in 2041. The first contribution from nuclear is expected in 2023, and the plan shows approximately 7 GWe nuclear capacity by 2041.

Nuclear Power in Bangladesh
In Ruppur

Mention the factors to be considered in selecting the site of a nuclear power plant.

- Availability of water. ...
- Distance from load center. ...
- Distance from populated area. ...
- Accessibility to site. ...
- Waste disposal. ...
- Land Availability. ...
- Water Availability. ...
- Fuel Availability.

Chapter-8
RENEWABLE ENERGY SOURCES

Here are a few common sources of renewable energy:

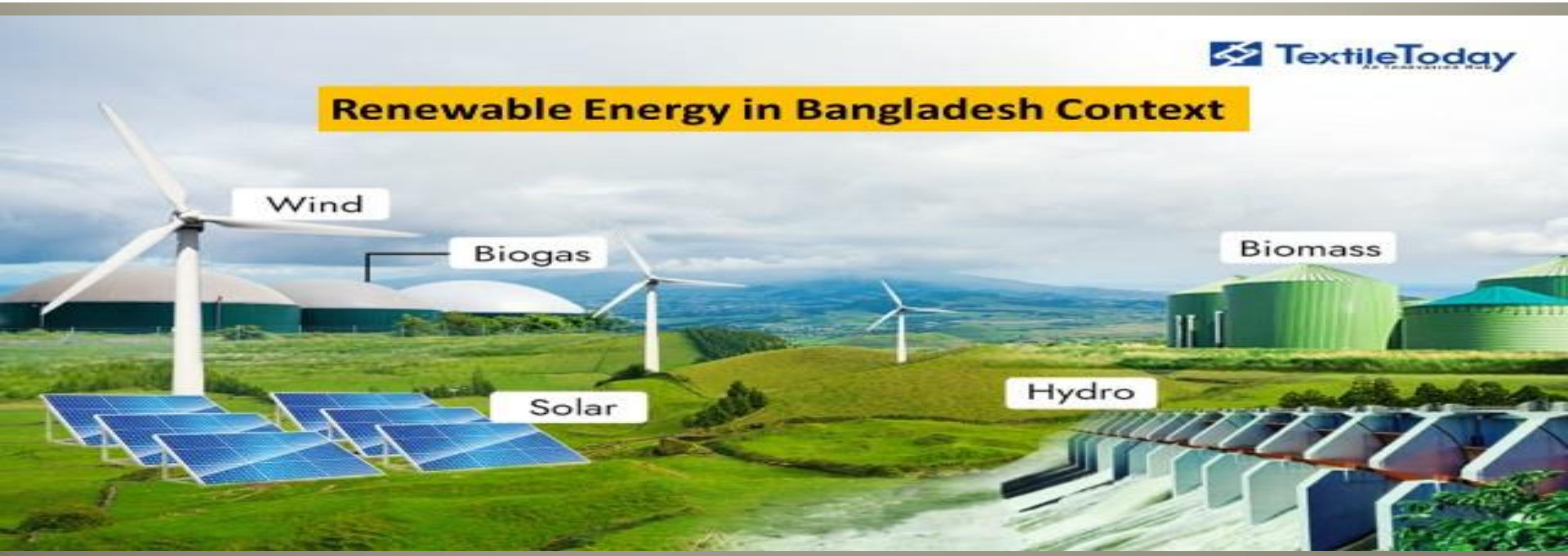
- SOLAR ENERGY. Solar energy is the most abundant of all energy resources and can even be harnessed in cloudy weather. ...
- WIND ENERGY. ...
- GEOTHERMAL ENERGY. ...
- HYDROPOWER. ...
- OCEAN ENERGY. ...
- BIOENERGY.

Promising practices of renewable energy in Bangladesh

- Renewable energy (RE) comprises of energy from the sun (directly), usually called solar, biomass, wind, tidal, geothermal and hydro. The endowment of these resources will determine how much of each form of renewable energy source can be exploited in a country. For example, Bangladesh does not have geothermal potential and its hydro potential, especially that based on elevation, is small. Tidal is a new form of energy source that is yet to achieve commercialisation. It thus leaves solar, wind and biomass as the only current options. With regards to biomass, the principal problem is the high demand of agricultural and animal wastes for cooking in rural areas.

Promising practices of renewable energy in Bangladesh

- In the case of Bangladesh, the principal barriers with biomass are; the price is high and collecting large quantities is difficult, hence expensive. Wind has always been a problematic resource to evaluate in the context of Bangladesh. A group of experts believe that the wind potential in Bangladesh, especially onshore, is limited.



Different types of solar cell

- Solar cells are more complex than many people think, and it is not common knowledge that there are various different types of cell. When we take a closer look at the different types of solar cell available, it makes things simpler, both in terms of understanding them and also choosing the one that suits you best.

- Crystalline silicon cells
- Monocrystalline cells
- Polycrystalline cells
- Thin film solar cells

Operating principle of solar cell

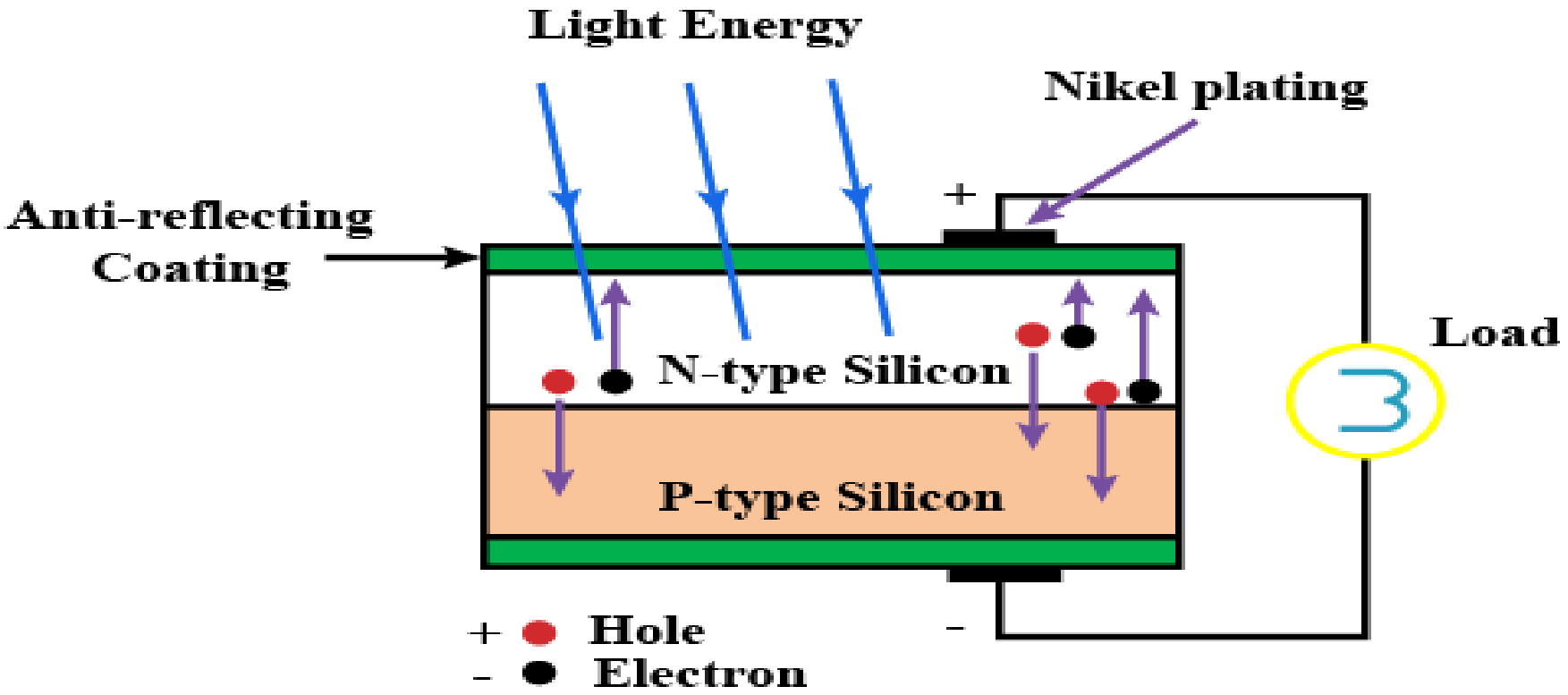
- Solar Energy:
- By taking advantage of a process known as the greenhouse effect. The basic idea is that the solar energy passes through a layer of glazed glass where it is absorbed by the underlying material. The solar energy excites the molecules in the underlying material resulting in heat.

Construction and working Principal of Solar cell

When light reaches the p-n junction the light photons can easily enter in the junction, through very thin p-type layer. The light energy, in the form of photons, supplies sufficient energy to the junction to create a number of electron-hole pairs. The incident light breaks the thermal equilibrium condition of the junction. The free electrons in the depletion region can quickly come to the n-type side of the junction

Construction and working Principal of Solar cell

Similarly, the holes in the depletion can quickly come to the p-type side of the junction. Once, the newly created free electrons come to the n-type side, cannot further cross the junction because of barrier potential of the junction.



Advantages And Disadvantages Of Solar Power Plant.

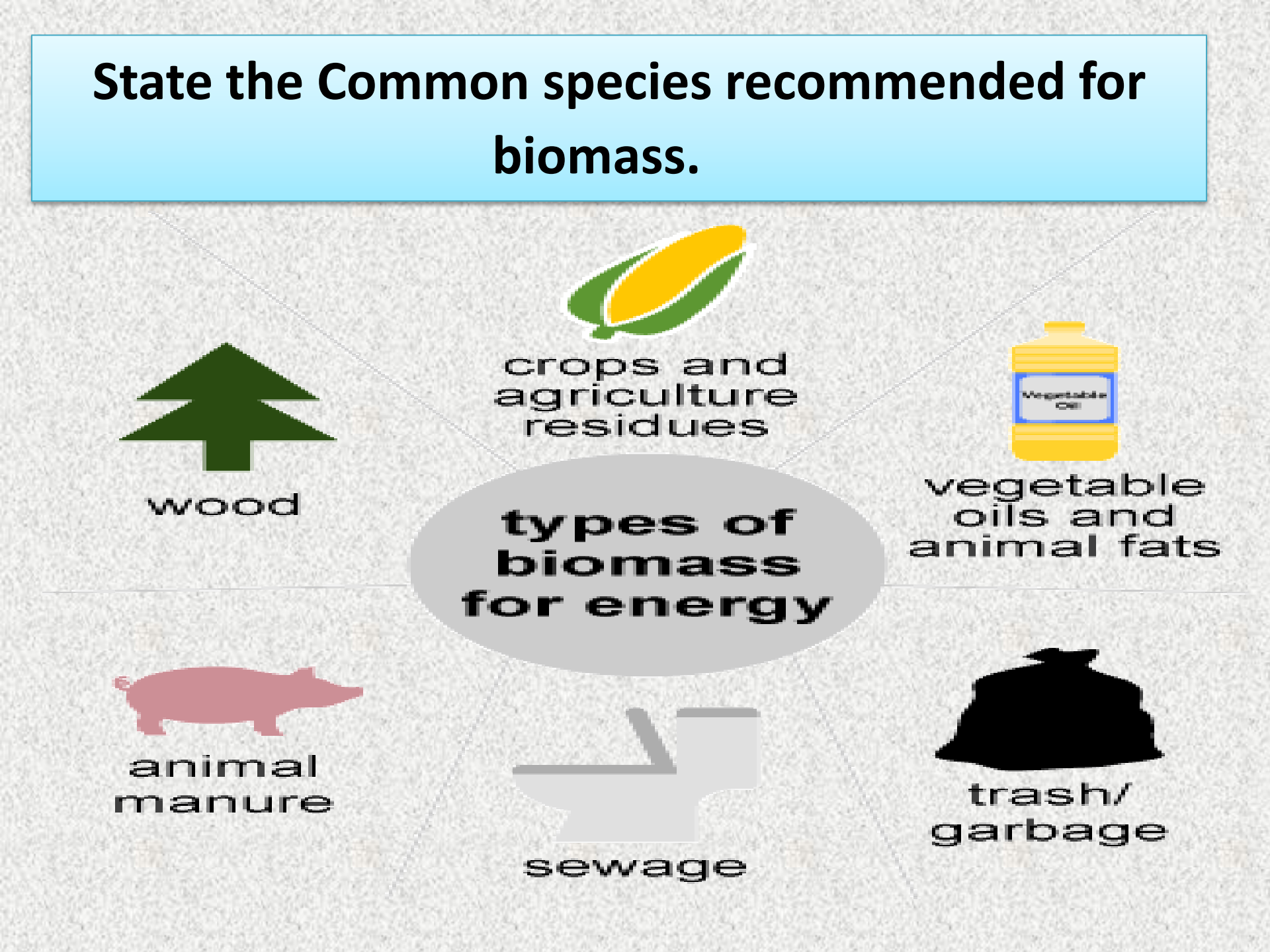
Advantages	Disadvantages
Reduces consumption of fossil fuels.*	Currently, electricity from PV systems is more expensive than electricity produced from fossil fuel or nuclear power plants.
Reduces production of greenhouse gases.*	Expensive to buy.
Reduces production of various pollutants.*	Requires engineering expertise to design and install systems.
Good for remote applications: satellites, rural hospital equipment in developing countries, telecommunication equipment, etc.	Production of PV systems from single silicon crystals is technically challenging, and energy- and time-consuming.
Reduces the loss of electricity due to power line resistance (distribution losses) because it can be sited where the electricity is used.	Sunlight is not constant, so must get electricity from other sources at night or on cloudy days or store it (such as batteries, etc.)
Reduces water consumed in electrical generation processes by displacing electrical demand.	Sunlight is diffuse; PV would take much space to produce enough electricity to meet our current needs (an area ~one sixth the size of Arizona)
Does not contribute to thermal pollution of waterways.	* Once manufactured, PV systems produce no waste products. Manufacturing of almost any device uses some nonrenewable resources, consumes energy and produces waste products. PV systems consume some nonrenewable resources if a system component needs repair or maintenance (such as batteries, inverter, etc.).
No hidden costs.	
Can provide energy independence.	
PV cells last ~ 30 years.	
Uses a renewable energy source.	

State the Common species recommended for biomass.

The species with the largest biomass on Earth is thought to be bacteria. Bacteria are extremely abundant and can be found in virtually every environment on the planet, from the depths of the ocean to the soil to the human body. Their combined biomass is estimated to be greater than that of any other group of organisms.

- Biomass Feedstocks. ...
- Dedicated Energy Crops. ...
- Agricultural Crop Residue. ...
- Forestry Residues. ...
- Algae. ...
- Wood Processing Residues. ...
- Sorted Municipal Waste. ...
- Wet Waste.

State the Common species recommended for biomass.



Environmental merits and de merits using renewable energy

Advantages of Renewable Energy

1)A Fuel Supply That Never Runs Out
2) Zero Carbon Emissions
3) Cleaner Air and Water
4) A Cheaper Form of Electricity
5) Renewable Energy Creates New Jobs

Disadvantages of Renewable Energy:

1) Higher Capital Costs
2) Electricity Production Can Be Unreliable
3) Energy Storage Is a Challenge
4) It’s Impacted by Environmental Conditions

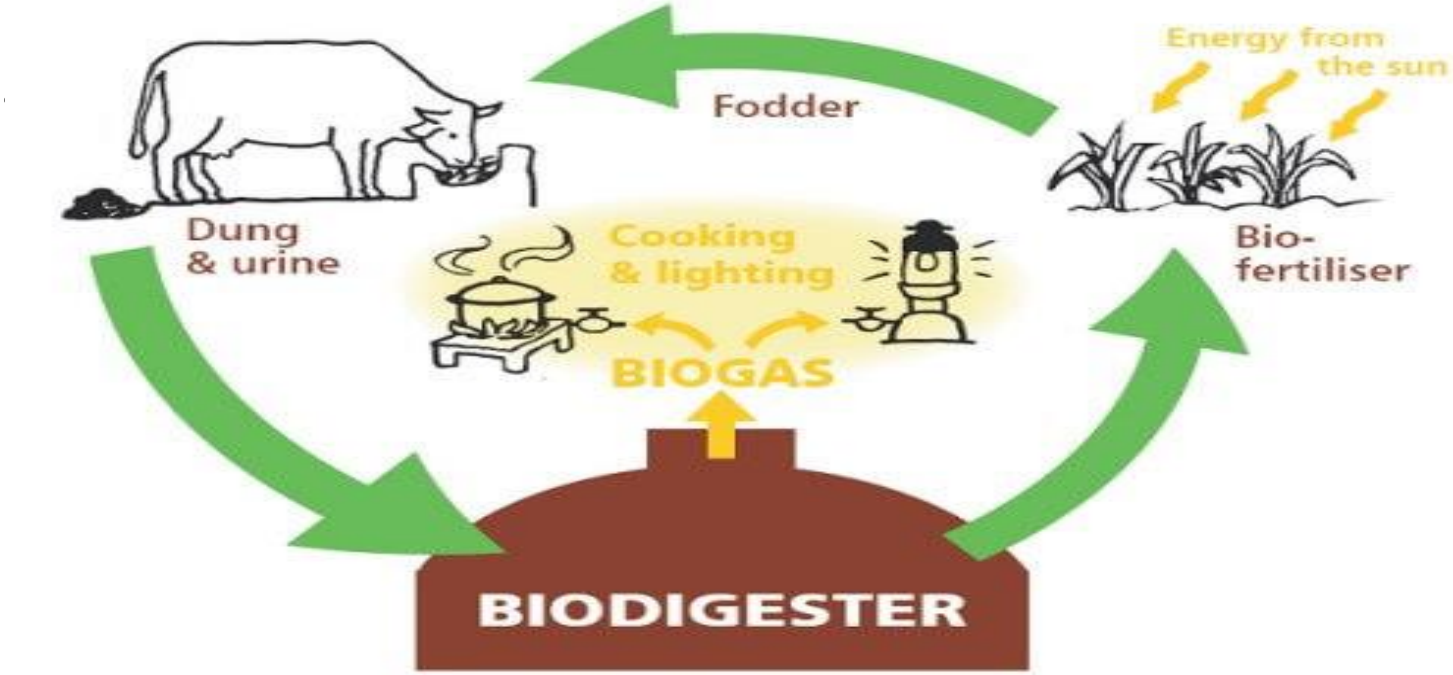
Agriculture waste as a biomass

- Globally, large amounts of agricultural waste biomasses are produced and used. Organic agricultural waste is also a potential source of energy and using, for example, animal manure for biogas is recognized as a cost-effective mitigation technology for greenhouse gas (GHG) emissions in agriculture. This chapter presents an overview of the magnitude of the global agricultural waste production, and presents concrete examples of how it is recycled in selected regions.

Agriculture waste as a biomass

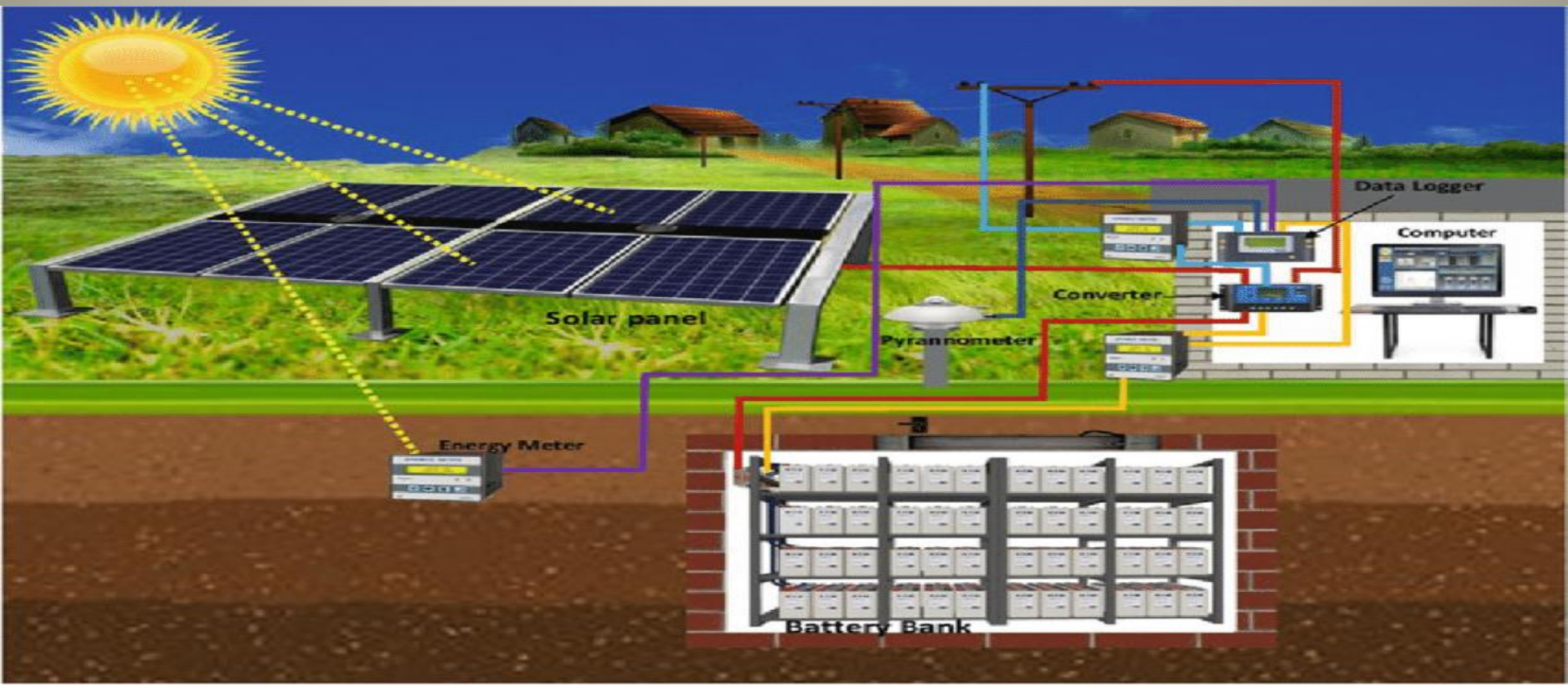
Mention of Biomass digester

- A biogas digester (also known as a biogas plant) is a large tank where inside Biogas is produced through the decomposition/breakdown of organic matter through a process called anaerobic digestion. It's called a digester organic.



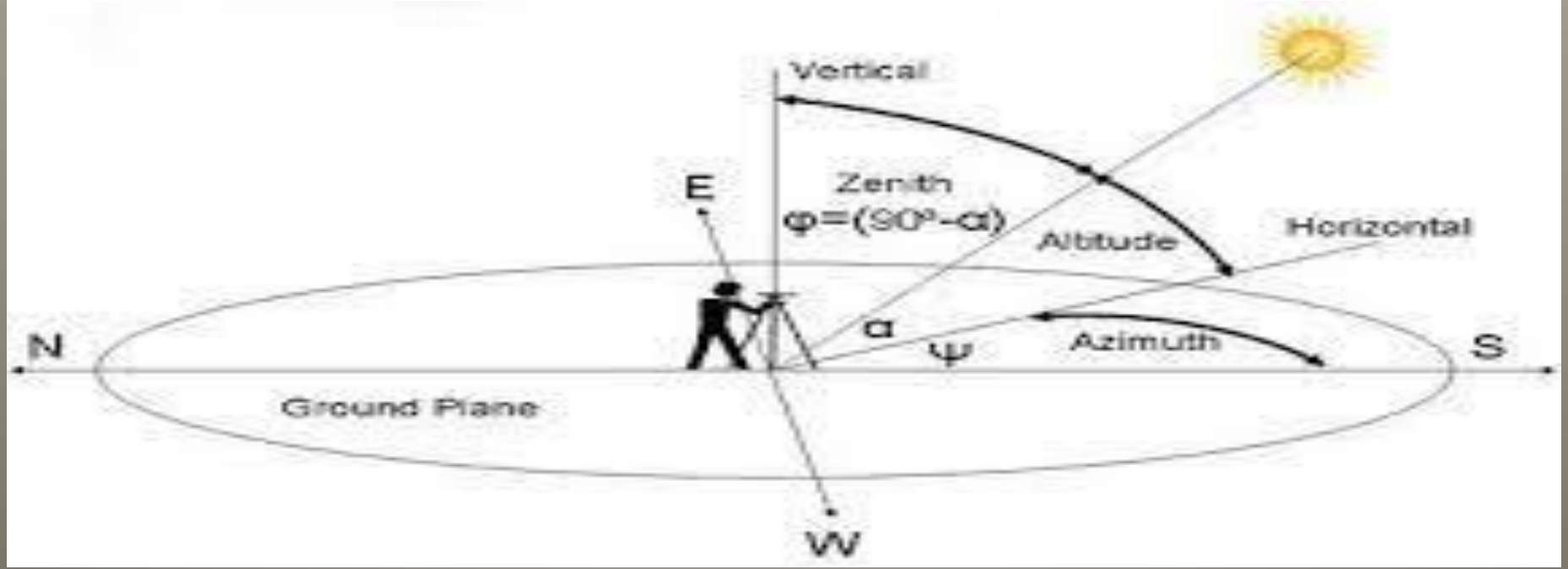
Chapter-9
SOLAR POWER PLANT

- A solar power plant is a facility that converts solar radiation, made up of light, heat, and ultraviolet radiation, into electricity suitable to be supplied to homes and industries.



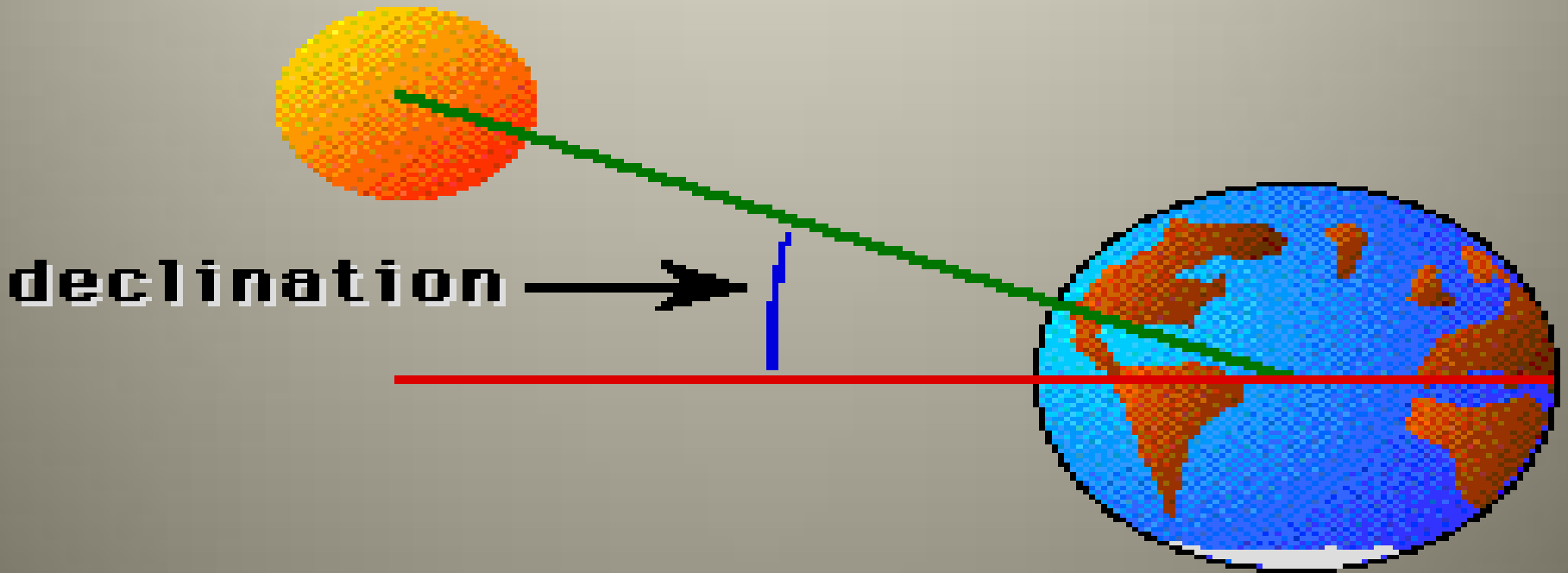
Describe solar radiation geometry

- Solar geometry is the measurement of the angle of the sun to the earth and the corresponding amount of solar energy hitting a given object or surface. It is helpful to consider the position of the sun when deciding the placement of a structure's windows and the amount of sunlight entering the building.



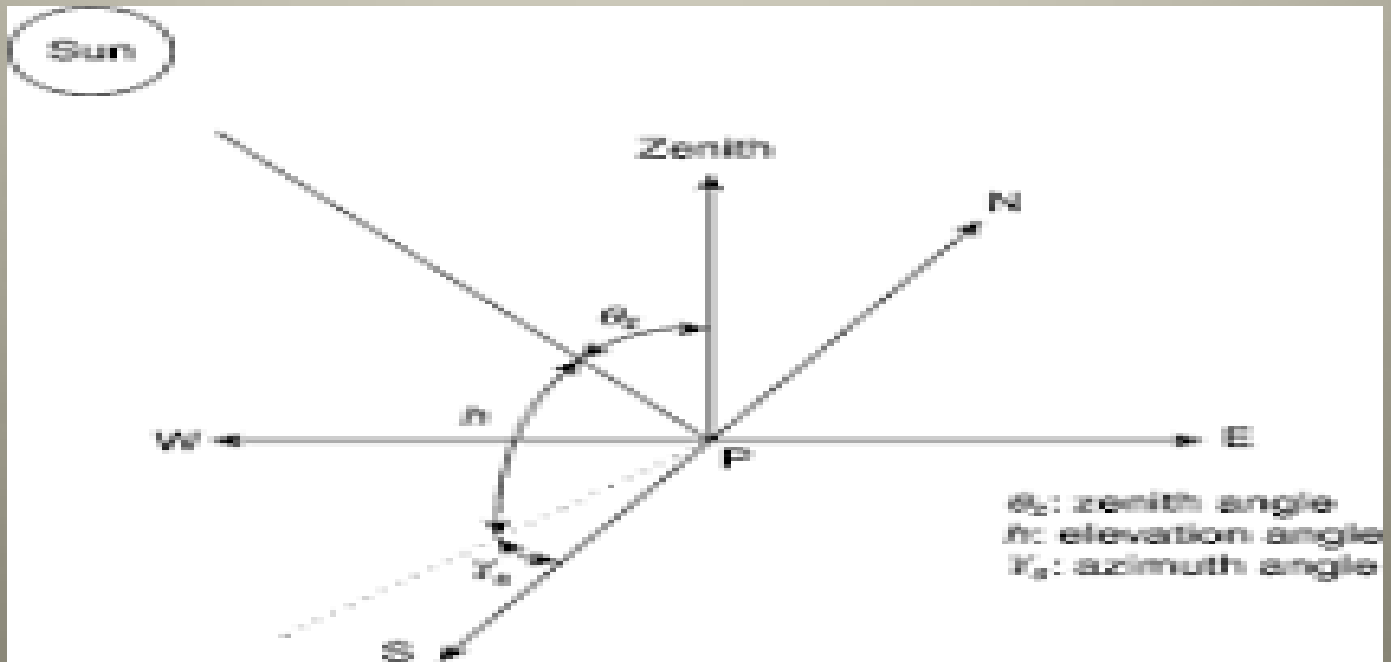
Describe solar Declination

- The solar declination is the different in degrees between the Earth's equator and the Sun's equator. At the spring and fall equinoxes the two equators are parallel, with a declination of 0 degrees. On the solstices the declination between the two reaches its maximum of about 23.5 degrees.



Describe solar Hour Angle

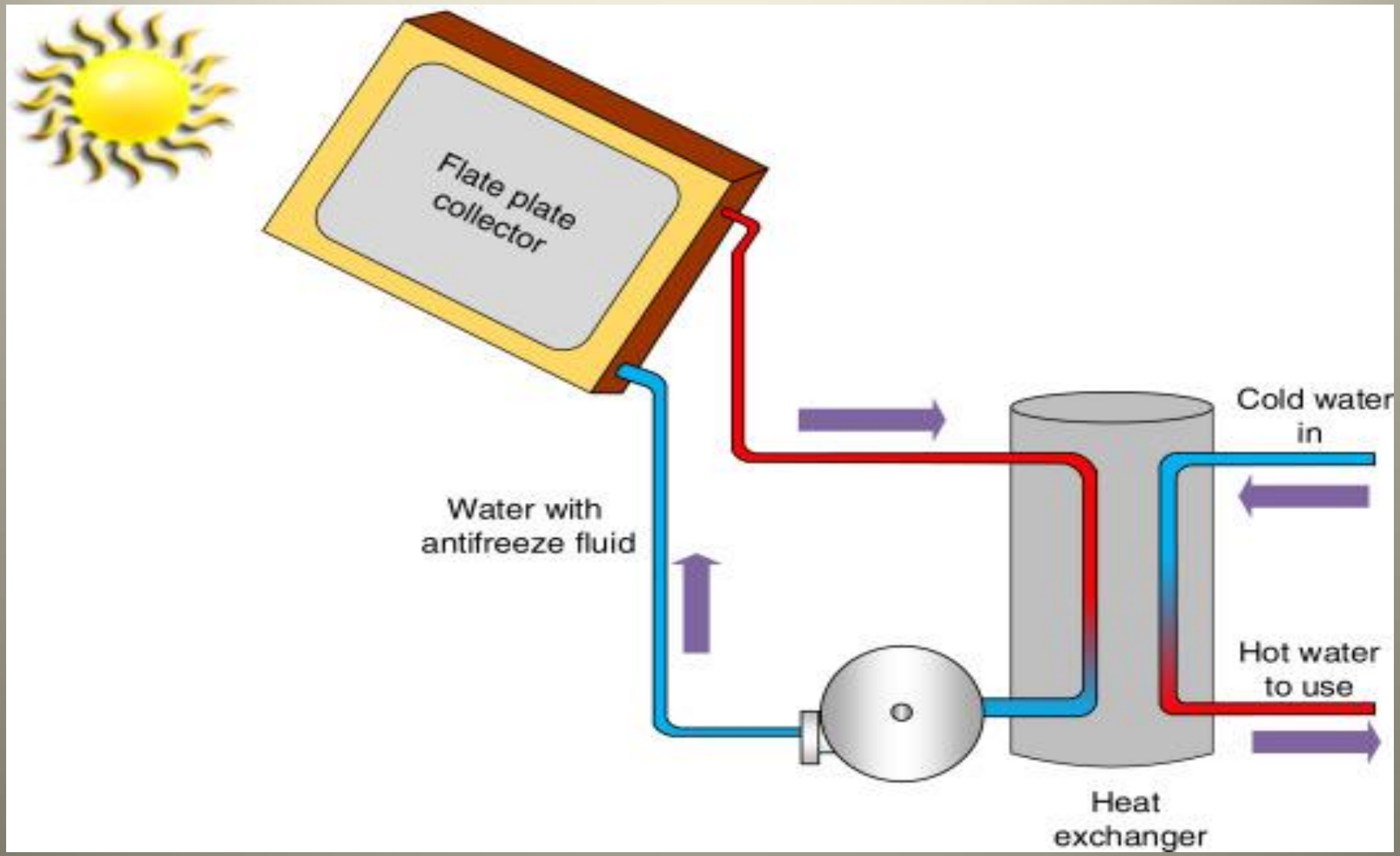
- The hour angle is the angular displacement of the sun east or west of the local meridian due to rotation of the earth on its axis at 15° per hour with morning being negative and afternoon being positive. For example, at 10:30 a.m. local apparent time the hour angle is −22.5° (15° per hour times 1.5 hours before noon).



Describe the Construction and working principle of typical flat plate collector and solar concentrate collector.

- The working of a flat plate collector (FPC) involves the transfer of heat or thermal energy. The operating medium exchanges heat from the sun's rays.
- The heat-absorbing plate of the collector is exposed to sunlight. As the sun rays hit the flat plate surface, a portion of their energy is transformed into heat. This leads to a rise in the temperature of the flat plate solar collector.
- When a fluid is passed inside the collector, the temperature of the fluid increases as the heat from the absorbing plate heat is transmitted to the fluid. Eventually, the fluid transmits the thermal energy from collectors to the functioning energy systems for different uses. It works on the principles of the 1st & 2nd Laws of Thermodynamics.

Describe the Construction and working principle of typical flat plate collector and solar concentrate collector.

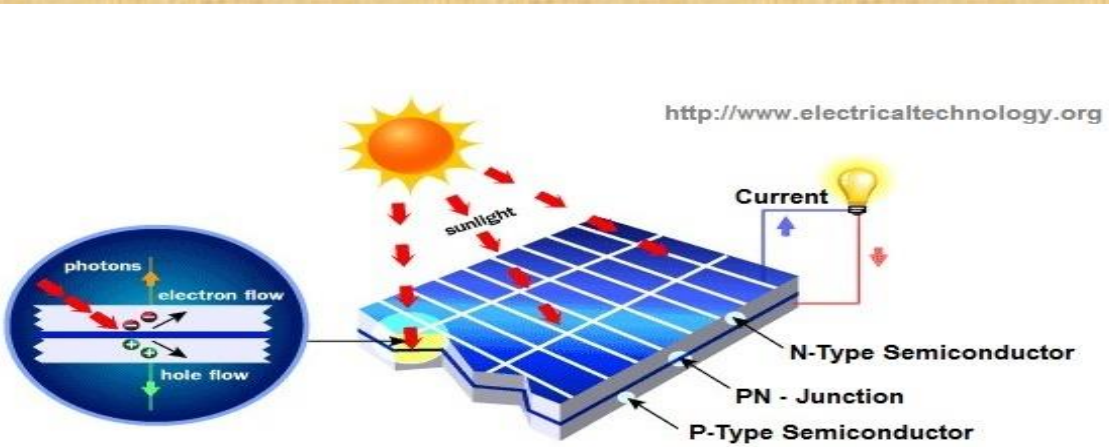


Discuss the basic principles of Photovoltaic cell and fuel cell

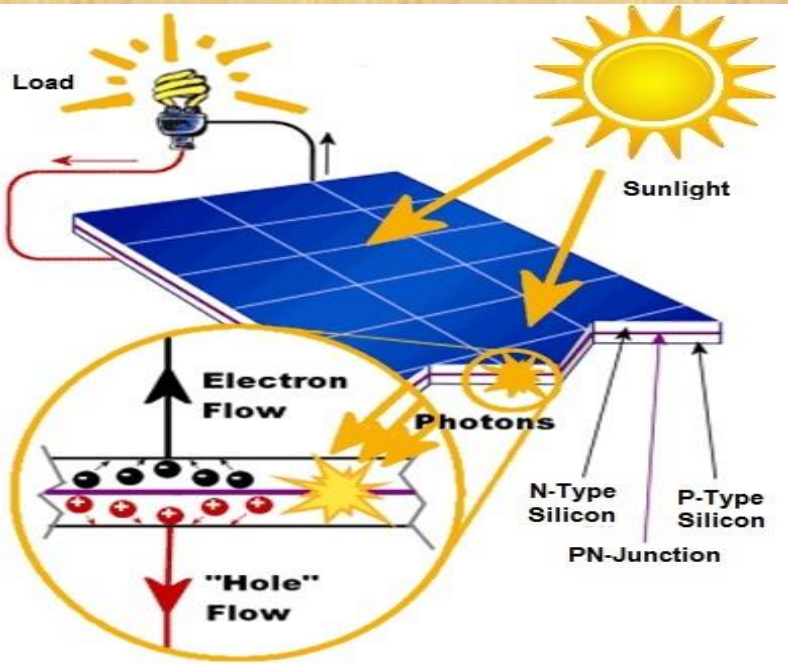
- Direct use of solar energy can be performed in essentially two different ways: (1) the transformation of sunlight directly into electricity in semiconducting devices that are more popularly known as solar cells; and (2) the collection of heat in solar collectors. The transformation of solar radiation into electrical current is referred to as “photovoltaic energy conversion” (PV), and this is the meaning of the word “photovoltaic energy conversion.”
- The photovoltaic effect is responsible for this phenomenon.

Discuss the basic principles of Photovoltaic cell and fuel cell

- The phenomena that can cause a potential difference to occur at the interface of two materials that are not identical is referred to as the “photovoltaic effect,” and it is described using the word “photovoltaic effect.” As a result, the entire field that studies the conversion of solar energy into electricity is referred to as “photovoltaics.

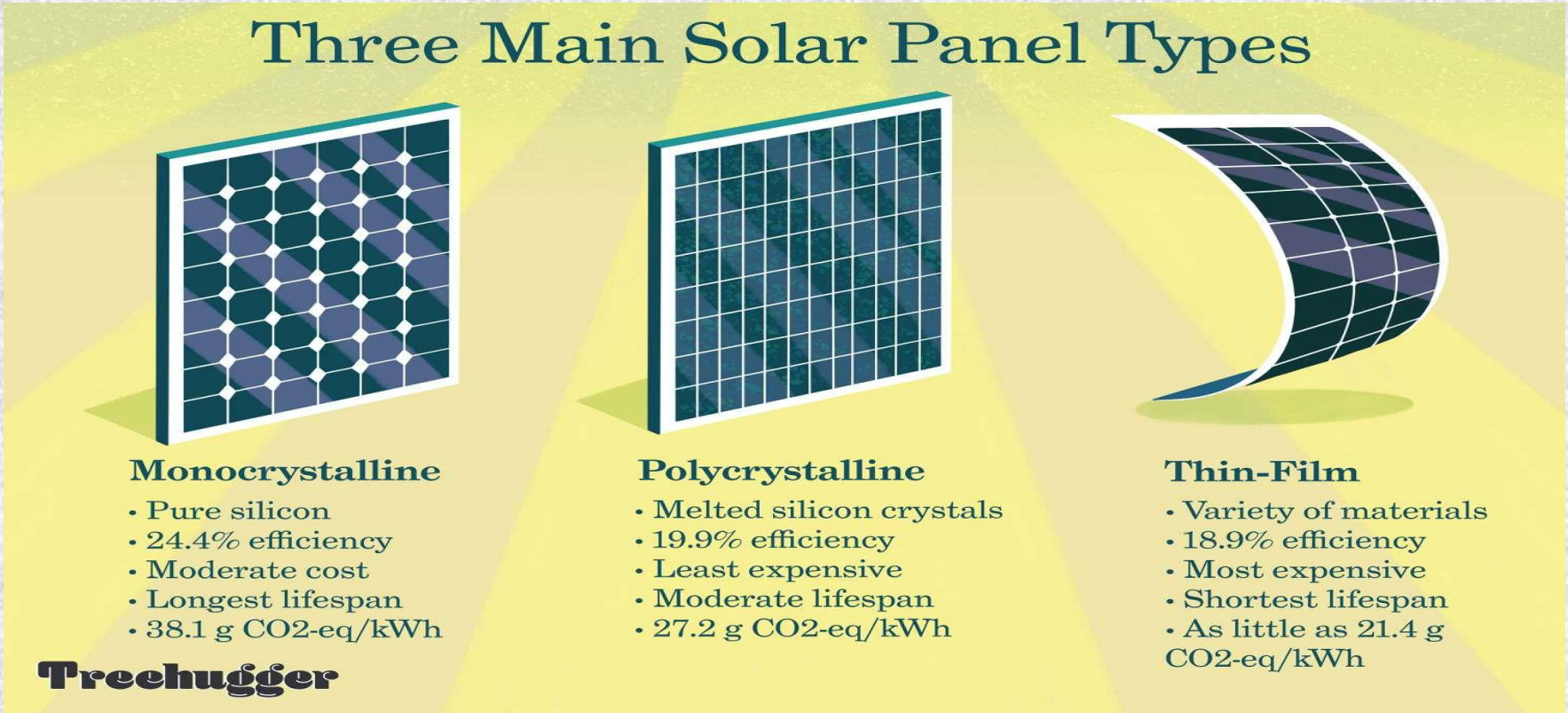


Basic Operating Principle of a Solar Cell



Mention different types of Photovoltaic cell

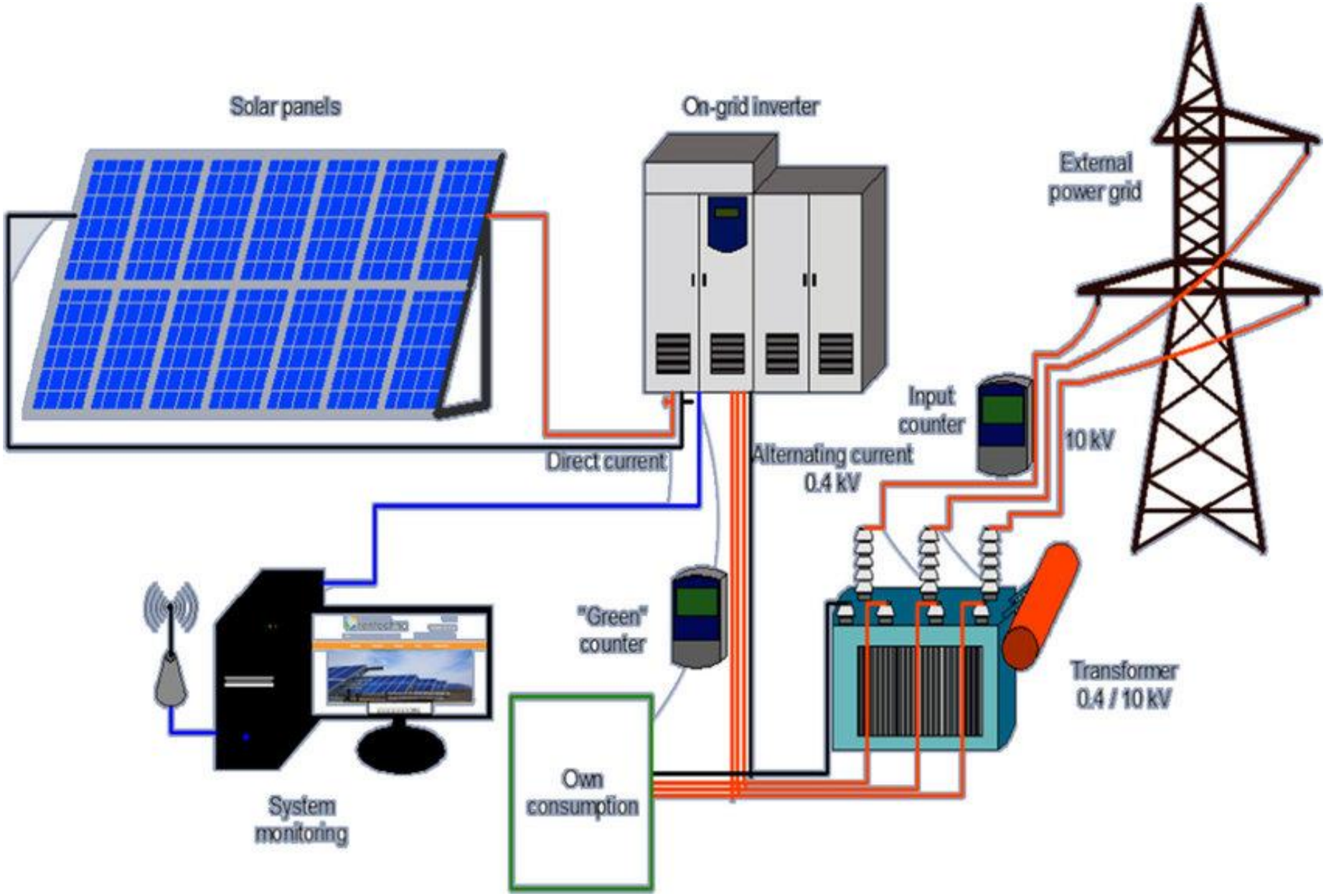
- There are three main types of solar PV systems: grid-tied, hybrid and off-grid. Each type of solar panel system has their advantages and disadvantages and it really comes down to what the customer wants to gain from their solar panel installation.



Mention the applications of Photovoltaic cell

- **Photovoltaic Applications**
- Solar Farms. Many acres of PV panels can provide utility-scale power—from tens of megawatts to more than a gigawatt of electricity.
- Remote Locations.
- Stand-Alone Power.
- Power in Space.
- Building-Related Needs.
- Military Uses.
- Transportation.

Draw a Block diagram of solar power plant



Describe the advantages and limitations of solar power plant.

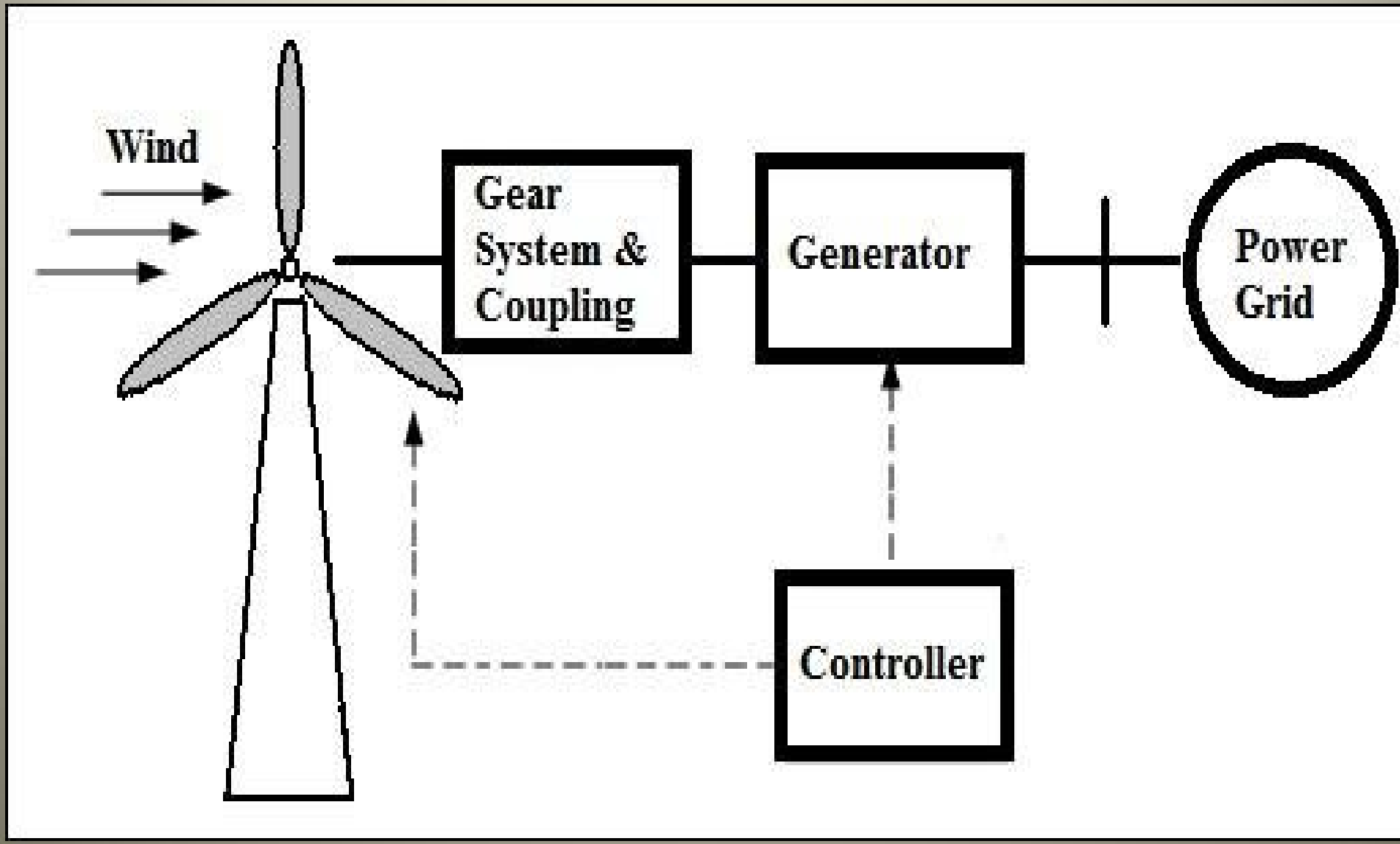
Advantage	Disadvantage
Renewable & Pollution Free	Needs Lots of Space
Reduce Electricity Bill	High Initial Cost
Less to No Maintenance for Years	No Solar Power at Night & Cloudy Days
More Solar Energy in Summer	Less Solar Energy in Winter
Diverse Application	DC Equipment are Expensive
Can be Stored in Battery	Expensive Battery

Chapter-10

Mention the factors to be considered in selecting the site for the wind mill power plant

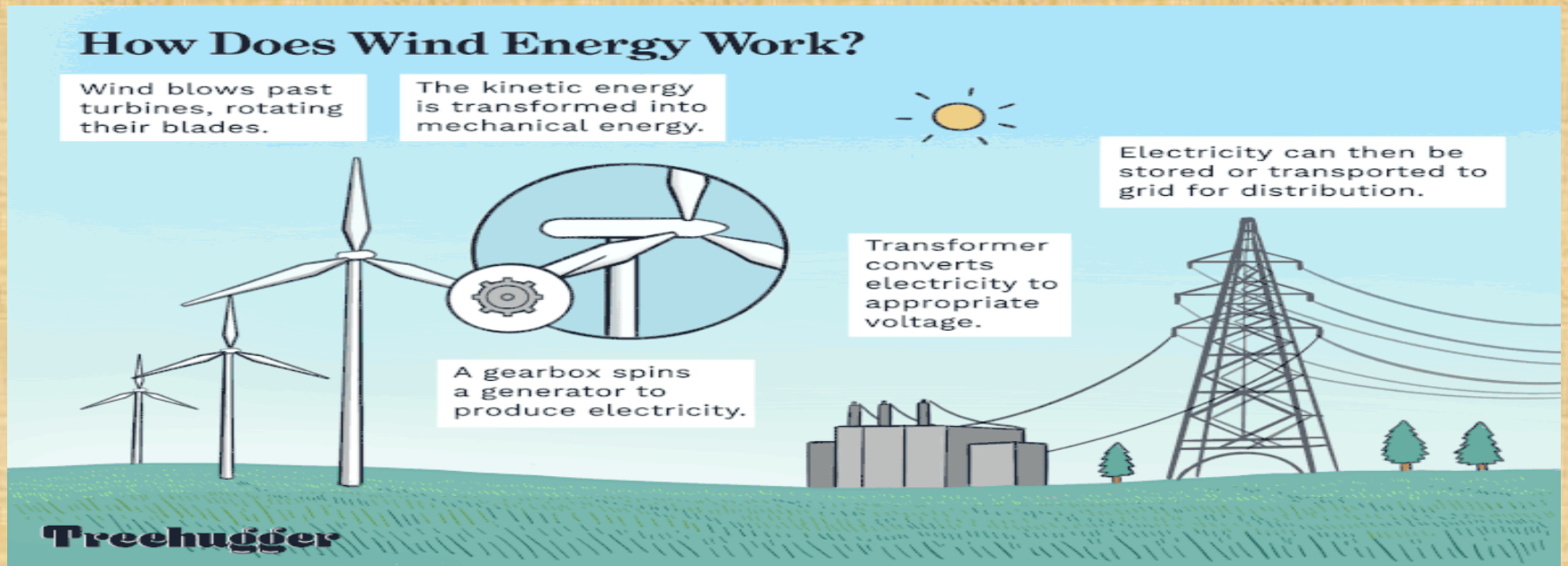
- Location and planning a wind energy facility. A yardstick is used to select locations for wind energy development that is referred to as Wind Power Density (WPD.) ...
- Wind speed
- Altitude
- Wind park effect
- Environmental and aesthetic impacts.

Draw the schematic diagram of a wind mill power plant.



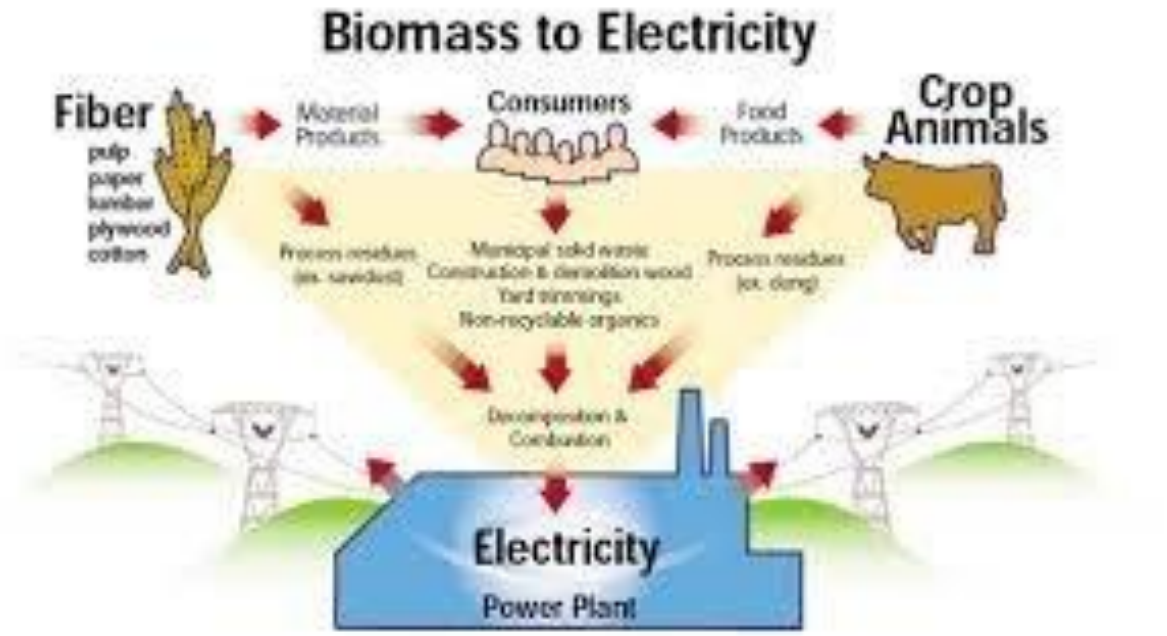
Describe the principle of electricity generation with the help of wind energy

- Wind power generation means getting the electrical energy by converting wind energy into rotating energy of the blades and converting that rotating energy into electrical energy by the generator. Wind energy increases with the cube of the wind speed, therefore WTGs should be installed in the higher wind speed area.



Mention the components of a wind mill power plant

- Direct combustion is the most common method for converting biomass to useful energy. All biomass can be burned directly for heating buildings and water, for industrial process heat, and for generating electricity in steam turbines.



Classify biomass

- What are 6 types of biomass?
- Biomass Feedstocks. ...
- Dedicated Energy Crops. ...
- Agricultural Crop Residue. ...
- Forestry Residues. ...
- Algae. ...
- Wood Processing Residues. ...
- Sorted Municipal Waste. ...
- Wet Waste.

List Biomass digester

- **Types of Biogas Digesters and Plants**
- 2.1 Fixed Dome Biogas Plants.
- 2.2 Floating Drum Plants.
- 2.3 Low-Cost Polyethylene Tube Digester.
- 2.4 Balloon Plants.
- 2.5 Horizontal Plants.
- 2.6 Earth-pit Plants.
- 2.7 Ferro-cement Plants.

Compare between biomass and conventional fuel

Biofuel vs Biomass

Comparison in a tabular form

Biomass	Biofuel
The term biomass refers to all organic matter that comes from plants and animals.	Biofuel refers to any fuel derived from biomass, that is, animal wastes or plant or algae.
Derived from all plants and plant-derived materials, including forestry residues, pulp and paper mills waste, animal manure, urban wood waste and so on.	Produced directly or indirectly from organic material including plant materials and animal wastes.
Biomass such as wood and wood processing wastes are burned to produce heat in industries and used for electricity generation.	Solid biofuels are used to generate electricity and in combined heat and power systems and liquid biofuels are used to replace fossil fuels petrol and diesel.

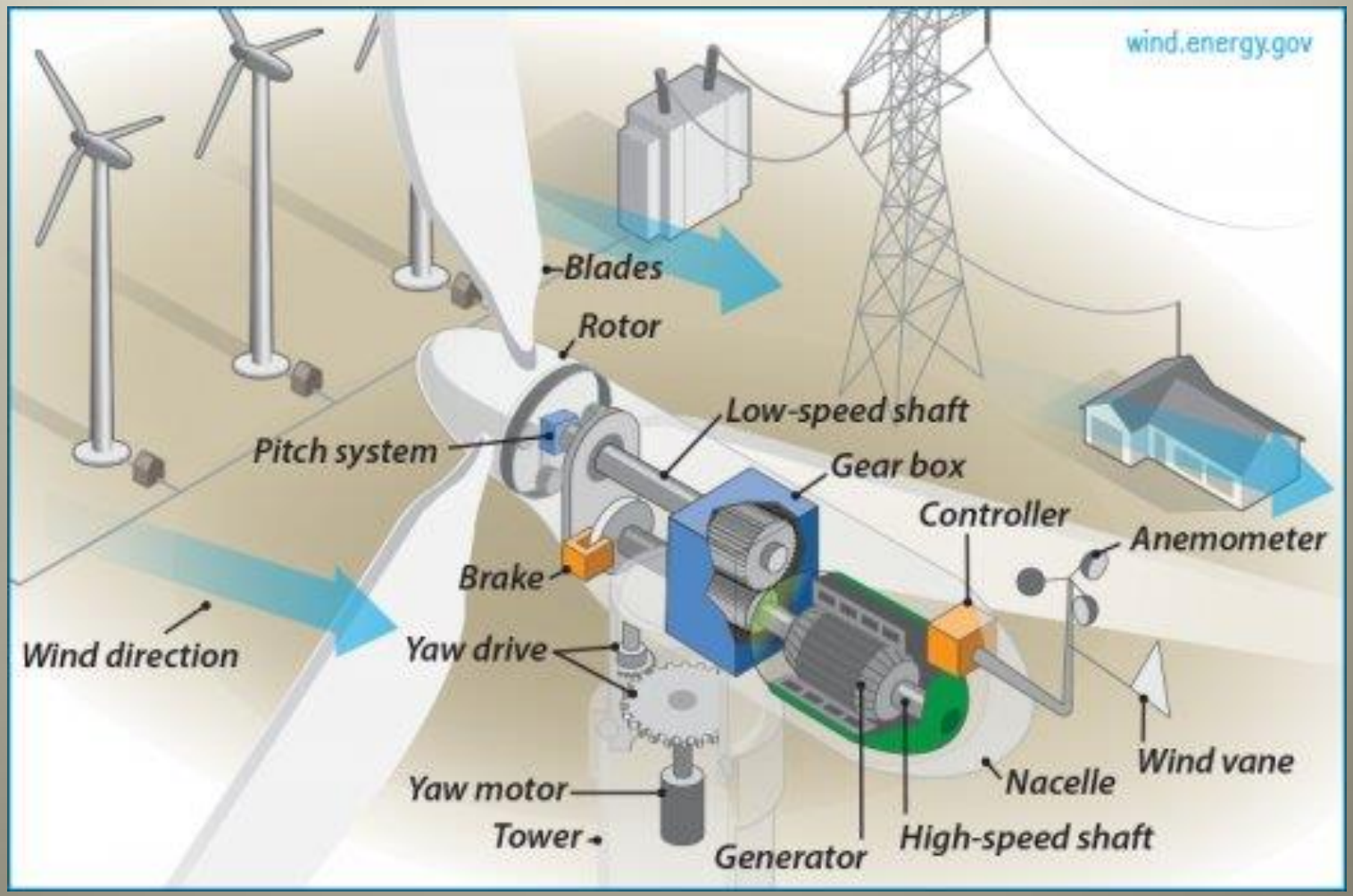
DB Difference Between.net

Operation of wind mill plant

- The majority of wind turbines consist of three blades mounted to a tower made from tubular steel. There are less common varieties with two blades, or with concrete or steel lattice towers. At 100 feet or more above the ground, the tower allows the turbine to take advantage of faster wind speeds found at higher altitudes.
- Turbines catch the wind's energy with their propeller-like blades, which act much like an airplane wing. When the wind blows, a pocket of low-pressure air forms on one side of the blade. The low-pressure air pocket then pulls the blade toward it, causing the rotor to turn. This is called lift. The force of the lift is much stronger than the wind's force against the front side of the blade, which is called drag. The combination of lift and drag causes the rotor to spin like a propeller

- A series of gears increase the rotation of the rotor from about 18 revolutions a minute to roughly 1,800 revolutions per minute -- a speed that allows the turbine’s generator to produce AC electricity.

Wind mill plant



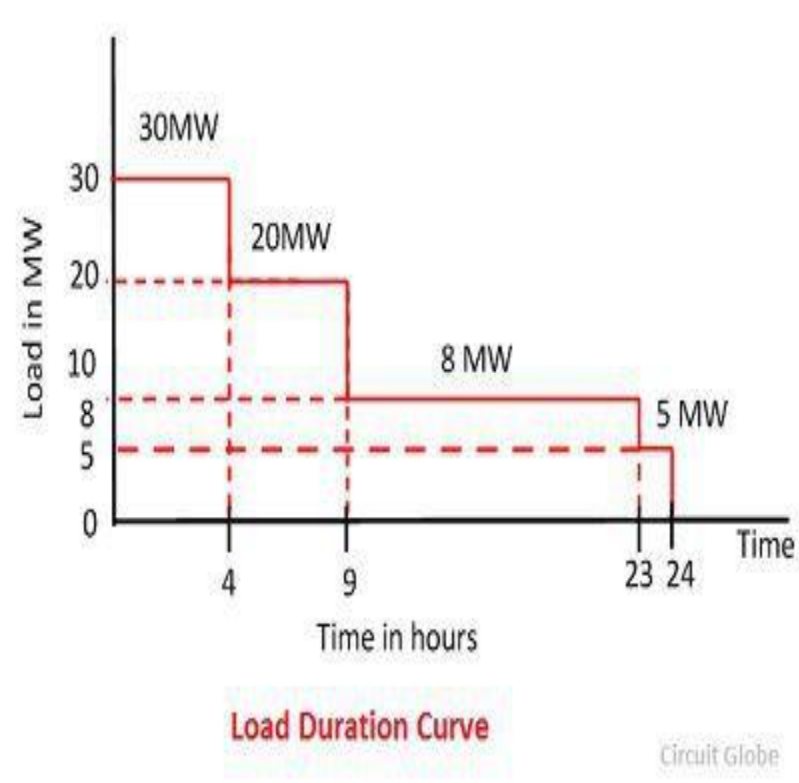
Chapter-11
Understand the features of economic power plant

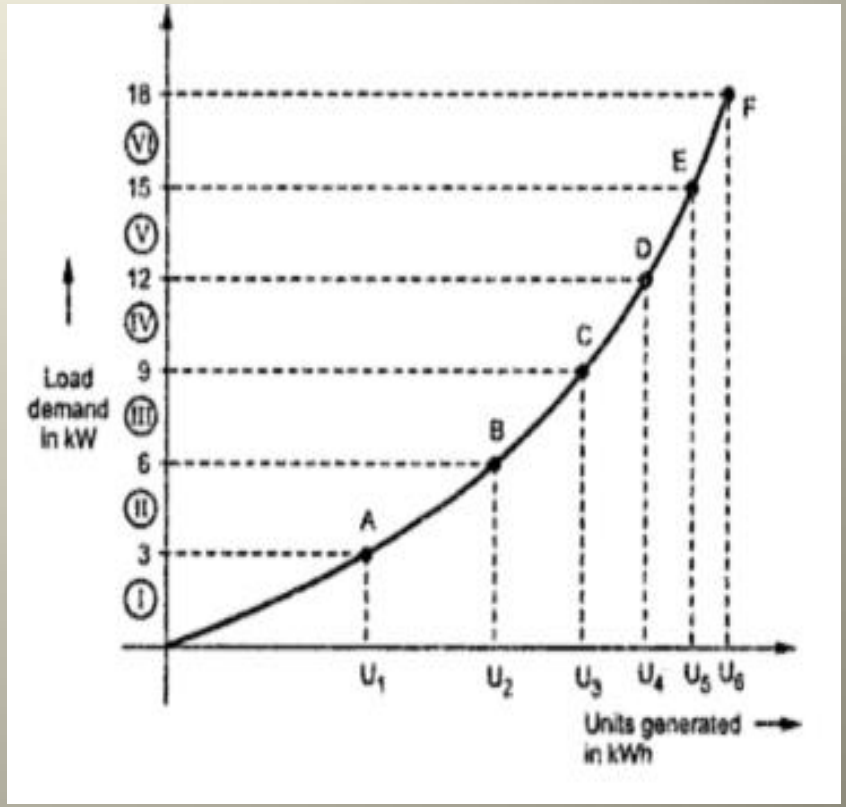
- **Firm Power**. **Firm Power** or **power**-producing capacity intended to be available at all times during the period covered by a guaranteed commitment to deliver, even under adverse conditions.
- **Cold reserve** in a power system is that **reserve** capacity which is available for service but normally not ready for immediate loading. A **Cold reserve** is ensured by special **reserve** units with small start-up and spin-up time. Period of the **cold reserve** start-up is varies from 2 to 24 hours and more
- **Spinning reserve** is the extra generating capacity that is available by increasing the power output of generators that are already connected to the power system. For most generators, this increase in power output is achieved by increasing the torque applied to the turbine's rotor.

Mension the term used in system operation load duration curve, integrated duration curve

- Load duration curve::The load duration curve is defined as the curve between the load and time in which the ordinates representing the load, plotted in the order of decreasing magnitude, i.e., with the greatest load at the left, lesser loads towards the rights and the lowest loads at the time extreme right.
- integrated duration curve::The curve which represents the total number of units generated for the given demand is called as Integrated Load Curve. Fig. A Integrated Duration Curve. The above figure shows the Integrated Duration Curve, its X-axis represents units generated in kWh & Y-axis represents Demand of load in kW

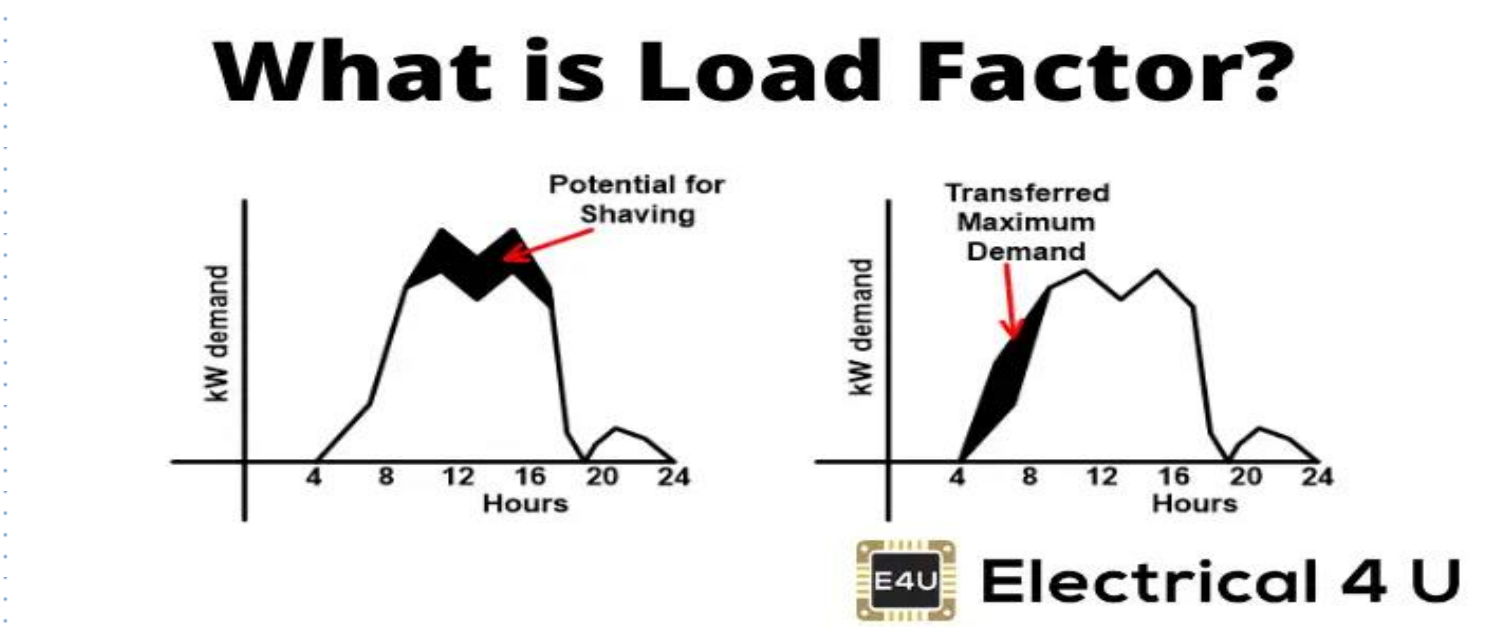
Load duration curve, Integrated duration curve





Describe load factor

- A load factor is the ratio of the average electric load to the peak load over a period of time. The load factor is the actual kilowatt-hours delivered on a system in a given period of time, as opposed to the total possible kilowatt-hours that could be delivered in a given period of time.



Describe demand factor

- Demand factor: It is defined as the ratio of maximum demand on the power station to its connected load. Demand factor = Maximum demand / Total connected load. The value of the demand factor is usually less than 1. It is because maximum demand is always less than the connected load.

Describe the affecting factors the cost of power plant

- Cost of Fuels
- Power Plant Costs
- Transmission and Distribution System Costs
- Weather
- Regulations
- Seasons
- Location
- Type of Consumer

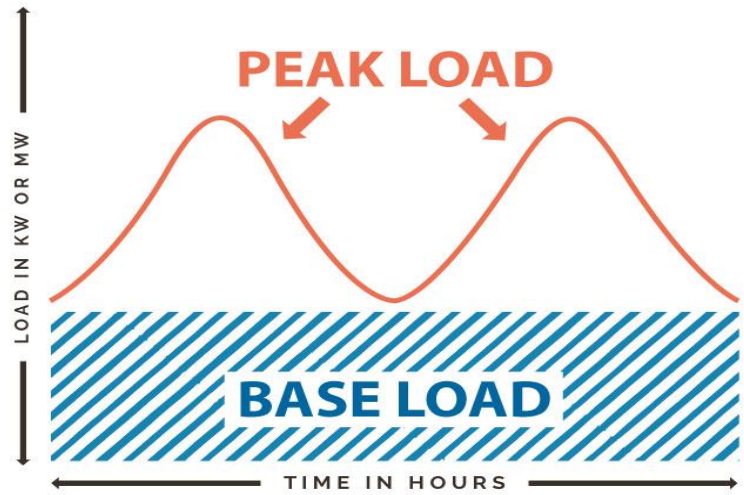
Explain load dispatch center-capacity and load scheduling

- **Load dispatch center** is a coordinating agency for state electricity boards for ensuring a mechanism for safe and secure grid operation. **Load dispatch center** is an important link between generation and transmission, which co-ordinates the power requirements of consumers of electricity.

- **Load scheduling** is one form of **load** management action that allows companies to save energy by minimizing their demand. In order to have an efficient **load schedule** operation, the energy manager or business should conduct power logging and record all sessions so as to measure the usage of energy over a specific time.

Describe peak-hour

- Peak power occurs when our demand for electricity “spikes”. Our demand for electricity fluctuates throughout the day depending on whether we are working, sleeping, or doing household activities such washing, cooking, watching TV or using the internet.

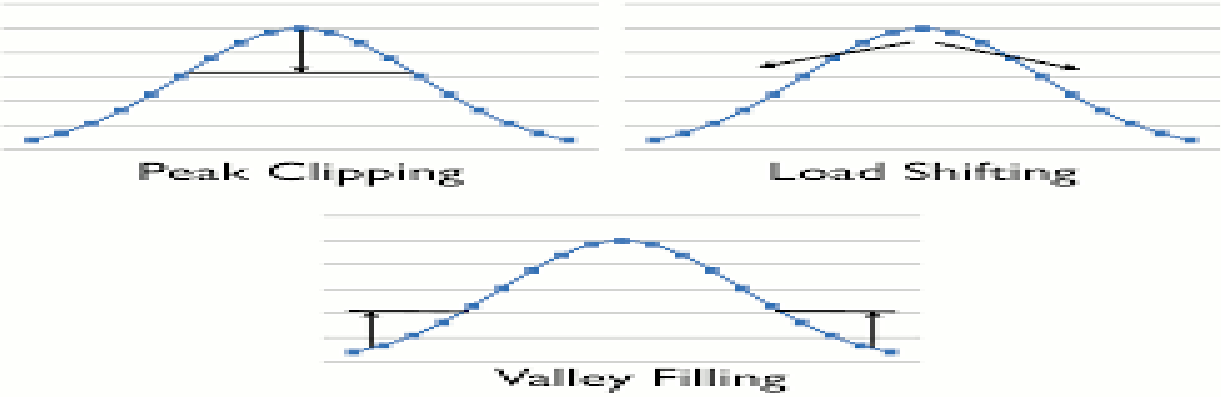


SINO VOLTAICS

Base Load and Peak Load

Explain load management

- **Load management** also known as **demand side management** (**DSM**), is the process of balancing the supply of electricity on the network with the electrical load by adjusting or controlling the load rather than the power station output. This can be achieved by direct intervention of the utility in real time, by the use of frequency sensitive relays triggering the circuit breakers (ripple control), by time clocks, or by using special tariffs to influence consumer behavior.



Explain load management

- Load management allows utilities to reduce demand for electricity during peak usage times (peak shaving), which can, in turn, reduce costs by eliminating the need for peaking power plants.
- Load management can also help reduce harmful emissions, since peaking plants or backup generators are often dirtier and less efficient than base load power plants. New load-management technologies are constantly under development — both by private industry and public entities.


ANY
QUESTIONS?


Thanks
to you all!