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MALABAR POLYTECHNIC CAMPUS CHERPULASSERY

DIPLOMA EXAMINATION - OCT 2018

FIFTH SEMESTER DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

RENEWABLE ENERGY SOURSES

Time: 3 Hrs

Max marks: 100

PART A

I. Answer the following questions in one or two sentences each carries 2 mark.

1. Conventional energy directly means the energy source which is fixed in nature like oil, gas, nuclear and coal. In other words conventional energy is also termed as non-renewable energy sources. Their use leads to increased greenhouse gas emissions and other environmental damage.

2.Transformation of a compound into smaller and simpler compounds, or compounds of higher molecular weight, under elevated temperatures usually in the range of 400°C to 800°C to as high as 1400°C. It differs from combustion in that it occurs in the absence of air and therefore no oxidation takes place.

3. A solar furnace is a structure that uses concentrated solar power to produce high temperatures, usually for industry. Parabolic mirrors or heliostats concentrate light (Insolation) onto a focal point. ... It employs an array of plane mirrors to gather sunlight, reflecting it onto a larger curved mirror.

4. There are two main types of wind turbines, horizontal and vertical axis.

5. A solar regulator is a small box consisting of solid state circuitry that is placed between a solar panel and a battery. Its function is to regulate the amount of charge coming from the panel that flows into the deep cycle battery bank in order to avoid the batteries being overcharged.

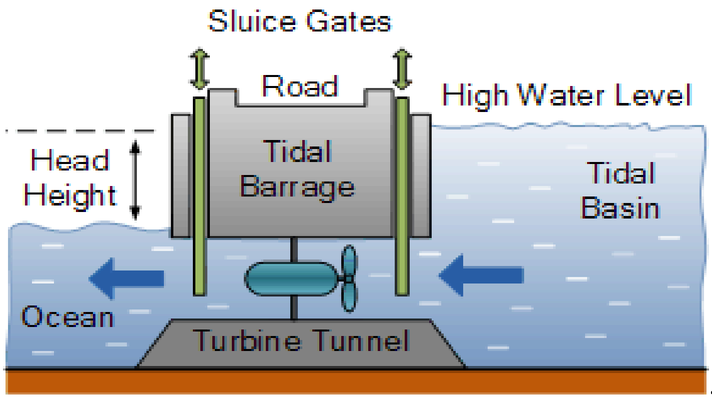
PART B

II. Answer the following questions. Each carries 6 marks.

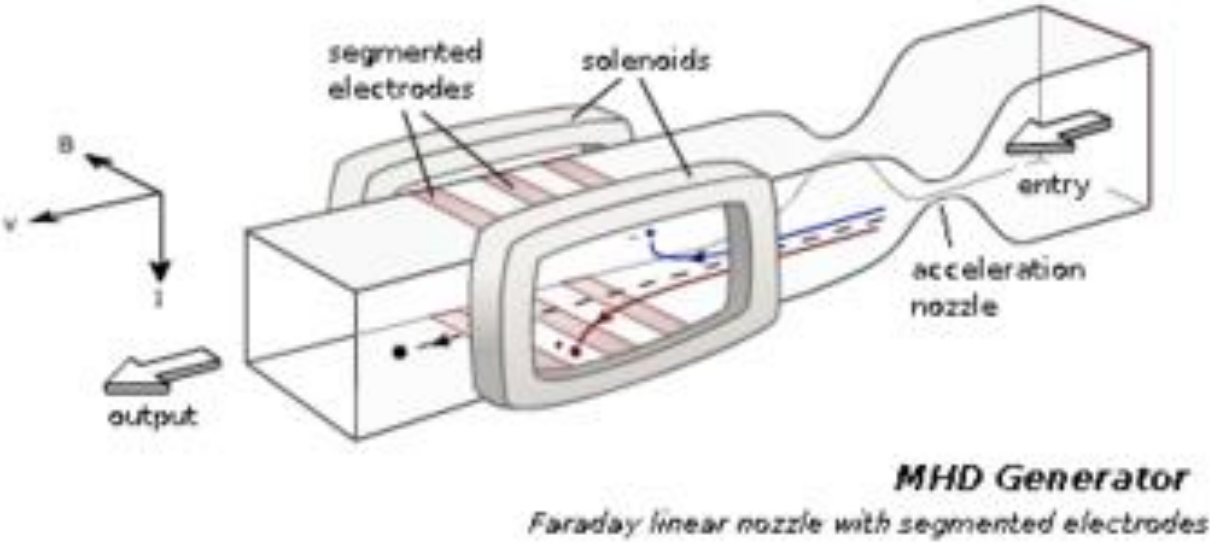
1. Tidal power generation that involves the construction of a fairly low dam wall, known as a “barrage” and hence its name, across the entrance of a tidal inlet or basin creating a tidal reservoir. This dam has a number of underwater tunnels cut into its width allowing sea water to flow through them in a controllable way using “sluice gates”. Fixed within the tunnels are huge water turbine generators that spin as the water rushes past them generating tidal electricity

Tidal barrages generate electricity using the difference in the vertical height between the incoming high tides and the outgoing low tides. As the tide ebbs and flows, sea water is allowed to flow in or out of the reservoir through a one way underwater tunnel system. This flow of tidal water back and forth causes the water turbine generators located within the tunnels to rotate producing tidal energy with special generators used to produce electricity on both the incoming and the outgoing tides.

The one disadvantage of **Tidal Barrage Generation** is that it can only generate electricity when the tide is actually flowing either “in” or “out” as during high and low tide times the tidal water is stationary. However, because tides are totally predictable, other power stations can compensate for this stationary period when there is no tidal energy being produced. Another disadvantage of a tidal barrage system is the environmental and ecological effects that a long concrete dam may have on the estuaries they span.



2. Magneto hydrodynamic generator
A magneto hydrodynamic generator (MHD generator) is a magneto hydrodynamic device that transforms thermal energy and kinetic energy into electricity. MHD generators are different from traditional electric generators in that they operate at high temperatures without moving parts. MHD was developed because the hot exhaust gas of an MHD generator can heat the boilers of a steam power plant, increasing overall efficiency.
An MHD generator, like a conventional generator, relies on moving a conductor through a magnetic field to generate electric current. The MHD generator uses hot conductive plasma as the moving conductor. The mechanical dynamo, in contrast, uses the motion of mechanical devices to accomplish this. MHD generators are technically practical for fossil fuels, but have been overtaken by other, less expensive technologies, such as combined cycles in which a gas turbine's or molten carbonate fuel cell's exhaust heats steam to power a steam turbine.

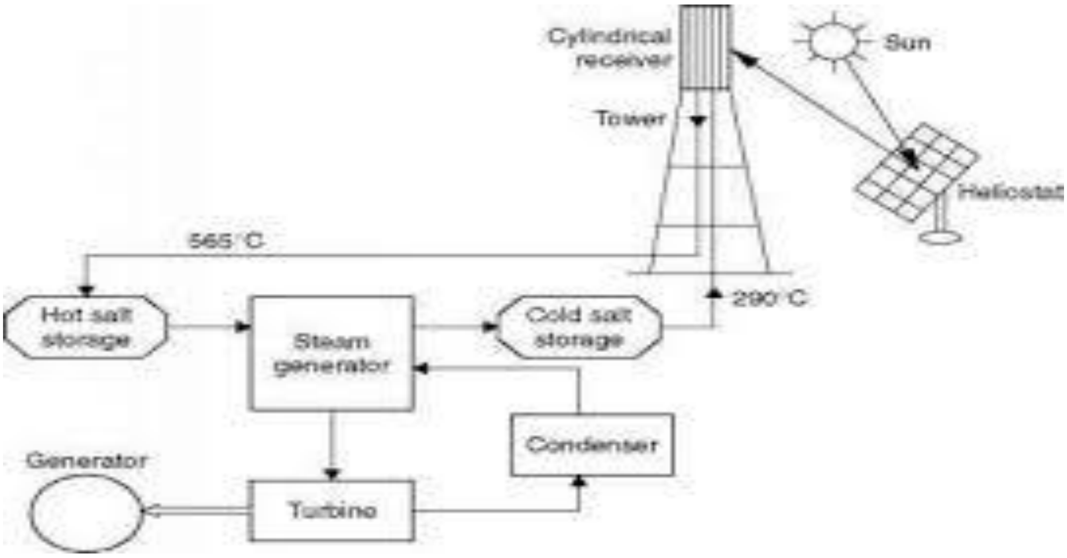


3. A Pyrheliometer is an instrument for measurement of direct beam solar irradiance. ... The signal voltage is converted via a formula to measure watts per square meter. It is used with a solar tracking system to keep the instrument aimed at the sun. A Pyrheliometer is often used in the same setup with a pyranometer.

4. Solar thermal power generation systems collect and concentrate sunlight to produce the high temperature heat needed to generate electricity. All solar thermal power systems have solar energy collectors with two main components: *reflectors* (mirrors) that capture and focus sunlight onto a *receiver*. In most types of systems, a heat-transfer fluid is heated and circulated in the receiver and used to produce steam. The steam is converted into mechanical energy in a turbine, which powers a generator to produce electricity. Solar thermal power systems have tracking systems that keep sunlight focused onto the receiver throughout the day as the sun changes position in the sky.

Types of concentrating solar thermal power plants
There are three main types of concentrating solar thermal power systems:

- Linear concentrating systems, which include parabolic troughs and linear Fresnel reflectors
- Solar power towers
- Solar dish/engine systems



5. Through several different storage processes, excess energy can be stored to be used during periods of lower wind or higher demand.

Battery Storage

Electrical batteries are commonly used in solar energy applications and can be used to store wind generated power. Lead acid batteries are a suitable choice as they are well suited to trickle charging and have a high electrical output charging efficiency.

Compressed Air Storage

Wind turbines can use excess power to compress air, this is usually stored in large above-ground tanks or in underground caverns. When required the compressed air can be used through direct expansion into a compressed air motor. It can also be injected in an internal combustion turbine, where it is burnt with fuel to provide mechanical energy which then powers a generator.

Hydrogen Fuel Cells

Hydrogen fuel cells can also be used to store excess energy. A hydrogen generator is used to electrolyse water using power generated from the wind turbine, storing the resulting hydrogen and converting it back to electricity using a fuel cell power system when needed.

Pumped Storage

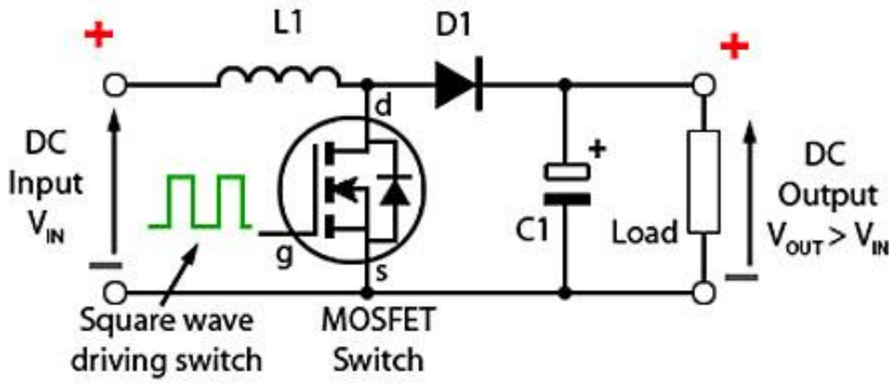
Pumped storage is associated with hydroelectric power generation but is yet to be used with wind power generation. Water could theoretically be pumped up to an elevated reservoir utilizing excess generated power and then be used to drive a water turbine when required. The technology is proven and has been used for centuries, giving a relatively high overall efficiency of 70%. Existing hydroelectric power plants could be utilized if they are in an area suitable for a wind farm.

6. Here are a few of the factors to consider when establishing a wind farm:

- 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.

7. Boost Converter Working

In this converter the first transistor is switched ON continually and for the second transistor the square wave of high frequency is applied to the gate terminal. The second transistor is in conducting when the on state and the input current flow from the inductor L through the second transistor. The negative terminal charging up the magnetic field around the inductor. The D2 diode cannot conduct because the anode is on the potential ground by highly conducting the second transistor.



Boost Converter Working

By charging the capacitor C the load is applied to the entire circuit in the ON State and it can construct earlier oscillator cycles. During the ON period the capacitor C can discharge regularly and the amount of high ripple frequency on the output voltage. The approximate potential difference is given by the equation below.

VS + VL

During the OFF period of second transistor the inductor L is charged and the capacitor C is discharged. The inductor L can produce the back e.m.f and the values are depending up on the rate of change of current of the second transistor switch. The amount of inductance the coil can occupy. Hence the back e.m.f can produce any different voltage through a wide range and determined by the design of the circuit. Hence the polarity of voltage across the inductor L has reversed now. The input voltage gives the output voltage and at least equal to or higher than the input voltage. The diode D2 is in forward biased and the current applied to the load current and it recharges the capacitors to VS + VL and it is ready for the second transistor.

PART C

III. Answer any one full question. Each carries 15 marks.

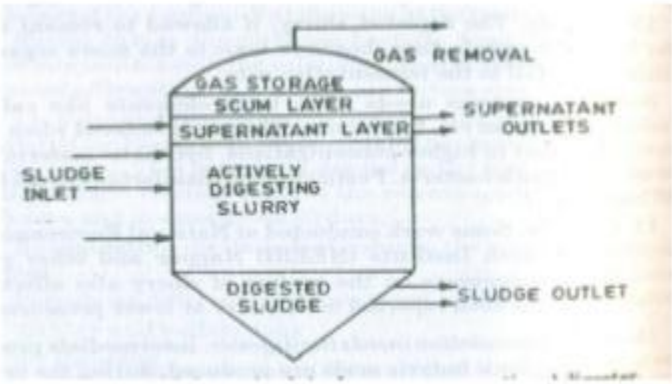
UNIT-1

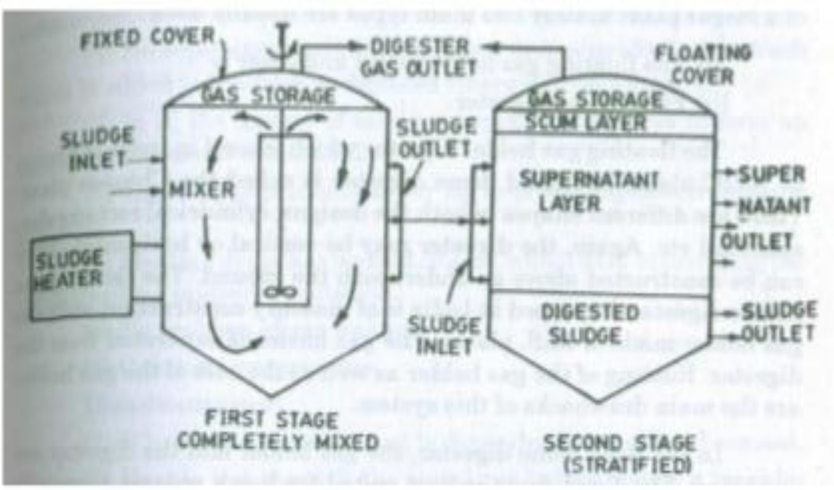
1. Continuous OR Batch type biogas plants.- In the continuous type of biogas plant the biomass is fed regularly to the digester & it delivers the biogas continuously. ...

   1) Single stage continuous type biogas plants

   2) Two stage continuous type biogas plant

(1)Schematic of Single stage and Double stage Continuous Plant:





2. Commonly used biogas plants in India.

Deenbandhu Biogas Plant

Gayatri Model:

TNAU Model:

. Krishna Biogas Plant

Manipal Model

Spherical Biogas Plant

Astra Model

Belur Math Model

Neeri Model:

Bajwa-KVIC Model

Jyoti Top Loaded Digester

Jwala Biogas Plant

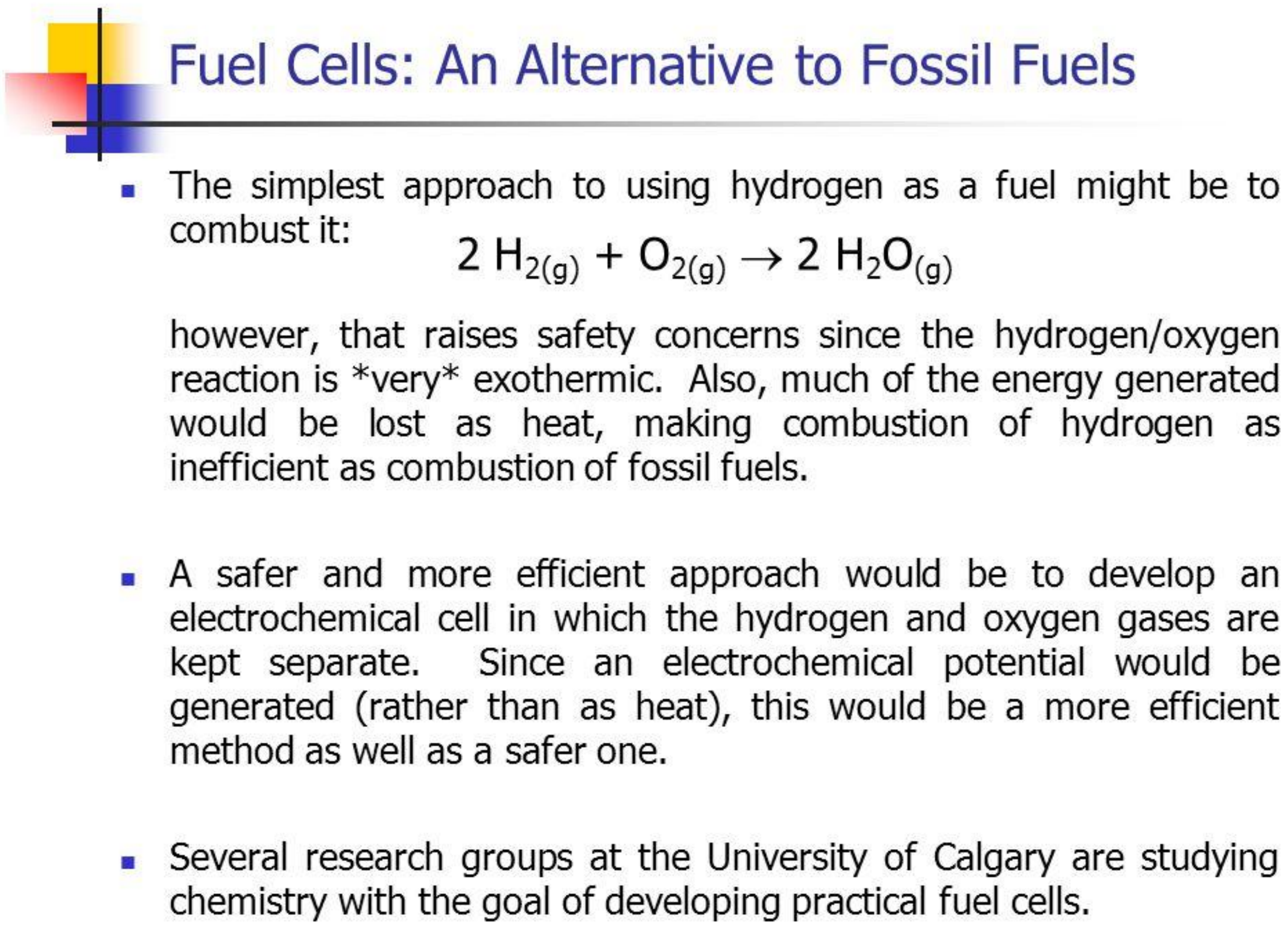
Mud Jar Biogas Plant:

Kachra’ Biogas Plant

Flexible Biogas Plant (FLXI)

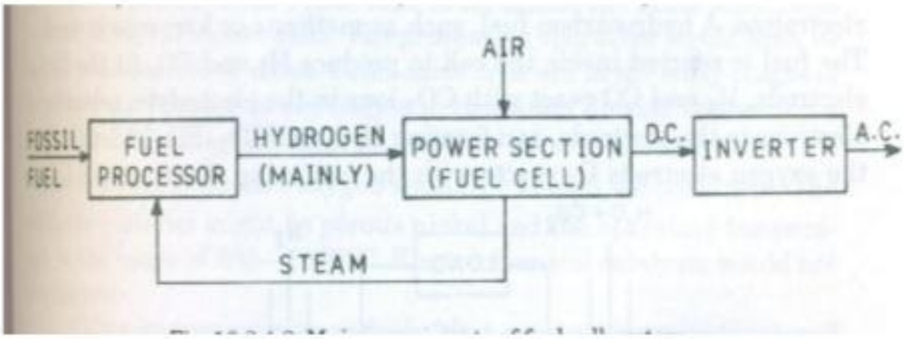
OR

1.



Fossil Fuel Cells:

- The most interesting fuel cells for the near future are modified hydrogen- oxygen cells, in which a gaseous or liquid hydrocarbon is the source of hydrogen.

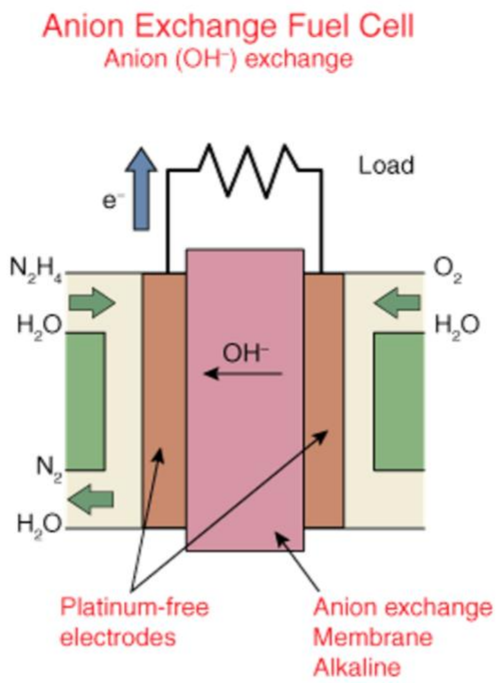


2.

HYDRAZINE FUEL CELL

- Methanol - direct and indirect usage.
- Gives lower voltage though.
- Theoretical voltage- 1.56 volts. But decomposes.
- Carbon monoxide gives high voltage but poisons catalyst.
- Most membranes transport protons, acidic, thus need high quality corrosion resistant membrane - platinum.
- But if hydroxyl ions transported instead, no need of corrosion resistance
- Hydrazine spontaneously explodes upon contact with calcium oxide, barium oxide, iron oxides, copper oxide, chromate salts, and many others.
- Special coatings applied to counteract like nitrates, permanganates.

Japanese car manufacturer Daihatsu is investigating the use of hydrazine as a fuel for fuel cell electric vehicles. One main advantage of a hydrazine fuel cell compared to a traditional fuel cell, is the use of cheaper more readily available metal catalysts instead of the traditional, expensive platinum catalyst used for most fuel cells.



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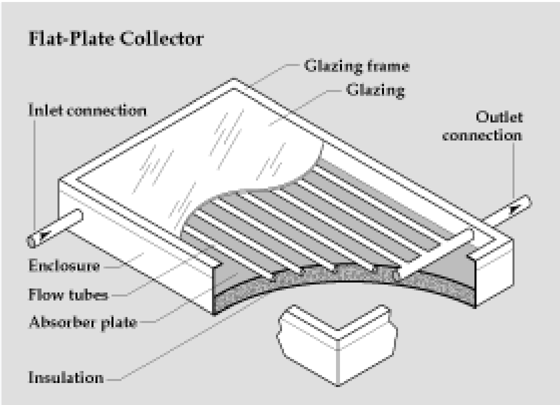
UNIT-2

1. Types of Solar Collectors

There are many different types of solar collectors, but all of them are constructed with the same basic premise in mind. In general, there is some material that is used to collect and focus energy from the Sun and use it to heat water. The simplest of these devices uses a black material surrounding pipes that water flows through. The black material absorbs the solar radiation very well, and as the material heats up the water it surrounds. This is a very simple design, but collectors can get very complex. Absorber plates can be used if a high temperature increase isn't necessary, but generally devices that use reflective materials to focus sunlight result in a greater temperature increase.

Flat Plate Collectors



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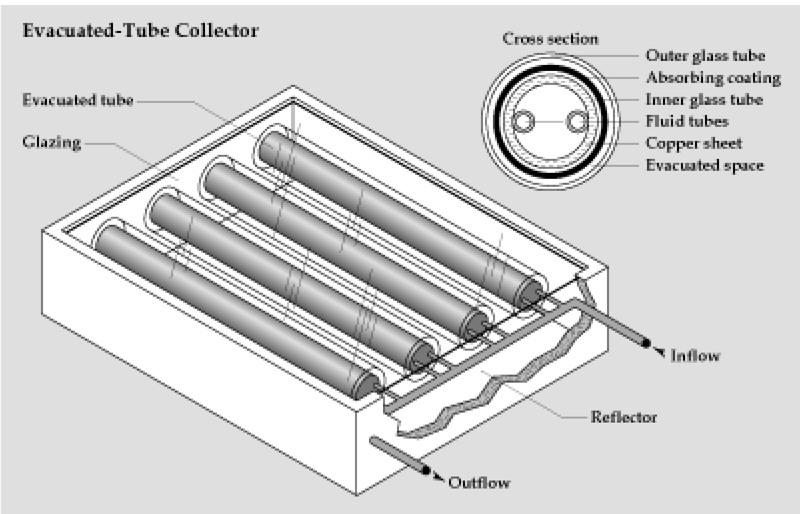
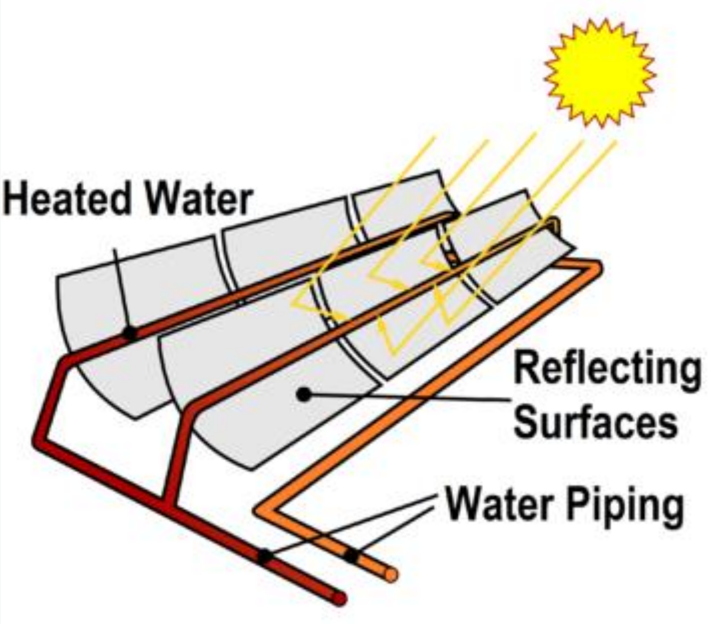
These collectors are simply metal boxes that have some sort of transparent glazing as a cover on top of a dark-coloured absorber plate. The sides and bottom of the collector are usually covered with insulationto minimize heat losses to other parts of the collector. Solar radiation passes through the transparent glazing material and hits the absorber plate.[4] This plate heats up, transferring the heat to either water or air that is held between the glazing and absorber plate. Sometimes these absorber plates are painted with special coatings designed to absorb and retain heat better than traditional black paint. These plates are usually made out of metal that is a good conductor - usually copper or aluminum.[4]

Evacuated Tube Collectors



This type of solar collector uses a series of evacuated tubes to heat water for use.[2] These tubes utilize a vacuum, or evacuated space, to capture the suns energy while minimizing the loss of heat to the surroundings. They have an inner metal tube which acts as the absorber plate, which is connected to a heat pipe to carry the heat collected from the Sun to the water. This heat pipe is essentially a pipe where the fluid contents are under a very particular pressure.[6] At this pressure, the "hot" end of the pipe has boiling liquid in it while the "cold" end has condensing vapour. This allows for thermal energy to move more efficiently from one end of the pipe to the other. Once the heat from the Sun moves from the hot end of the heat pipe to the condensing end, the thermal energy is transported into the water being heated for use.[2]

Line Focus Collectors



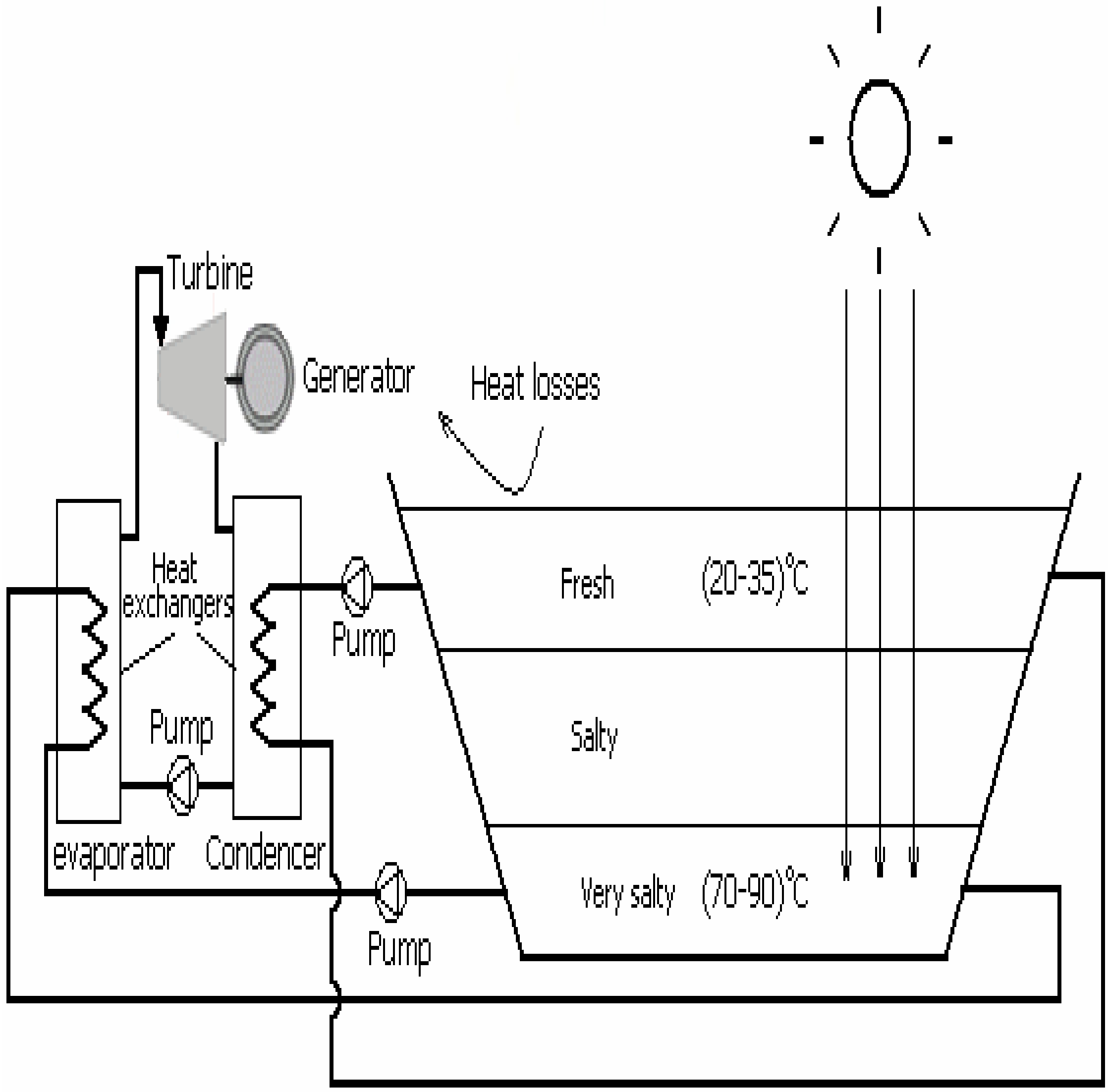
These collectors, sometimes known as parabolic troughs, use highly reflective materials to collect and concentrate the heat energy from solar radiation.[8] These collectors are composed of parabolically shaped reflective sections connected into a long trough.[2] A pipe that carries water is placed in the center of this trough so that sunlight collected by the reflective material is focused onto the pipe, heating the contents. These are very high powered collectors and are thus generally used to generate steam for Solar thermal power plants and are not used in residential applications. These troughs can be extremely effective in generating heat from the Sun, particularly those that can pivot, tracking the Sun in the sky to ensure maximum sunlight collection.[2]

Point Focus Collectors

These collectors are large parabolic dishes composed of some reflective material that focus the Sun's energy onto a single point. The heat from these collectors is generally used for driving Stirling engines.[2] Although very effective at collecting sunlight, they must actively track the Sun across the sky to be of any value. These dishes can work alone or be combined into an array to gather even more energy from the Sun.[10]

Point focus collectors and similar apparatuses can also be utilized to concentrate solar energy for use with Concentrated photovoltaics. In this case, instead of producing heat, the Sun's energy is converted directly into electricity with high efficiency photovoltaic cells designed specifically to harness concentrated solar energy.

2. SOLAR POND



A solar pond is simply a pool of saltwater which collects and stores solar thermal energy. The saltwater naturally forms a vertical salinity gradient also known as a "halocline", in which low-salinity water floats on top of high-salinity water. The layers of salt solutions increase in concentration (and therefore density) with depth. Below a certain depth, the solution has a uniformly high salt concentration

When the sun's rays contact the bottom of a shallow pool, they heat the water adjacent to the bottom. When water at the bottom of the pool is heated, it becomes less dense than the cooler water above it,

and convection begins. Solar ponds heat water by impeding this convection. Salt is added to the water until the lower layers of water become completely saturated. High-salinity water at the bottom of the pond does not mix readily with the low-salinity water above it, so when the bottom layer of water is heated, convection occurs separately in the bottom and top layers, with only mild mixing between the two. This greatly reduces heat loss, and allows for the high-

OR

1.

A **solar-powered pump** is a pump running on electricity generated by photovoltaic panels or the radiated thermal energy available from collected sunlight as opposed to grid electricity or diesel run water pumps.[1] The operation of solar powered pumps is more economical mainly due to the lower operation and maintenance costs and has less environmental impact than pumps powered by an internal combustion engine (ICE). Solar pumps are useful where grid electricity is unavailable and alternative sources (in particular wind) do not provide sufficient energy.

A photovoltaic solar powered pump system has three parts:

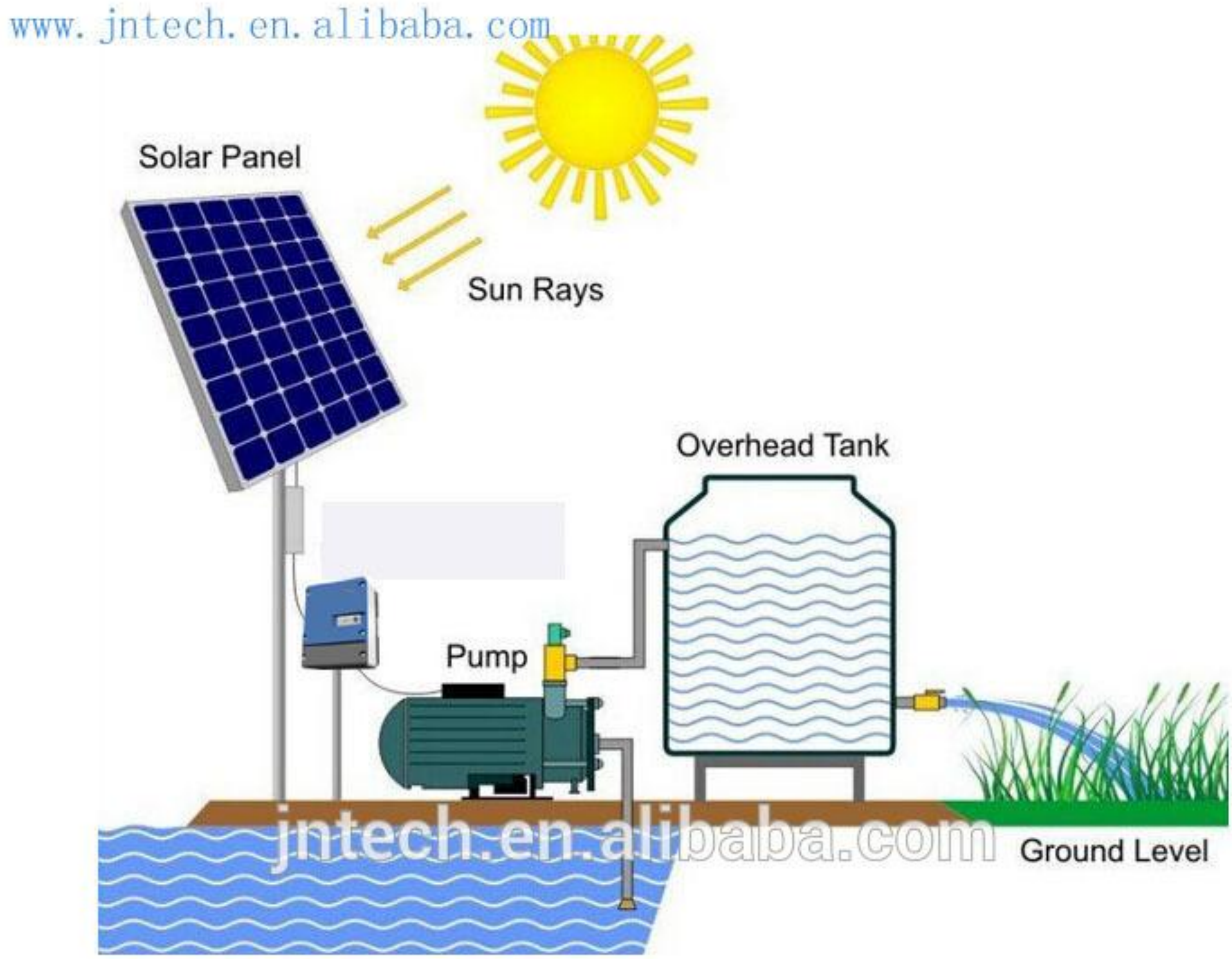
- Solar panels.
- the controller
- the pump

The solar panels make up most (up to 80%) of the systems cost. The size of the PV-system is directly dependent on the size of the pump, the amount of water that is required (m^3/d) and the solar irradiance available.

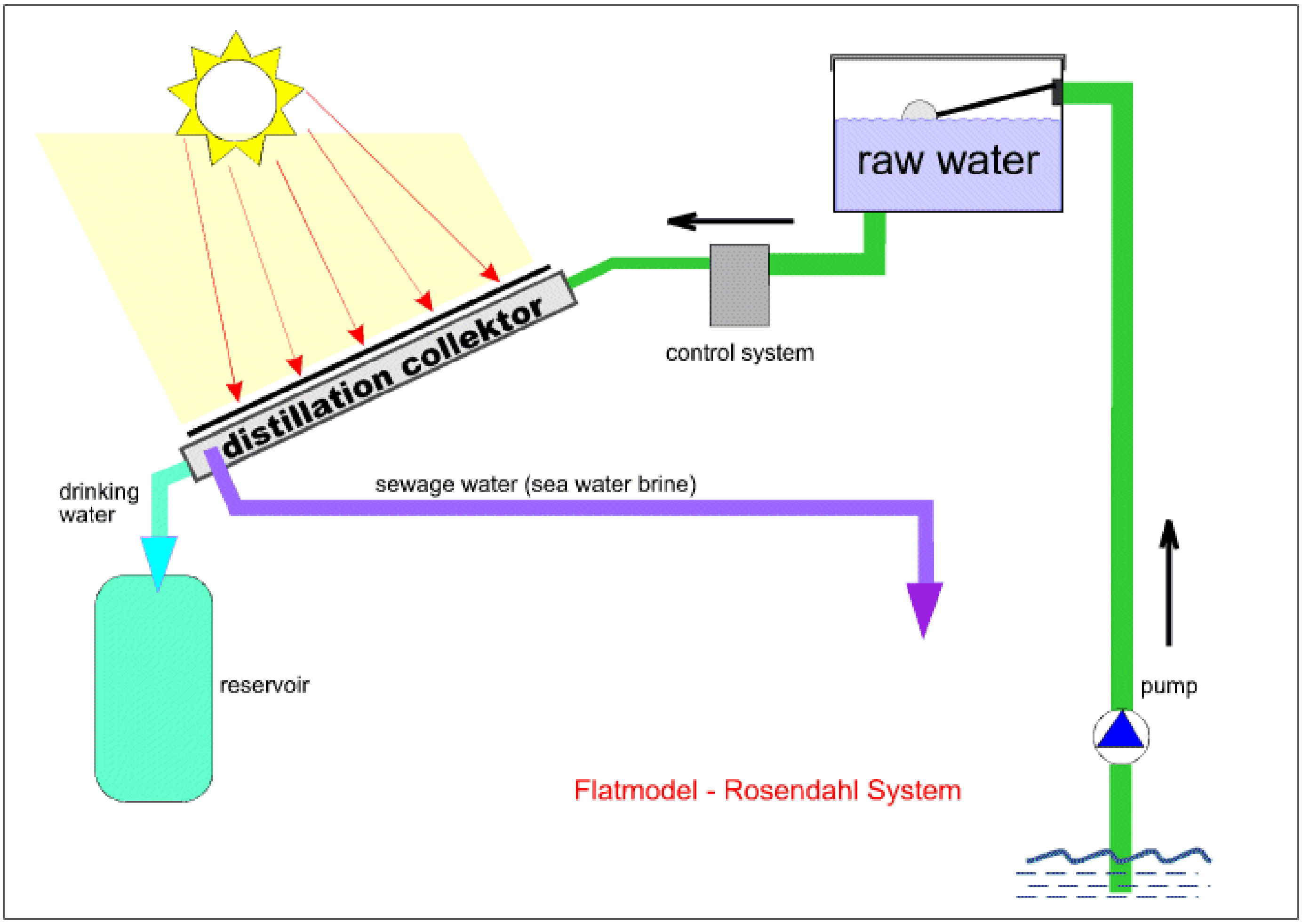
The purpose of the controller is twofold. Firstly, it matches the output power that the pump receives with the input power available from the solar panels. Secondly, a controller usually provides a low voltage protection, whereby the system is switched off, if the voltage is too low or too high for the operating voltage range of the pump. This increases the lifetime of the pump thus reducing the need for maintenance. Other ancillary functions include automatically shutting down the system when water source level is low or when the storage tank is full, regulating water output pressure, blending power input between the solar panels and an alternate power source such as the grid or a petrol generator, and remotely monitoring and managing the system through an online portal offered as a cloud service by the manufacturer.

Voltage of the solar pump motors can be AC (alternating current) or DC (direct current). Direct current motors are used for small to medium applications up to about 4 kW rating, and are suitable for applications such as garden fountains, landscaping, drinking water for livestock, or small irrigation projects. Since DC systems tend to have overall higher efficiency levels than AC pumps of a similar size, the costs are reduced as smaller solar panels can be used.

Finally, if an alternating current solar pump is used, an inverter is necessary that changes the direct current from the solar panels into alternating current for the pump. The supported power range of inverters extends from 0.15 to 55 kW and can be used for larger irrigation systems. However, the panel and inverters must be sized accordingly to accommodate the inrush characteristic of an AC motor. To aid in proper sizing, leading manufacturers provide proprietary sizing software tested by third party certifying companies. The sizing software may include the projected monthly water output which varies due to seasonal change in insolation.



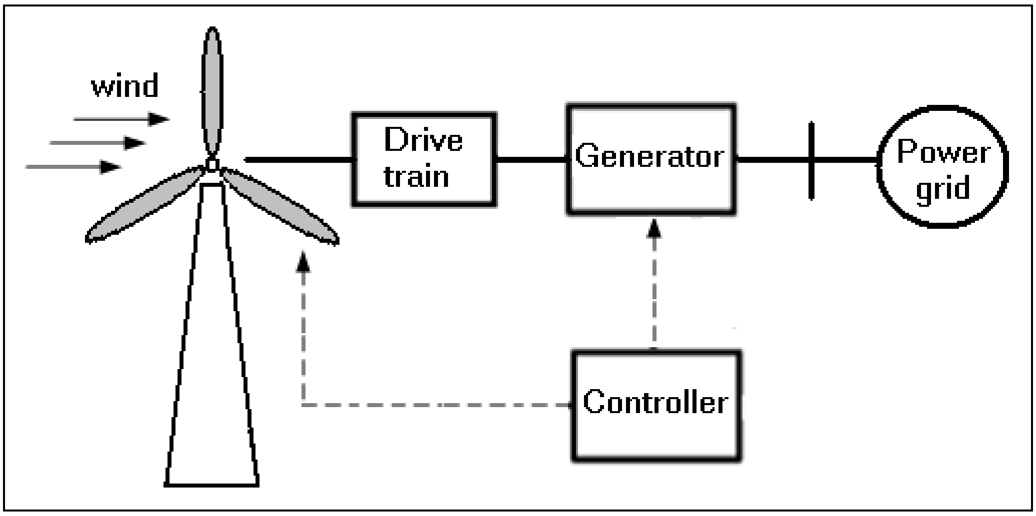
2. **Solar distillation plant.**



Distillation of water with solar energy is quite simple. Think about how nature creates rain: The Sun heats and evaporates water, which at the same time is separated from salt, dirt or anything else for that matter. When the temperature and pressure is right, the water molecules reforms and returns to liquid. Regardless of where in the World you are located, if you catch rain before it hits the ground, it is considered safe to drink.

UNIT-3

1.



1. Wind (moving air that contains kinetic energy) blows toward the turbine's rotor blades.
2. The rotors spin around, capturing some of the kinetic energy from the wind, and turning the central drive shaft that supports them. Although the outer edges of the rotor blades move very fast, the central axle (drive shaft) they're connected to turns quite slowly.
3. In most large modern turbines, the rotor blades can swivel on the hub at the front so they meet the wind at the best angle (or "pitch") for harvesting energy. This is called the pitch control mechanism. On big turbines, small electric motors or hydraulic rams swivel the blades back and forth under precise electronic control. On smaller turbines, the pitch control is often completely mechanical. However, many turbines have fixed rotors and no pitch control at all.
4. Inside the nacelle (the main body of the turbine sitting on top of the tower and behind the blades), the gearbox converts the low-speed rotation of the drive shaft (perhaps, 16 revolutions per minute, rpm) into high-speed (perhaps, 1600 rpm) rotation fast enough to drive the generator efficiently.
5. The generator, immediately behind the gearbox, takes kinetic energy from the spinning drive shaft and turns it into electrical energy. Running at maximum capacity, a typical 2MW turbine generator will produce 2 million watts of power at about 700 volts.
6. Anemometers (automatic speed measuring devices) and wind vanes on the back of the nacelle provide measurements of the wind speed and direction.
7. Using these measurements, the entire top part of the turbine (the rotors and nacelle) can be rotated by a yaw motor, mounted between the nacelle and the tower, so it faces directly into the oncoming wind and captures the maximum amount of energy. If it's too windy or turbulent, brakes are applied to stop the rotors from turning (for safety reasons). The brakes are also applied during routine maintenance.
8. The electric current produced by the generator flows through a cable running down through the inside of the turbine tower.
9. A step-up transformer converts the electricity to about 50 times higher voltage so it can be transmitted efficiently to the power grid (or to nearby buildings or communities). If the electricity is flowing to the grid, it's converted to an even higher voltage (130,000 volts or more) by a substation nearby, which services many turbines.
10. Homes enjoy clean, green energy: the turbine has produced no greenhouse gas emissions or pollution as it operates.
11. Wind carries on blowing past the turbine, but with less speed and energy (for reasons explained below) and more turbulence (since the turbine has disrupted its flow).

2. Various Disadvantages of Wind Energy

Wind energy, without any doubt, offers the best advantages in regard to the environment and cost. However, it harbors some disadvantages worth putting into perspective if you intend to invest in wind energy. Here are a few:

1. Wind is inconsistent

Wind energy has a lot in common with solar energy in terms of consistency. Although wind energy qualifies as a renewable resource, wind speeds fluctuate each day. This can be a big disappointment to wind turbine developers who will commit every penny and every ounce of energy in the project only to end up with fluctuating wind patterns.

This is why developers must do their research first to pinpoint the best location for setting up turbines before actual installation. The best location must have sufficient supply of wind. This explains why you'll almost always see wind turbines installed on top of high elevations like hills and mountains or off shores where there are minimal obstacles that could potentially slow down the speed of wind. Higher elevations are preferred since the higher up you go, the stronger the winds.

2. Involves high upfront capital investment

A lot has been done to bring down the cost of installing turbines; the overall costs, however, remain on the higher side. The first step to installing a turbine is usually to do a rigorous survey to determine the winds speed of the location. This involves erecting a sample turbine to gauge the wind speeds over a stipulated period. If the location is found to be ideal, the wind turbine will be manufactured and transported to the site and set up on a strong foundation. The entire process adds up to the cost of setting up a wind turbine.

When talking about offshore wind turbines, the cost becomes more pronounced. This is because it's a daunting task to install wind turbines offshore than onshore. Some firms even go to the extent of commissioning bespoke ships with the ability to transport and install wind turbines at sea.

3. Visual impact

Although wind turbines come with eye-catching designs, they impact the natural beauty of the landscape. When a lot more wind turbines are set up, the area becomes unsightly. The local community starts to sound alarm bells, and this can escalate to a conflict.

Though many people believe that wind turbines actually look nice but majority of them disagree. People consider wind turbines to have an undesirable experience. Petitions usually come in court before any proposed wind farm development but few people think otherwise and feel they should be kept in tact for everyone to enjoy its beauty.

4. Can reduce the local bird population

Wind turbines are particularly disadvantageous to the local bird species. A lot of bird death as a result of collision with turbine blades has been reported in these areas. This can wipe out the population of certain bird species. Also, wind turbines require them to be dig deep into the earth which could have negative effect on the underground habitats. However, there has been an influx of bladeless wind turbines in the marketplace designed to reduce bird deaths. This could be a game changer for turbine manufacturers.

5. Noise disturbances

The most hated disadvantage to wind turbines is the noise they produce. The sound produced by one turbine can be perceived from far distances. Combine many turbines, and the noise becomes unbearable. Many homeowners' lives have been turned upside down due to the noise pollution from turbines. Although the emphasis is to site wind turbines away from the local community, most companies disregard this rule. This explains the strong public objections to wind turbine installations in most areas. The visual pollution is another reason why people do not find it attractive to install it in their backyard.

6. Takes up significant portion of land

The best location of wind turbines can be the most fertile land where farming is practiced. Installation of wind turbines would take away land that has been the bedrock of agricultural activities for many years.

7. Safety Concerns

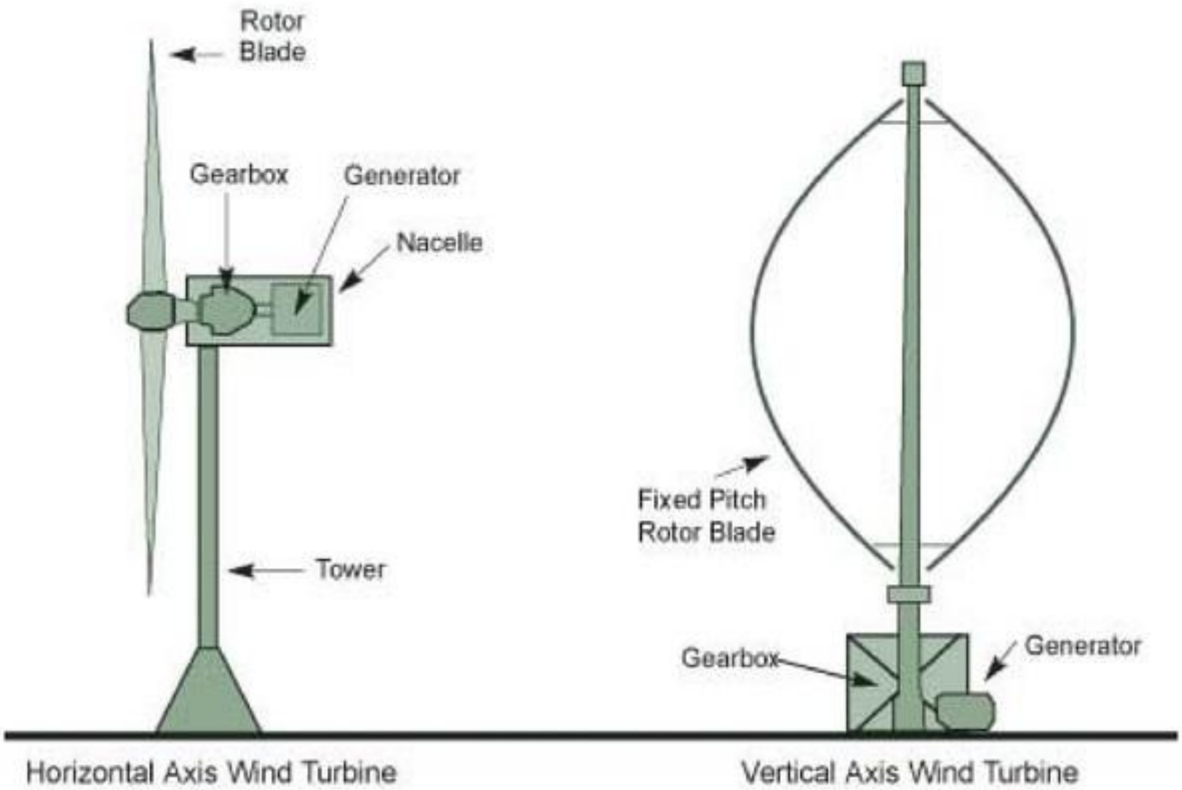
In the last couple of decades, the frequency of tornadoes, hurricanes and cyclones have increased considerably. Now these severe storms can cause extensive damage to the wind turbines and can be a safety hazard to the people working in these wind farms. The damage may cause huge damage to wind turbines.

8. Suited To Particular Region

[Wind turbines](#) are suited to the coastal regions which receive wind throughout the year to generate power. Therefore, countries that do not have any coastal or hilly areas may not be able to take any [advantage of wind power](#). The location of a wind power system is crucial, and one should determine the best possible location for wind turbine in order to capture as much wind as possible. Just like solar energy which relies heavily on sun to produce power, wind energy needs high speed winds to produce power on constant basis.

OR

1.



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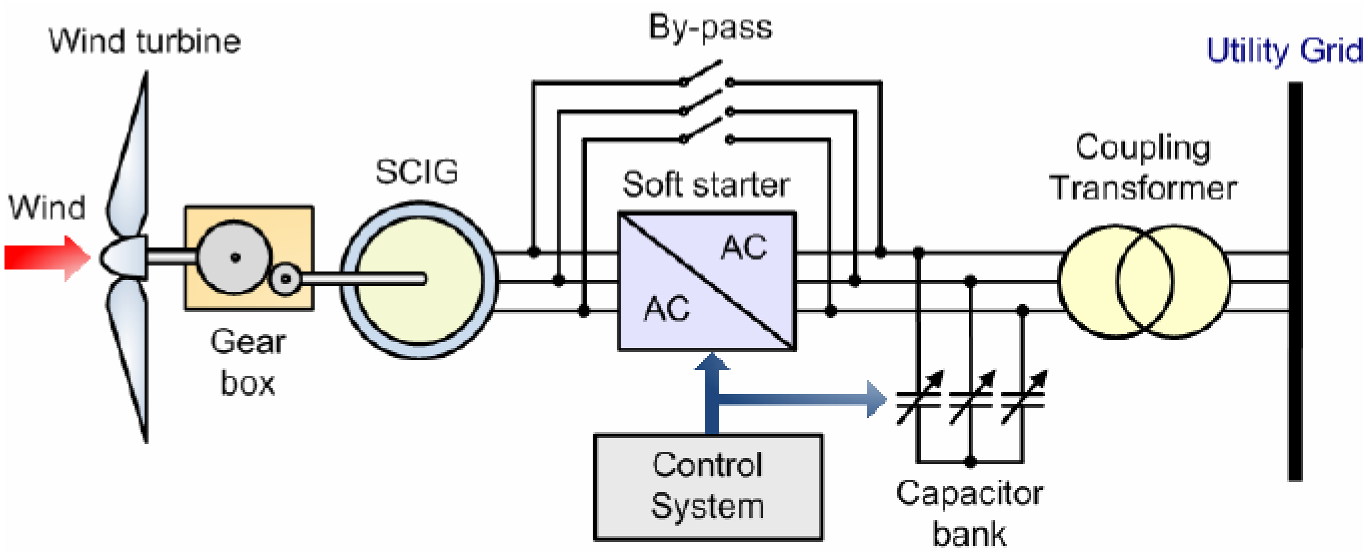
Horizontal axis means the rotating axis of the wind turbine is horizontal, or parallel with the ground. ... However, in small wind and residential wind applications, vertical axis turbines have their place. The advantage of horizontal wind is that it is able to produce more electricity from a given amount of wind.

Essentially, you have two vertically oriented blades revolving around a vertical shaft. But the Darrieus models use an airfoil design. A wind turbine airfoil works in the same way as an airplane wing. ... But with a vertical axis wind turbine, the swept area is a cylinder perpendicular to air flow.

2.

VARIABLE SPEED CONSTANT FREQUENCY OF WIND ENERGY CONVERSION SYSTEM.



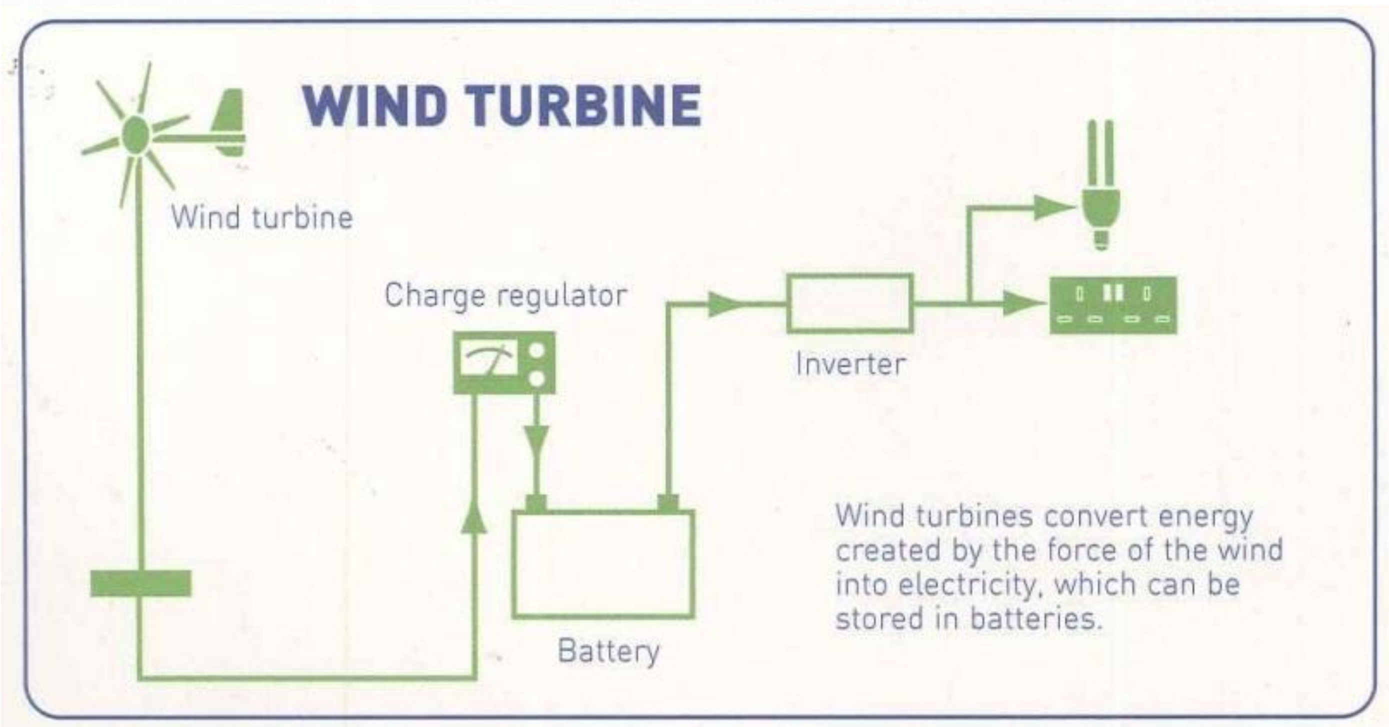
To eliminate the adverse effect of the fluctuation and intermittence of wind power on the quality and stability of electrical power system, an energy storage system is introduced into the closed-loop hydraulic system of hydraulic wind turbine for the first time. The whole hydraulic system consists of a fixed displacement pump, a variable displacement motor, two proportional control valves and an energy storage system. The energy storage system absorbs or releases oil as the wind fluctuates. When the wind suddenly disappears, the generator can continue to produce electrical energy by means of the discharge of the hydraulic energy stored in the energy storage system. On the basis of modelling all hydraulic components, the simulation model of the hydraulic system is established. A new control method is presented within this article, which keeps the motor speed constant to generate constant frequency electrical power when the rotational speed of the wind wheel changes. Ultimately, simulations under the two conditions of step and sine wind wheel speeds are done. The simulation results demonstrate how the motor, the proportional valves and the energy storage system work together when the wind wheel speed varies and also prove validity of the control method we designed.

UNIT-4

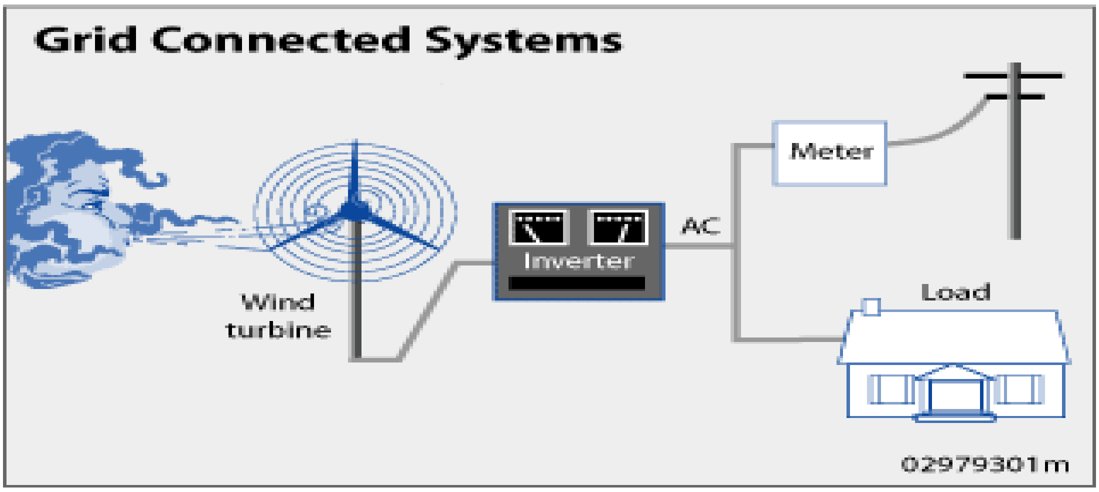
1.

Objective of Stand-Alone Systems:

- A **stand-alone power system** (**SAPS**), also known as **remote area power supply** (**RAPS**), is an off-the-grid electricity system for locations that are not fitted with an electricity distribution system
- There are several types of wind energy systems.There are stand-alone systems which provide reliable power solely from the wind. A stand-alone system may have a method for storing energy when wind conditions are not good. Usually, batteries are used for storage.
- These are applicable for micro systems(100watts or less) and can be used for remote area lighting, portable and emergency lighting etc.



2.



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A grid-connected system allows you to power your home or small business with renewable energy during those periods (daily as well as seasonally) when the sun is shining, the water is running, or the wind is blowing. Any excess electricity you produce is fed back into the grid.

OR

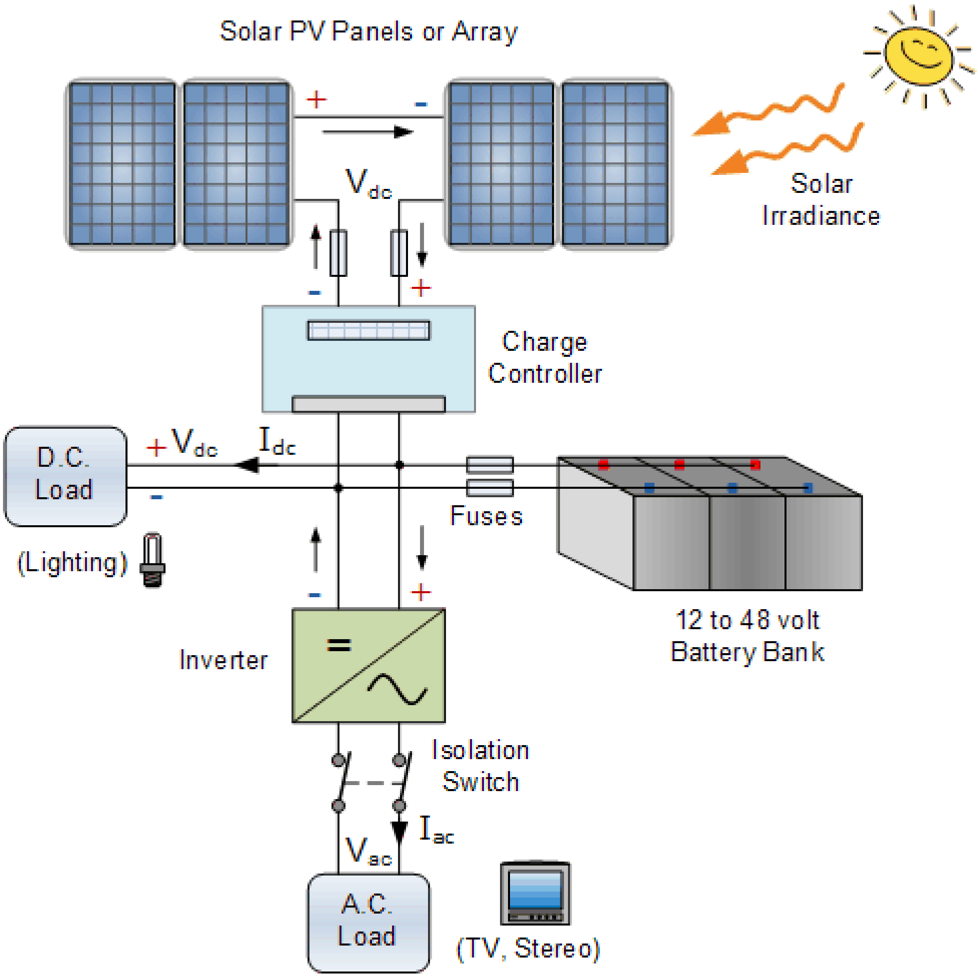
1. ## A Stand Alone Solar System

A free standing or **Stand Alone PV System** is made up of a number of individual photovoltaic modules (or panels) usually of 12 volts with power outputs of between 50 and 100+ watts each. These PV modules are then combined into a single array to give the desired power output. A simple *stand alone PV system* is an automatic solar system that produces electrical power to charge banks of batteries during the day for use at night when the suns energy is unavailable. A stand alone small scale PV system employs rechargeable batteries to store the electrical energy supplied by a PV panels or array.

Stand alone PV systems are ideal for remote rural areas and applications where other power sources are either impractical or are unavailable to provide power for lighting, appliances and other uses. In these cases, it is more cost effective to install a single stand alone PV system than pay the costs of having the local electricity company extend their power lines and cables directly to the home.

A stand alone photovoltaic (PV) system is an electrical system consisting of and array of one or more PV modules, conductors, electrical components, and one or more loads. But a small-scale PV system does not have to be attached to a roof top or building structures for domestic applications, they can be used for camper vans, RV's, boats, tents, camping and any other remote location. Many companies now offer portable solar kits that allow you to provide your own reliable and free solar electricity anywhere you go even in hard to reach locations.

Simplified Stand Alone PV System



While a major component and cost of a standalone PV system is the solar array, several other components are typically needed. These include:

- • Batteries: Batteries are an important element in any stand alone PV system but can be optional depending upon the design. Batteries are used to store the solar-produced electricity for night time or emergency use during the day. Depending upon the solar array configuration, battery banks can be of 12V, 24V or 48V and many hundreds of amperes in total.
- • Charge Controller: A charge controller regulates and controls the output from the solar array to prevent the batteries from being over charged (or over discharged) by dissipating the excess power into a load resistance. Charge controllers within a standalone PV system are optional but it is a good idea to have one for safety reasons.
- • Fuses and Isolation Switches: These allow PV installations to be protected from accidental shorting of wires allowing power from the PV modules and system to be turned "OFF" when not required saving energy and improving battery life.
- • Inverter: The inverter can be another optional unit in a stand alone system. Inverters are used to convert the 12V, 24V or 48 Volts direct current (DC) power from the solar array and batteries into an alternating current (AC) electricity and power of either 120 VAC or 240 VAC for use in the home to power AC mains appliances such as TV's, washing machines, freezers, etc.

• Wiring: The final component required in and PV solar system is the electrical wiring. The cables need to be correctly rated for the voltage and power requirements. Thin telephone wire will not work!

2. GRID CONNECTED SOLAR ENERGY SYSTEM.

A grid-connected photovoltaic power system or grid-connected PV power system is electricity generating solar PV power system that is connected to the utility grid. A grid-connected PV system consists of solar panels, one or several inverters, a power conditioning unit and grid connection equipment