​**Which type of motor (AC motor or DC motor) is the most suitable Solar system?**

Ans: Motor is a device used to move drives like Pumps, Mills and other rotating devices in the solar system. Drive is connected to Motor, when motor moves drive moves. Motors with Drives do multiple functions like pumping water in household, gardening, irrigation, and rotate to various types of Mills like flour, rice, grain, oil impeller etc.

There are two types of motors available in shop; we can select motor as per our requirement:

**AC Motor**

The AC motor is vital in our system. Motor runs with AC current. Motor consumes more power as motor torque is higher as compared to DC motor. AC motor output (Water flow in case water pump and milling productivity in case of Mills) is more as compared to DC motor.

**DC Motor**

The DC motor runs at DC current. It takes less power as torque is very less. DC motors can operate a wide range of voltages and can start as low as 1.5 V whereas AC motors won’t start working unless and until 220-230 Volts are achieved. DC motor size is less as compared to AC motor.

With all of the above merits, DC motor price is higher than AC motor. Also, during DC motor operate during solar hours ( 5 to 6 hours in a day)

Nowadays, Motor is available for **Dual Functioning Motor** which can run AC as well as DC current. These kinds of motors are very successful in the solar system. Motor may operate at DC current during solar hours and may operate at AC current after solar hours.

**Conclusion:**

It is advised to use a DC motor or dual functioning motor and connect the drive to the solar system. Solar system with a DC or dual functioning motor will help to reduce electricity bills. As we know, the electrical tariff of industrial/ commercial connections is very high. Also, the tariff is increasing day by day, the industries/ commercial shops where use of motors is high they face huge electrical bills.

**Ques:  What is PV in the solar system and how does it work?**

Ans. When the light from the Sun falls onto a solar PV module, a packet of energy called photons falls onto the module and creates an electric current through a process named the photovoltaic effect. In a PV module there are many cells and each cell generates a very small amount of energy. Each cell within the PV module connected to each other and each PV module connected to another PV module. So the collective energy of all modules generates a higher amount of energy as a solar array. Energy generated by solar modules is DC current which can be directly utilized by DC sources like DC fan, DC light, mobile phone, laptop, DC motor etc. Our household equipment runs at AC current so we need an instrument name inverter which converts DC current to AC current.  Our grid system works as AC current, if we want to sell DC power then we need to convert the DC into AC, then we can sell power.

Now a day’s use of DC current is increased in areas where power cuts are high like rural areas. We as a Maven provide a very economical solution to our customers. We make a suitable package for small commercial shop and rural area where we provide a combination of PV module, Battery, portable solar structure, DC appliances like lights and Fans, DC wiring etc. there are large number of DC equipment are available in market like Solar AC, Refrigerator, TV, Washing machine etc. We make it available at customer demand.

**Ques:  How to select inverter capacity for home?**

It is very important to select the right inverter for your home/ shop. First stage in selecting an inverter is to identify the size of the inverter. Size of the inverter depends on the load to run on the inverter.

First understand your Power Requirement:  you should know before buying an inverter is your “Power requirement” that is what all electrical appliances (like fan, tube lights, television, CFL, Air condition, motor etc.) you want to run at the time of power failure.

Suppose a you have following list of electrical appliance and you want to run on inverter during power failure

|  |  |  |  |
| --- | --- | --- | --- |
| **Electrical appliance name** | **Rated load (Watt)** | **No of appliances** | **Total load (Watt)** |
| Fan | 40 | 5 | 200 |
| LED Light | 10 | 10 | 100 |
| Television | 150 | 1 | 150 |
| Air condition | 1500 | 1 | 1500 |
| Refrigerator | 150 | 1 | 150 |
| Motor | 500 | 1 | 500 |
| **Power Requirement ( Watt)** | | | **2600** |

Inverter: Inverter is measured in VA/ KVA/ MVA. Here VA stands for Volt Ampere.  Most of the inverters have the efficiency range from 60 % to 90%. This efficiency of the inverter is also known as the power factor of an inverter. Power factor of most inverters ranges from 0.6 to 0.9.

To know the power of the inverter;

Total Load to be divided by power factor,

Suppose an inverter is having power factor is 0.75

Power of inverter (VA) = 2600/0.75 = 3466 VA

Now you have to select an inverter rating close to 3466 VA. In the market, 4000 VA rating inverters are available.

**Ques: What is the difference between PWM and MPPT charge controller?**

Charge control devices control the energy coming from solar panels. It adjusts the current and the voltage then sends it to batteries. Charge control device prevents overcharge and over discharge of the batteries. Therefore, it protects the system. Each solar energy system requires a charge control device. Charge control devices divided into two as PWM (Pulse Width Modulation) and MPPT (Maximum Power Point Tracking)

**Pulse Width Modulation (PWM)**

PWM charge control devices can be explained as an electrical switch between batteries. The switch can be quickly switched on and off. Therefore, desired voltage can be obtained to charge the batteries. The charge current will be slowly decreased as the batteries are charged.

Panel voltage and battery voltage should be matched in PWM systems.

This Pulse Width Modulation (PWM) type is cheaper, and hence, commonly used for off-grid solar solutions for lower load in households and commercial shops. PWM is cheaper but comes with less flexibility and efficiency. It is very commonly used in rural area and small shops where load is less

**Maximum Power Point Tracking (MPPT)**

MPPT controllers are more expensive, but give greater flexibility in terms of number of panels.

MPPT is a technique to observe and regulate the energy going from solar panels to the batteries. Solar panels show changeable outputs according to weather conditions. MPPT charge control devices can match the solar panel voltage with battery voltage to maximize the charge efficiency.

In these systems, the full power of solar panels can be used by balancing between voltage and current according to the P = V x A equation.

**The benefits of MPPT are as follows:**

  The MPPT controller allows a panel array to be of higher voltage than the battery bank. This is relevant for areas with low irradiation or during winter with fewer hours of sunlight.

  MPPT charging efficiency is 30% more compared to PWM

  MPPT has more flexibility for system growth than PWM

  MPPT comes with higher warranty periods than the PWM.

**Ques: What is PV in the PV Module system and how does it work?**

**Working principle of PV Module/ Solar Cell**

A PV Module (Photovoltaic Cell) or solar cell is an electrical device that converts light energy into electrical energy. This phenomenon is known as the photovoltaic effect. The sunlight we receive on Earth in packets of solar energy called photons. When Photons hit the semiconductor material (Silicon, usually one or two layers) of a solar cell, the free electrons get loose and move toward the treated front surface of the cell thereby creating holes. This mechanism happens repeatedly and more electrons (Negative Charge) flows towards the front surface of the cell and create an imbalance of electrons. Now, when the front (–) and back (+) surface of the photovoltaic cell are joined by a conductor such as a copper wire then electricity is generated. Solar cells have positive and negative contacts, like the terminals in a Battery. If the contacts are connected with a conductive wire, current flows from the negative to positive contact

Individual solar cells can be combined to form modules commonly known as solar panels. The common single junction silicon solar cell can produce a maximum open-circuit voltage of approximately 0.5 to 0.6 volts and about 1 to 2 watts of electricity. When combined into a large solar panel, considerable amounts of renewable energy are generated.

The PV cells generate DC or direct current. This DC electricity has to be converted to AC or alternating current. An inverter is used to convert DC to AC.

**What is Net Metering?**

This is a mechanism which allows domestic or commercial users to export or sell their surplus energy to Grid when users generate their own electricity using solar systems. In this process, users get the​​ opportunity to sell generated excess power to Grid and withdraw back from the grid when there is a shortfall of power. If the amount of energy generated is more than the amount of energy consumed, then the owner gets compensated by Distribution company. On the other hand if the amount of energy consumed is more than the amount of energy generated, then it is withdrawn from the utility grid and the owner has to pay only the net amount.

An Off-grid system is generally a stand-alone system which doesn't need a net meter, while an On-grid system is connected to the main utility grid and incorporates the policy of net metering depending on the type of customers.

**Ques: What is the Cost of On-grid Solar Plant?**

**Cost of solar plant depends on following factors:**

**PV module**- Cost varies with size of PV module; bigger size is little costlier than smaller size eg. 400 Wp would be costlier than 335 Wp. Type of module: mono perk is costlier than polycrystalline, bifacial is costlier than mono perk and polycrystalline both. Manufacturing: Indian made PV module is little costlier than Imported module

**Solar Inverter**- cost varies with size of inverter: if inverter size is big, cost would be less. Cost varies with technology: MPPT technology is costlier than PWM inverter.

**Module mounting structure**- Cost varies with thickness of structure Ex. 5 mm thick structure would be costlier than 2 mm thick structure. Cost varies with height Ex. a 1.5-meter height structure would be costlier than a 1-meter height structure. Cost varies with type of structure like hot dip Galvanized Iron would be costlier than Pre GI structure; Pre GI Structure is costlier than Mild steel structure (MS) etc.

Cost of structure also with type of surface eg. If the surface is plain, cost would be more than slant surface facing south direction, North facing slant surface structure cost would be more than south facing structure, structure cost at Asbestos shed or fiber shed would be more than tin shed etc.

**Cable:** Cost of Varies with Cable size and brand: Copper Cable would be costlier than Aluminum cable. Also cable cost varies with size, length and brand

**Earthing**: Cost varies with number of earthing, 3 Nos earthing is costlier than 2 Nos earthing. Cost also varies with type of earthing like Pipe earthing, plate earthing, mat earthing and marconite earthing ( In general marconite earthing is being used)

**Installation**: If erection of module is simple and approachable, cost would be low and if erection of module is at complicated and unapproachable surface, the cost would be higher. Erection cost also depends on the size of the solar plant due to the marginal values. Small plants will have higher cost and large sized solar plants have lower cost.

**Transportation**: Cost increases if distance increases from Manufacturing plant/ Dealer.

**Cost of 1 KW single phase On-grid Solar Plant:**

Considering above all factors we can say that the cost of 1 KW solar plant for single phase comes in between Rs 48000/- to Rs 55000 per KW.

**Cost of 2 KW single phase On-grid Solar Plant:**Rs 95000/- to Rs 108000/-

**Cost of 3 KW single phase On-grid Solar Plant:**Rs 140000/- to Rs 156000/-

**Cost of 5 KW single Phase On-grid Solar Plant:**Rs 210000/- to Rs 250000/-

**Cost of 6 KW to 10 KW On-grid solar plant**

Considering above all factors we can say that cost per KW solar plant for three phases comes in between Rs 46000/- to Rs 55000 per KW.

**Cost of 10 KW to 15 KW On-grid solar plant**

Considering above all factors we can say that the cost of per KW solar plant for three phases comes in between Rs 44000/- to Rs 52000 per KW.

**Cost of 15 KW and above On-grid Solar Plant:**Customer may ask for competitive quotation

As the size of the plant increases, the unit cost of the plant decreases.

**Ques: What is the Cost of Off-grid Solar Plant:**

**Cost of solar plant depends on following factors:**

**PV module**- Cost varies with size of PV module; bigger size is little costlier than smaller size eg. 400 Wp would be costlier than 335 Wp. Type of module: mono perk is costlier than polycrystalline, bifacial is costlier than mono perk etc. Manufacturing: Indian made PV modules are little costlier than Imported modules.

**Solar Inverter**- Cost of Off Grid inverter is higher than On Grid inverter. Also cost varies with size of inverter: if inverter size is big, cost would be less. Cost varies with technology: MPPT technology is costlier than PWM inverter. In general, small inverters come in PWM technology. Inverters are readily available in the market in between the inverter rating 1 KVA to 15 KVA, requirement above 15 KVA needs to be customized by the manufacturer.

**Module mounting structure**- Cost varies with thickness of structure Ex. 5 mm thick structure would be costlier than 2 mm thick structure. Cost varies with height Ex. a 1.5-meter height structure would be costlier than a 1-meter height structure. Cost varies with type of structure like hot dip Galvanized Iron would be costlier than Pre GI structure; Pre GI Structure is costlier than Mild steel structure (MS) etc.

Cost of structure also with type of surface eg. If the surface is plain, cost would be more than slant surface facing south direction, North facing slant surface structure cost would be more than south facing structure, structure cost at Asbestos shed or fiber shed would be more than tin shed etc.

**Cable:** Cost of Varies with Cable size and brand: Copper Cable would be costlier than Aluminum cable. Also cable cost varies with size, length and brand

**Earthing**: Cost varies with number of earthing, 3 Nos earthing is costlier than 2 Nos earthing. Cost also varies with type of earthing like Pipe earthing, plate earthing, mat earthing and marconite earthing ( In general marconite earthing is being used)

**Installation**: If erection of module is simple and approachable, cost would be low and if erection of module is at complicated and unapproachable surface, the cost would be higher. If Solar plant size is big, the cost of erection is reduced.

**Battery:** Cost of Battery varies with brand, warranty (2 to 7 years), size (like 100 AH, 150 AH, 200 AH) and type (Lead Acid and Lithium Ion). Cost increases if warranty increases and battery size increases. There is a difference in cost of Lead Acid and Lithium Ion Batteries. Lithium ion batteries are costlier than lead acid.

**Transportation**: Cost increases if distance increases from Manufacturing plant/ Dealer.

**Cost of 1 KW Off-grid Solar Plant:**

Considering above all factors we can say that the cost of 1 KW solar plant for single phase comes in between Rs 70000/- to Rs 75000.

**Cost of 1 KW Off-grid Solar Plant:**140000/- to 150000/-

**Cost of 3 KW Off-grid Solar Plant:** 200000/- to 220000/-

**Cost of 5 KW Off-grid Solar Plant:** 280000/- to 300000/-

**Cost of 7.5 KW Off-grid Solar Plant:** 425000/- to 430000/-

**Cost of 10 KW Off-grid Solar Plant:** 560000/- to 580000/-

**Cost of 10 KW and above Off-grid Solar Plant:**Customer may ask for competitive quotation

**Ques: how to choose solar panel for Solar Water Pump and flour mill?**

To Know about which solar panel is most suitable for Solar Pump and Flour Mill, first we should understand the types of solar panel.

**Type of Solar PV Module (Solar Panel)**

1. Polycrystalline

2. Mono perc

3. Half cut Mono perc

**Mono perc Vs. Polycrystalline Solar Panels**

Polycrystalline PV Module has blue- colored PV cells with straight edges whereas Mono perc PV module has black colored PV cells with rounded edges. Polycrystalline have a lower efficiency compared with Mono perc PV cell. Polycrystalline PV Module generate less power as compared to Mono perc PV module. However, polycrystalline panels also have a lower price, since their manufacturing process is simpler.

|  |  |  |
| --- | --- | --- |
| Features | Monoperc PV Module | Polycrystalline PV Module |
| Manufacturing | Made up of one single silicon crystal | Made up many silicon blocks melded together |
| Cost | More expensive | Less expensive |
| Appearance | Panels have black | Panels have blue hue |
| Efficiency | More efficient | Less efficient |
| Lifespan | 25-40 years | 20-35 years |

**Mono Perc Full Cell Vs Mono Perc Half cell**

Traditional Mono Perc full cell panels are made with 60 or 72 cells however A half-Cell panel has double the number of cells into 120 or 144 cells per panel. By doubling the number of cells this technology creates more possibilities to generate energy from sunlight.

Half-Cells with 120 or 144 cells have lower resistance which means more energy is being captured and produced. Half-Cell panels have smaller cells on each panel which reduces mechanical stresses on the panel. The smaller cell has the less chance of the panel micro cracking.

Moreover, Half-Cell technology provides higher power output ratings and is usually more reliable than traditional full cell panels.

Half Cell panel has basically 2 panels which are connected to each other parallel and their cells are internally connected in series whereas full cell has only one panel and their cells are connected in series. Half cell 2 panels and their parallel connection gives following advantages-

1. String of half-cell is smaller (due to split into 2 panels) so it reduces shadow effect. When shadow of any object fall on panel, the only affected string stop generating power and rest of the panel continue producing power however in full cell panel, whole affected string stop working and produce less power

2. In half cell panel heat production is less as compared to Full cell panel. In half cell panel strings are small in length so Resistance (R) would be less.

3. In half cell formation of hot spot is reduces as compared to full cell

4. A half-cell panel has 9 bus bars in each cell whereas a full cell panel has 5 bus bars in each cell, so half cell current generates more than Full cell.

**Solar panel for Solar Water Pump and flour mill**

Whenever a heavy motor runs it consumes electricity and the tariff of electricity is increasing day by day. So, Farmers and small businessmen are installing solar plants to reduce their electricity bill. Now there is a question: which type of solar panel is best for heavy motor running and why?

Half cut solar panel is the best for solar water pump and Flour mill which has following advantages:

1. Half Cut cell solar panel work hours are more than Full cell solar panel. Full cell solar panels work for an average 5 to 6 hours in a day however half cut solar panels work for 6 to 7 hours a day.

2. Half Cut Cell Solar panels produce electricity even in cloudy or Foggy weather whereas Full cell panels don’t produce electricity or very less electricity.

3. Half cut cell solar panel has more efficiency than Full cell panel

4. Half Cut cell solar panel has less effect of shadow as compared to full cell solar panel. Whenever a shadow falls on a half cut cell, only the affected part of the panel stops working however the rest of the panel continues working. On the other hand, in the Full cell panel the affected area of the whole string stops working.