ALMIPL SOLAR

Powering The New Age (Energy)

HOW SOLAR ENERGY WORKS?

Mohammed Mubarak
Solar Energy

VOLUME - 1

Company Profile

ALMI Production Land Solar Private Limited is a **Chennai based Solar Trading Company.**

Our technology is the most advanced and suitable technology for rooftop applications due to their higher efficiency and safety. We specialize in solar power electronics, energy metering & monitoring, battery management solutions etc.

Our product portfolio includes Inverter, multi-function, battery management solutions, remote monitoring solutions. We are a R&D focused company and due to our varied product portfolio are well positioned to provide tailored on-grid / off-grid / AC / DC solutions to our customers of any scale.

- **Vision:**

"Empower Green Energy & Lighting Everywhere".

- **Mission:**

"Pursuing the ultimate energy efficiency, lighting quality and sustainable environment".

- **Philosophy:**

"Energy saving, Environment friendly, CO2 reduction and Healthy Living".

We are dedicated to provide the best PV solutions through innovative business approach, operational excellence & technological experts.

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OFFICE DESK

MOHAMMED MUBARAK

MANAGING DIRECTOR

India is one of the very few cities in the country, which enjoy almost 90% sunny days in the year – not less than 300 days each year! In addition, due to the rapid growth of the urban as well as rural constructions, ample free space is available on the rooftops of both residential and commercial buildings. Particularly with the increase in the growth of high-rise buildings and shopping complexes and shopping malls in the city, this space is increased multi-fold in the last 5 – 8 years.

This is the right time for you to leverage this fast growing sector in India, and Set Up Your Own Solar Energy Business in India!
Come, be a part of this solar energy revolution, and also contribute towards the nation's Go Green Initiative!..

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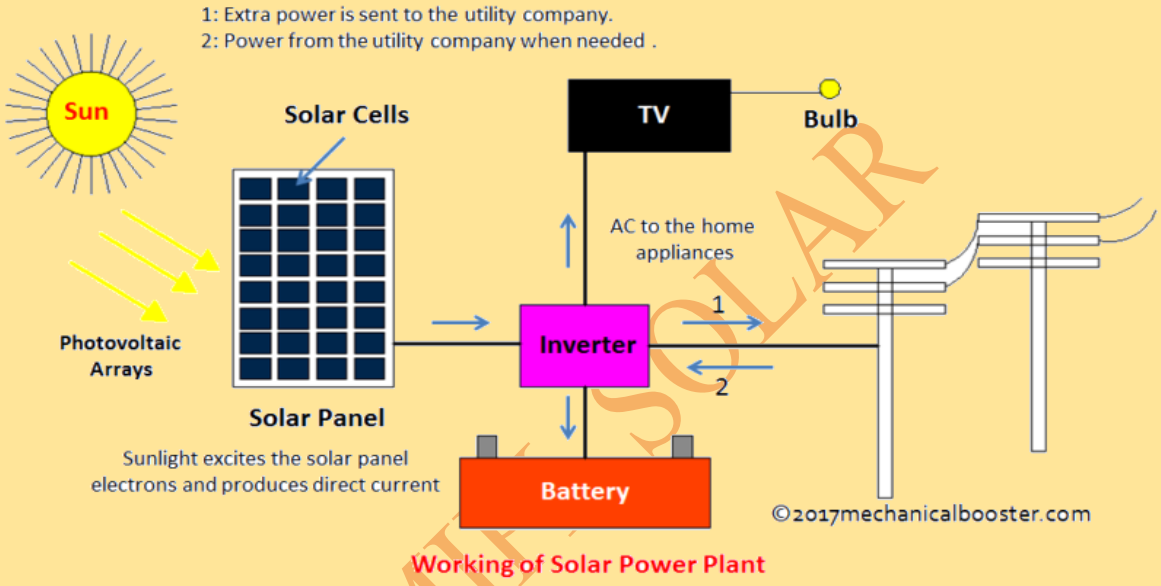
What is Solar?

Solar energy is the most abundant energy resource on Earth. It can be captured and used in several ways, and as a renewable energy source, is an important part of our clean energy future

- Solar energy comes from the sun and can be captured with various technologies, primarily solar panels.



Working of Solar Power Plant

Photovoltaic solar energy

Solar PV systems use cells to convert sunlight into electricity. The PV cell consists of one or two layers of a semi conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers causing electricity to flow. Greater the intensity of the light, the greater the flow of electricity.

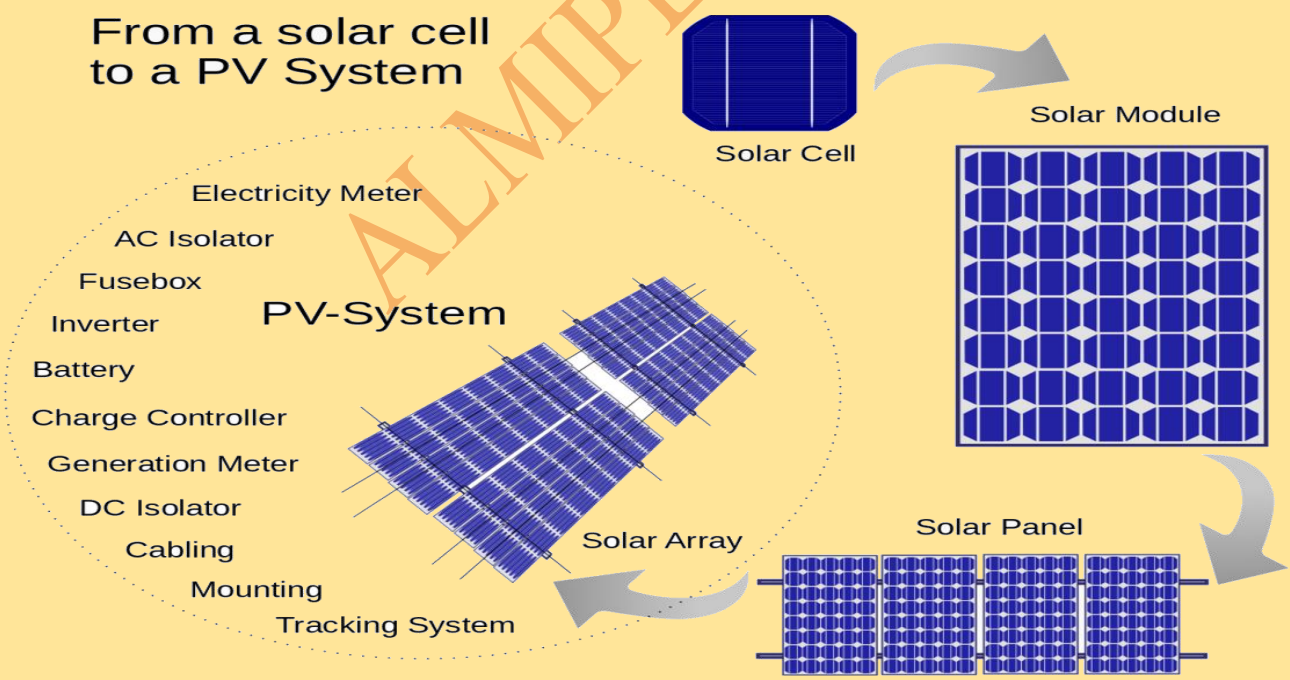
PV cells are referred to in terms of the amount of energy they generate in full sunlight; known as kilowatt peak or kWp.

Solar Cell is the basic building block of Solar PV technology. Most people are familiar with PV Solar Cells that power calculators. These cells are wired together to form a module (PV Solar Panel).

The PV Modules gather solar energy in the form of sunlight and convert it into direct current (DC) electricity. An inverter can convert this DC power into alternating current (AC power, which is the type of electricity used in your home). PV Modules are joined together to form a PV Solar Panel system. Large PV systems can be integrated into buildings to generate electricity.

COMPONENTS OF SOLAR PV SYSTEMS:

- Solar panels
- Electrical connections between solar panels
- Output power lines
- **Power inverter** (converts DC electricity to AC electricity)
- Mechanical mounting equipment
- Charge controller
- Wiring
- Batteries for energy storage
- Electrical meter (for grid-connected systems)
- Overcurrent and surge protection devices
- Power processing equipment
- Grounding equipment



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Utilities may use more advanced systems for generating substantial quantities of electricity such as:

- 3 **Single axis** or **double axis** tilting systems
- Automatic cooling and cleaning systems
- Fuel cell, battery or other type of power storage systems
- Transmission lines

This equipment enables engineers and technicians to build PV systems that can be integrated into buildings or constructed at an off-site location. If the photovoltaic system is located off-site, transmission lines would need to transport the power from the solar array to the site that requires the power.

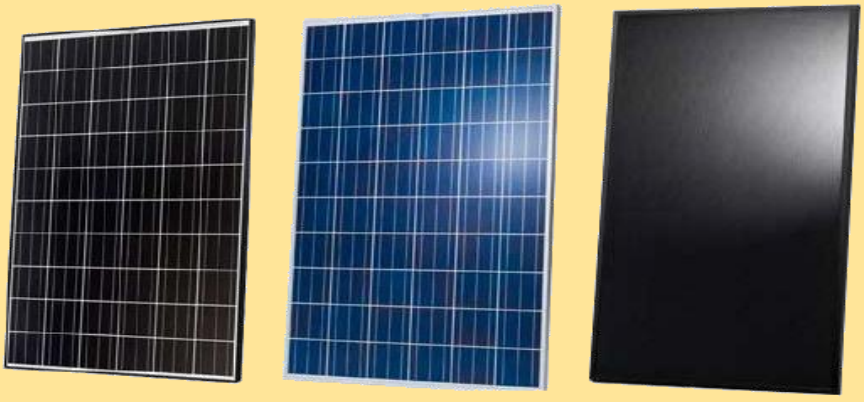
SOLAR PANELS:

Photovoltaic (PV) panels are comprised of individual cells known as **solar cells**. Each solar cell generates a small amount of electricity. When you connect many solar cells together, a **solar panel** is created that creates a substantial amount of electricity. PV systems vary in size, depending upon the application: it can vary from small, rooftop-mounted or building-integrated systems with capacities of tens of kilowatts to large utility-based stations that generate hundreds of megawatts of electrical power.

To produce electricity, solar cells are made from a semiconducting material that converts light into electricity. The most common material used as a semiconductor during the solar cell manufacturing process is silicon.

Types of Solar Panels

There are three types of solar panels that are widely available for use in photovoltaic systems, (1) monocrystalline, (2) polycrystalline, and (3) amorphous thin-film. Each type of panel has its advantages and disadvantages. The primary differences between these panel types are their cost and efficiency.



Monocrystalline Polycrystalline Thin Film

Vary in the composition of the silicon itself. Monocrystalline solar cells are cut from a single, pure crystal of silicon. Alternatively, polycrystalline solar cells are composed of fragments of silicon crystals that are melted together in a mold before being cut into wafers.

Types of Solar systems:

- **On-grid** - also known as a grid-tie or grid-feed solar system
- **Off-grid** - also known as a stand-alone power system (SAPS)
- **Hybrid** - solar plus battery storage with grid-connection

1.On-Grid System

On-grid or grid-tie solar systems are by far the most common and widely used by homes and businesses. These systems do not need batteries and use common solar inverters and are connected to the public electricity grid. Any excess solar power that you generate is exported to the electricity grid and you usually get paid a feed-in-tariff (FIT) or credits for the energy you export.

Unlike hybrid systems, on-grid solar systems are not able to function or generate electricity during a blackout due to safety reasons. Since blackouts usually occur when the electricity grid is damaged;

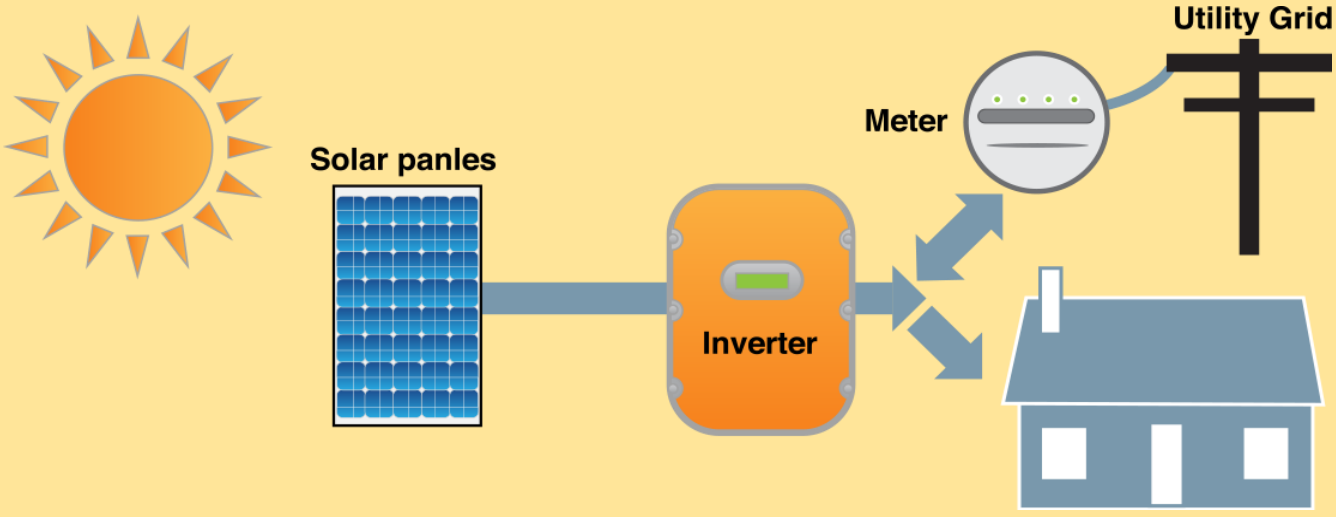
If the solar inverter was still feeding electricity into a damaged grid it would risk the safety of the people repairing the fault/s in the network.

Most hybrid solar systems with battery storage are able to automatically isolate from the grid (known as islanding) and continue to supply some power during a blackout.

- ***The meter***. Excess solar energy runs through the meter, which calculates how much power you are either exporting or importing (purchasing).

  Metering systems work differently in many states and countries around the world. In this description I am assuming that the meter is only measuring the electricity being exported to the grid, as is the case in most of Australia. In some states, meters measure all solar electricity produced by your system, and therefore your electricity will run through your meter *before* reaching the switchboard and not after it. In some areas (currently in California), the meter measures both production and export, and the consumer is charged (or credited) for net electricity used over a month or year period. I will explain more about metering in a later blog.

- ***The electricity grid***. Electricity that is sent to the grid from your solar system can then be used by other consumers on the grid (your neighbours). When your solar system is not operating, or you are using more electricity than your system is producing, you will start importing or consuming electricity from the grid.



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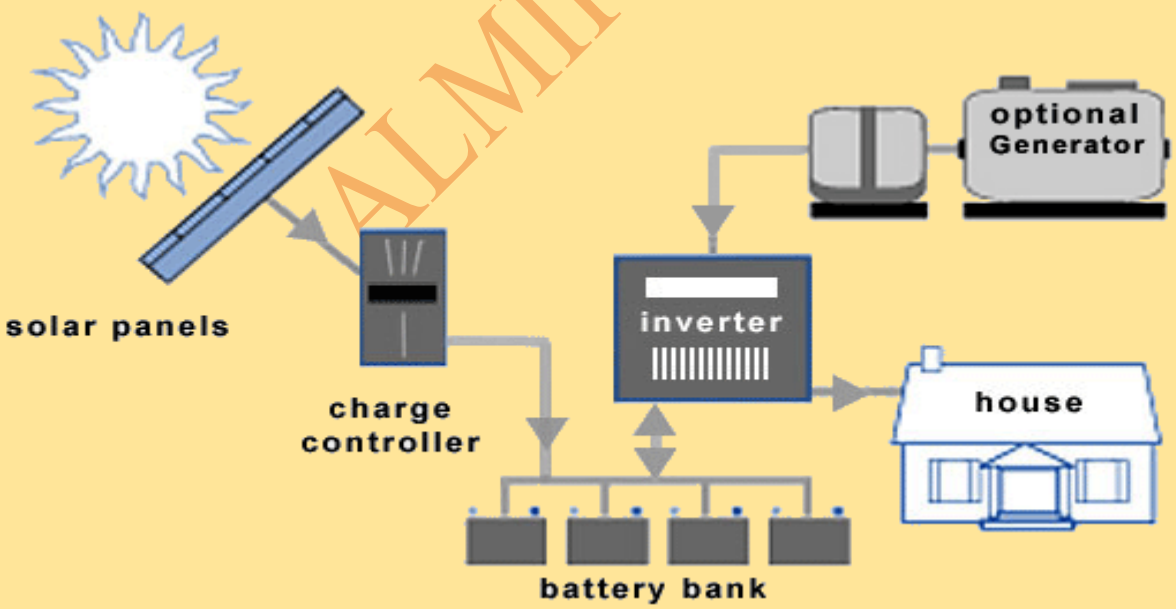
2. Off-Grid System

An off-grid system is not connected to the electricity grid and therefore requires battery storage. An off-grid solar system must be designed appropriately so that it will generate enough power throughout the year and have enough battery capacity to meet the home's requirements, even in the depths of winter when there is less sunlight.

The high cost of batteries and inverters means off-grid systems are **much more expensive** than on-grid systems and so are usually only needed in more remote areas that are far from the electricity grid. How - ever battery costs are reducing rapidly,

- ***The battery bank***: In an off-grid system there is no public electricity grid. Once solar power is used by the appliances in your property, any excess power will be sent to your battery bank. Once the battery bank is full it will stop receiving power from the solar system. When your solar system is not working (night time or cloudy days), your appliances will draw power from the batteries.



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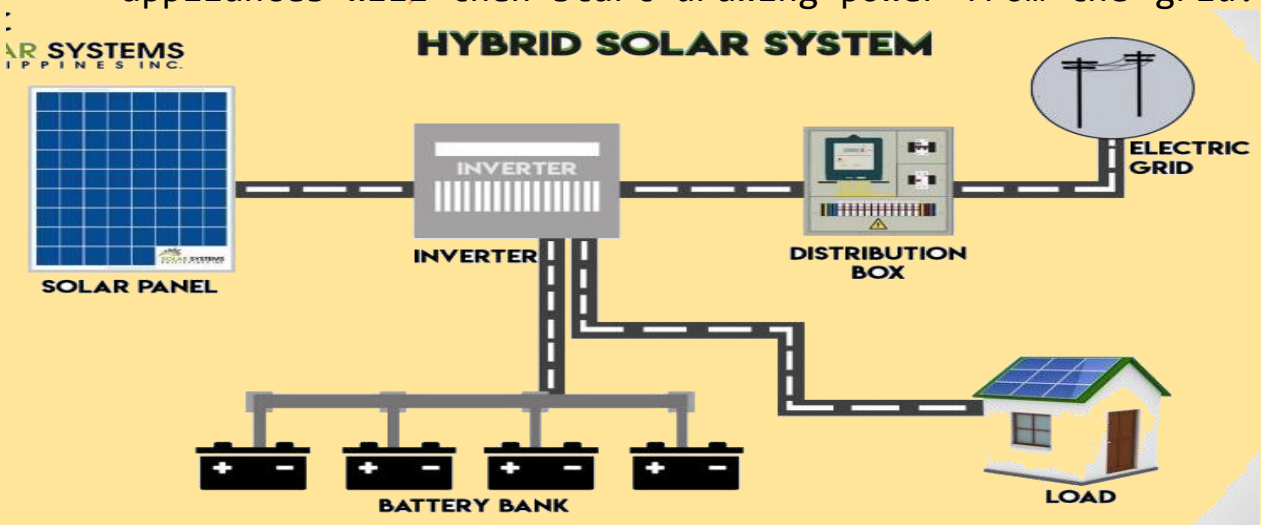
3.Hybrid System

Modern hybrid systems combine solar and battery storage in one and are now available in many different forms and configurations. Due to the decreasing cost of battery storage, systems that are already connected to the electricity grid can start taking advantage of battery storage as well. This means being able to store solar energy that is generated during the day and using it at night. When the stored energy is depleted, the grid is there as a back-up, allowing consumers to have the best of both worlds. Hybrid systems are also able to charge the batteries using cheap off-peak electricity (usually after midnight to 6am)

The battery bank. In a hybrid system once the solar power is used by the appliances in your property, any excess power will be sent to the battery bank.

Once the battery bank is fully charged, it will stop receiving power from the solar system. The energy from the battery can then be discharged and used to power your home, usually during the peak evening period when the cost of electricity is typically at it's highest.

- ***The meter and electricity grid.*** Depending on how your hybrid system is set up and whether your utility allows it, once your batteries are fully charged excess solar power not required by your appliances can be exported to the grid via your meter. When your solar system is not in use, and if you have drained the usable power in your batteries your appliances will then start drawing power from the grid.



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Advantages:

1. Solar power is pollution free and causes no greenhouse gases to be emitted after installation
2. Reduced dependence on foreign oil and fossil fuels
3. Renewable clean power that is available every day of the year, even cloudy days produce some power
4. Return on investment unlike paying for utility bills
5. Virtually no maintenance as solar panels last over 30 years
6. Creates jobs by employing solar panel manufacturers, solar installers, etc. and in turn helps the economy
7. Excess power can be sold back to the power company if grid intertwined
8. Ability to live grid free if all power generated provides enough for the home / building
9. Can be installed virtually anywhere; in a field to on a building
10. Use batteries to store extra power for use at night
11. Solar can be used to heat water, power homes and building, even power cars
12. Safer than traditional electric current
13. Efficiency is always improving so the same size solar that is available today will become more efficient tomorrow.
14. Aesthetics are improving making the solar more versatile compared to older models; i.e. printing, flexible, solar shingles, etc.
15. Federal grants, tax incentives, and rebate programs are available to help with initial costs

Advantages of Solar Energy

1. Renewable Energy Source:

Among all the benefits of solar panels, the most important thing is that solar energy is a truly renewable energy source. It can be harnessed in all areas of the world and is available every day. We cannot run out of solar energy, unlike some of the other sources of energy.

Solar energy will be accessible as long as we have the sun, therefore sunlight will be available to us for at least 5 billion years when according to scientists the sun is going to die.

2. Reduces Electricity Bills:

Since you will be meeting some of your energy needs with the electricity your solar system has generated, your energy bills will drop. How much you save on your bill will be dependent on the size of the solar system and your electricity or heat usage. Moreover, not only will you be saving on the electricity bill, there is also a possibility to receive payments for the surplus energy that you export back to the grid. If you generate more electricity than you use (considering that your solar panel system is connected to the grid).

3. Diverse Applications:

Solar energy can be used for diverse purposes. You can generate electricity (photovoltaics) or heat (solar thermal). Solar energy can be used to produce electricity in areas without access to the energy grid, to distill water in regions with limited clean water supplies and to power satellites in space. Solar energy can also be integrated into the materials used for buildings. Not long ago Sharp introduced transparent solar energy windows.

4. Low Maintenance Costs:

Solar energy systems generally don't require a lot of maintenance. You only need to keep them relatively clean, so cleaning them a couple of times per year will do the job. Most reliable solar panel manufacturer's offer **20-25 years** warranty. Also, as there are no moving parts, there is no wear and tear. The inverter is usually the only part that needs to be changed after **5-10 years** because it is continuously working to convert solar energy into electricity and heat (solar PV vs. solar thermal).

Apart from the inverter, the cables also need maintenance to ensure your solar power system runs at maximum efficiency. So, after covering the initial cost of the solar system, you can expect very little spending on maintenance and repair work.

5. Technology Development:

Technology in the solar power industry is constantly advancing and improvements will intensify in the future. Innovations in quantum physics and nanotechnology can potentially increase the effectiveness of solar panels and double, or even triple, the electrical input of the solar power systems.

Typical Solar applications

- Solar Pump applications- Fountain/Pool/Circulation pump for ponds/Irrigation pumps/Home pumps /Submersible AC/DC pumps
- Solar Street light
- Solar lantern
- Solar air conditioners
- Solar charging stations for e-vehicles
- Common area facilities for apartment/STP/Water treatment facilities
- Solar Electric Fencing
- Solar cleaning solution and accessories-
- Drones for identifying healthiness of modules
- Government buildings for solar rooftop installation

Solar portable 12 V DC power supply

How to estimate the area requirement for a given capacity of Solar PV?

A general rule of thumb is to have 100 square feet or 10 sqm of shadow free area for every KW of solar power generation. This is at the current levels of efficiency of Solar Panels. So if a 1 MW solar power plant is to be set up we need 1000 KW * 100 sft/KW = 100000 sq. ft approx.2.5 acres

1.Shadow test:To collect maximum sunlight during the day, the solar PV panel should face as much south as possible. The rooftop must be checked for the shadows of trees or adjoining builds etc., particularly from south direction. A clear rooftop without any shadow from all around is an ideal case for solar PV installations. In case there is shadow on rooftop, a detailed analysis of time and direction of sunlight needs to be performed by an expert to estimate the energy received by rooftop.

2.**Rooftop type**: The load carrying capacity of the roof should be checked.The solar panels with structure typically weigh 15Kg per Sq. meter. This weight varies with technology and type of structure.

3.Sizing of solar system: Size of solar system depends on the rooftop area available for panels. This can be calculated by dividing the available area by each panel area and multiplying it by panel's rated output. For estimate purpose, 70% of rooftop area can be used for panel's installation. Certain solar panels in market can use as high as 90% of rooftop area, but have much higher cost. As a thumb rule, 10 Sq meter area is required for 1 Kw capacity solar system.

Size of solar system = Panel's rated output*(Rooftop area / Each panel area)*70%

4.System output (annual units generated): The output per panel and hence system output depends on panel efficiency and the solar radiation at the site. These two factors define CUF (Capacity Utility Factor) for solar system for a particular location. For India typically 19% CUF is taken for estimation. The annual number of units generated by solar system can be calculated as:

Units Generated Annually (in Kwh) = System Size in Kw * CUF * 365 * 24

As a thumb rule, 1 Kw capacity solar system generates 1600 – 1700 Kwh of electricity per year. The CUF varies with the geographical location of the installation site. Following table summarizes indicative CUFs at different cities in India.

5.**Pricing of solar system**: A typical rooftop solar system without battery and without grid connection costs Rs.125 per Wp. A system with battery with 5 hrs backup typically costs Rs.200 per Wp. These rates are for smaller systems upto 250 Kw capacity. For larger systems, price per Wp reduces and is typically in the range of Rs.100 per Wp for MW size systems. In addition to the above decision criteria, it may be worthwhile for the prospective project developer to weigh in on the financial incentives in their business cases.

TOP INNOVATIONS:

- **SOLAR PAINT** – Billion of pieces of light sensitive materials suspended in paint, which act like mini-Solar panels. The challenge is to scale up its efficiency.
- **SOLAR WINDOW** – Windows that change from transparent to tinted – and in the process convert Sunlight to electricity.
- **SOLAR CARS** – Fully solar-powered cars with ZERO emissions, a possibility? Engineers from Netherlands and Australia leading this change.
- **SOLAR ROADS** – US, France, China and Georgia are experimenting with installing solar panels on roads; It has not yet proven to viable, but R&D is on in full swing.
- **SOLAR WATER** – Fresh water from seawater using Solar Desalination? A process utilising nanoparticle-assisted vaporisation in a membrane distillation geometry is being studied to obtain a small-scale source of clean water.

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OUR RECENT PROJECTS

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OMR

GUMMIDIPOONDI

NEELANGARAI

KOLATHUR

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FOR FURTHER DETAILS

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