CAG
Citizen consumer and civic Action Group

ROOFTOP SOLAR PV SYSTEM HANDBOOK

FREQUENTLY ASKED QUESTIONS

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Frequently Asked Questions on

Residential Rooftop Solar PV Systems

CAG
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About CAG

Citizen consumer and civic Action Group (CAG) is a 39-year-old Chennai-based non-profit, non-political and professional organisation that works towards protecting citizens' rights in consumer and environmental issues, and promoting good governance processes including transparency, accountability and participatory decision-making.

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1 INTRODUCTION

Rooftop solar Photovoltaic (PV) systems offer a wide range of benefits, including environmental sustainability, energy independence, and a significant reduction in national energy demand. They provide a clean, renewable source of energy with no moving parts, low maintenance costs and a long lifespan of 25+ years, making them an attractive option for homeowners. By harnessing solar power, you can contribute to a greener planet, reduce reliance on conventional grid electricity, and lower your monthly energy bills. Despite these advantages, rooftop solar PV systems have not yet become widely popular, primarily due to high initial investment costs which characterised them in the past. Fortunately, advancements in technology and the commercialisation of solar solutions have made the market more competitive and accessible. Today, numerous companies in India manufacture solar panels, and thousands of empanelled vendors are available to install solar PV systems at affordable prices. The Indian government is also promoting solar adoption through subsidies for residential consumers under the PM Surya Ghar Muft Bijli Yojana, making it easier than ever to go solar.

As solar PV technology gains traction, many homeowners are showing interest but often have questions. These range from understanding the basics of solar systems and their components—such as types of solar panels (DCR vs. non-DCR), mounting structures, inverters, wiring, and capacity determination—to practical concerns like financing options, insurance schemes, subsidy procedures, and selecting a reliable vendor. Consumers may also be uncertain about metering mechanisms, such as net metering, or the maintenance required to keep their systems running efficiently.

This FAQ booklet, part of a Four-part handbook series, aims to address these questions with clear, concise answers to demystify rooftop solar for the average consumer. This guide will help you understand the benefits of solar PV systems and its fundamentals, and thus make informed decisions without being misled.

2 FAQ's ON FINANCIAL ASPECTS OF SOLAR PV SYSTEM

1. **The Government of Tamil Nadu provides 100 free units bi-monthly. Why should I invest in a solar PV system? When is solar the most economical option?**
   While the free units cover a portion of your electricity needs, you may still be consuming more, especially with appliances like air conditioners. Solar PV systems allow you to generate your own electricity, reducing your dependence on the grid and its fluctuating tariffs.

   If your monthly usage exceeds the free units, a solar PV system can offset the extra cost, keeping your bill minimal. A solar PV system locks in your energy cost for 25+ years, making you immune to rising tariffs. Installing solar PV systems ultimately helps generate clean and green energy.

2. **What is the cost of installing a rooftop solar PV system?**
   The cost of installing a rooftop solar photovoltaic (PV) system varies based on factors such as system capacity, component quality, and installation specifics.
   The typical cost of a 1 kW solar PV system ranges between these values:
   - On-Grid system : Rs. 50,000 – Rs. 80,000
   - Off-Grid system (Lead acid battery): Rs.90,000 – Rs.1,20,000
   - Hybrid (Li ion battery): Rs.1,25,000 - Rs.1,45,000

3. **Is there any subsidy available to install solar?**
   Yes, presently the Government of India is providing subsidies (Direct Benefit Transfer) for the installation of rooftop solar PV systems under the scheme "PM Surya Ghar: Muft Bijli Yojana". This is for residential households and group housing societies / Resident Welfare Associations.

4. **How much subsidy is available under the PM Surya Ghar scheme?**

Sn	Type of Residential Segment	Central Finance Assistance	Central Finance Assistance (Special category states)

1	Residential Sector (first 2 kW_p of RTS capacity or part thereof)	Rs. 30,000 / kW_p	Rs. 33,000 / kW_p
2	Residential Sector (with additional RTS capacity of 1 kW_p or part thereof)	Rs. 18,000 / kW_p	Rs. 19,800 / kW_p
3	Residential Sector (additional RTS capacity beyond 3 kW_p)	No additional subsidy	No additional subsidy
4	Group Housing societies / Residential Welfare Associations (GHS / RWA) etc, for common facilities including EV charging upto 500 kW_p (@3kW_p per house)	Rs.18,000 / kW_p	Rs. 19,800 / kW_p

5. How long does it take to receive the subsidy amount?

The subsidy will be processed within 15 days of approval by the concerned DISCOM. During the DISCOM inspection, if any queries are raised, it has to be resolved before receiving a subsidy..

6. How much can I tentatively save on electricity bills with solar installation?

For domestic service connection (LT 1A):

Sn	Bi-monthly Energy Consumption (units)	Bi-monthly Electricity bill without Solar (Rs.)	SPV system capacity req. (kW)	Investment (Rs.)	Subsidy (Rs.)	Net Investment (Rs.)	Bi-monthly Energy bill after solar installation (Rs.)	Bi-monthly Cost Savings (Rs.)	Payback Period (years)
1	Upto 350	1000	1	75,000	30,000	45,000	100	900	9
2	351 to 650	1,000 to 3,300	2	1,50,000	60,000	90,000	200	800 to 3,100	5 to 9
3	651 to 900	3,500 to 5,800	3	2,25,000	78,000	1,47,000	300	3,100 to 5,500	4 to 8
4	901 to 1200	5,800 to 9,200	4	3,00,000	78,000	2,22,000	400	5,500 to 8,800	4 to 7
5	1201 to 1450	9,200 to 12,000	5	3,75,000	78,000	2,97,000	500	8,800 to 11,500	4 to 6

For common service connection in multi-tenements (LT 1D):

Sn	Bi-monthly Energy Consumption (units)	Bi-monthly Electricity bill without Solar (Rs.)	SPV system capacity req. (kW)	Investment (Rs.)	Subsidy (Rs.)	Net Investment (Rs.)	Bi-monthly Energy bill after solar installation (Rs.)	Bi-monthly Cost Savings (Rs.)	Payback Period (years)
1	Upto 300	3,000	1	75,000	18,000	57,000	300	2,500	4
2	301 to 600	3,000 to 5,500	2	1,50,000	36,000	1,14,000	600	2,500 to 5,000	4 to 8
3	601 to 900	5,500 to 8,500	3	2,25,000	54,000	1,71,000	900	5,000 to 7,500	4 to 6
4	901 to 1100	8,500 to 10,000	4	3,00,000	72,000	2,28,000	1200	7,500 to 9,000	4 to 6
5	1101 to 1400	10,000 to 13,000	5	3,75,000	90,000	2,85,000	1500	9,000 to 11,500	4 to 6

MYTH : **Installing rooftop solar PV system is not cost effective and the payback period is too long.**

REALITY : **In India, substantial government subsidies, reducing installation costs, and increasing electricity tariffs, have made rooftop solar systems as attractive alternatives. The payback period for an on-grid system, whose life is about 20-25 years is just around 4 to 6 years. The environmental impact far exceeds any other benefits.**

7. What is the payback period?

For an on-grid solar PV system, the payback period comes to around 4 to 6 years.

8. **What fees do I need to pay to the electricity board (in registration, deposits, etc.)?**
   When installing a solar PV system, bi-directional meter charges need to be paid to the Distribution Licensee (Tamil Nadu Power Distribution Company Limited). For domestic consumers, three phase (Low Tension) LT connections, it is Rs. 5011, and for single phase LT connections, Rs. 2764. A registration fee of Rs. 500 for up to 20 kW and Rs. 100 thereafter for every 20 kW or part thereof is also applicable.

DEALER TRICKS : **Don't go for subsidy, it's too complicated and takes months to actually receive the amount.**

REALITY : **Wrong. The new online subsidy portal (National Portal for Rooftop Solar : https://pmsuryaghar.gov.in/) has streamlined the process. Reputable installers help you with documentation and you get your subsidy directly in your bank account within 3 days to maximum 90 days after commissioning and approval from DISCOM**

9. **Are there loans or EMI options available for solar PV installation? What are the interest rates?**
   Yes, under the PM Surya Ghar: Muft Bijli Yojana, a loan facility is available for the residential category. The national portal of this scheme is integrated with **Jan Samarth Portal**. Consumers can submit their loan application after login into the national portal.
   In the portal (https://pmsuryaghar.gov.in/#/), under the finance options for consumers, loan options offered by various banks are provided.

10. **What is the applicable Goods and Services Tax (GST) for solar PV systems?**
    In solar power projects, the supply involves both goods (solar panels, inverters, etc.) and services (installation). GST on supply of components is 12 %, applicable on 70% value of the project cost. GST on installation and commissioning of the system is 18% applicable on 30% value of the project cost. This results in an effective GST rate of 13.8% on the total project cost.

11. **For residential consumers, is there a subsidy available for off grid solar PV systems?**
    No, the Central Financial Assistance (PM Surya Ghar Subsidy scheme) is applicable only for grid-connected solar PV systems and hybrid systems.

12. Is subsidy applicable for hybrid systems?

Yes, subsidies are available for hybrid systems.

13. How do I apply for a rooftop solar subsidy?

Follow these steps for a subsidy under the PM Surya Ghar: Muft Bijli Yojana

Step 1: Visit the official website https://www.pmsuryaghar.gov.in/.

Step 2: Login with your mobile number and then enter valid OTP. (Either vendor or consumer can fill out the application form. In case one selects a vendor to fill the application, the consumer needs to first shortlist the vendor).

Step 3: Enter personal details, select your State, District, Electricity Distribution Company, Electricity Consumer Number and other details. For more details - kindly go through the consumer manuals or training videos in the **Knowledge Centre** section.

14. Can a solar system eliminate my electricity bill completely?

Yes, solar power can potentially eliminate your electricity bill, but it depends on several factors. In Tamil Nadu, domestic consumers follow the **Net Metering** billing mechanism. By installing a solar PV system of the right capacity, you can generate enough electricity to meet your household's entire energy needs.

During the day, solar panels power your home directly. Any excess energy generated is exported to the grid. At night, when your panels are not producing power, you can draw energy from the grid — and this is offset against the excess energy you exported earlier.

If your system is correctly sized and your usage patterns align well, your **net energy consumption can be zero**. However, a fixed **network (or wheeling) charge** of approximately Rs.100 per kW (bimonthly) for solar PV systems still applies.

Keep in mind, if your electricity consumption is very high or your solar system is undersized, you may still receive a bill for the additional grid power used.

15. Can solar PV installation help in obtaining a green building rating certification?

Installing a solar PV system is one of the compliance requirements in getting a green building certification under the energy efficiency/conservation category. If the other mandatory requirements and credits are complied with, the corresponding green building certification agency can award the green building certificate.

16. Can solar PV installation help in obtaining a Carbon Credit certification?

Installing a solar PV system can help you earn carbon credits because it reduces greenhouse gas emissions by replacing electricity generated from fossil fuels. To get a Carbon Credit certification, you need to register your solar project with a recognised carbon credit program like Verified Carbon Standard (VCS) or the Gold Standard. Then, you must monitor and measure how much your system reduces emissions and have an accredited third-party organisation verify these reductions to ensure they meet carbon credit standards. Once approved, you can sell or trade the carbon credits in voluntary or compliance markets for financial benefits. However, in practice, **only large-capacity systems (typically 100 kW or more)** usually pursue carbon credit certification. This is because the process involves significant costs, technical documentation, and compliance requirements that are often not economically viable for small residential systems. Still, emerging **aggregation models** are beginning to make it possible for small systems to participate collectively in carbon credit programs.

3 FAQ's ON SOLAR PV SYSTEM INSTALLATION AND USAGE

1. **How long does it take to complete the installation process?**
   After finalising the vendor, the actual installation of the rooftop solar system varies between 7 to 15 days, depending on the system size and the site conditions. For net metering, the time taken for approval by the distribution company (DISCOM) can vary between 7 to 14 days.

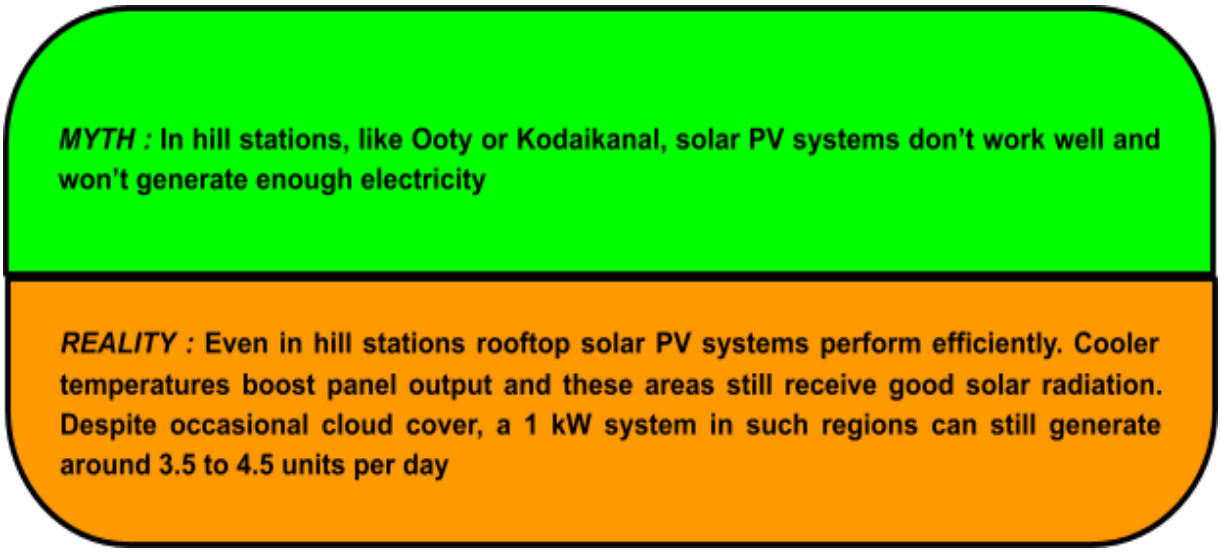
2. **Can I install solar without drilling my roof?**
   Yes, solar PV systems can be installed on rooftops without drilling holes. In ballast (Non-Penetrating) mounting systems, heavy concrete blocks or metal frames are used to hold the solar panels in place.

3. **What would be the total weight of the solar PV system, including mounting structures and other accessories?**
   Typically, a single solar PV panel weighs around 20 kg to 30 kg, depending on the wattage of the panel. Considering 3 panels are connected in a 1 kW system, the total weight of the panel comes to around 75 Kg. The weight of the 1 kW mounting structure is approximately 75 Kg. Around 150 kg can be installed over an area of 10 sq.m. on the roof. The load is spread over a large area, so the impact per square meter is relatively low.

4. **What is the optimum thickness (2 or 4 mm), section (C/T/ I section) for the mounting structure?**
   The ideal thickness and section type for a solar rooftop mounting structure depends on factors such as wind load, roof type, and panel weight. In general, a 2 mm thickness is sufficient for lighter loads, but a 4 mm thickness is preferred for greater durability and strength, particularly in regions with strong winds and particularly for elevated structures.

   Regarding section types, the C-section is commonly used for lightweight structures, as it provides good strength and is easy to install. The T-section is less frequently used but can be beneficial for designs that require additional support. The I-section, on the other hand, is best suited for heavy-duty installations, as it offers maximum load-bearing capacity.

5. **I live in an apartment. Can I install solar panels on the rooftop or balcony?**
   Solar panels cannot be installed on balconies as there won't be enough space in the balcony and no sunlight will be falling on the panels. On the rooftop of the apartment, a solar PV system can be installed for meeting the requirements of the common facility in the apartment, such as common lighting, common water supply, lift, etc.



6. **Can I install solar PV in a rented house? What happens if I relocate?**
   Yes, a solar PV system can be installed in a rented house provided permission is obtained from the owner of the house. In the event of relocation, the system can be relocated to the new house.

7. **If a house has multiple service connections (e.g., Ground +2 with three connections), how will billing and metering be managed?**
   Each service connection requires a separate bidirectional meter for individual billing and metering.

8. **How do I choose a reliable vendor for installation?**
   A reliable vendor can be chosen from the National Portal for PM Surya Ghar: Muft Bijli Yojana. The portal provides a list of registered/empanelled vendors. All the vendors registered on the National Portal will be given a vendor rating depending on the size and scale of installations done, quality of equipment, quality of workmanship, quality of service and other criteria. This vendor rating will be visible to the consumers on the National Portal. Consumers can shortlist multiple vendors and communicate with them, following which they can select their preferred vendor.

9. **What parameters should I consider while selecting a vendor?**

   When selecting a vendor, the following may be considered,

   - Whether they are an empanelled vendor in the PM Surya Ghar Scheme
   - Vendors' experience in the solar field. (No of projects completed, total capacity installed)
   - Customer feedback/rating on the websites
   - Visit existing customer sites where the system is already installed and conduct direct checks with the customers.

MYTH : **Many vendors install the solar PV system and then disappear. If any issues arises later, it becomes difficult to get service or support.**

REALITY : The rooftop solar market is expanding rapidly, and it's true that some vendors may operate briefly and exit the market, leaving customers without reliable after-sales service. This is why vendor selection is critical.

REMEDY : **To ensure service continuity and accountability, consumers should choose vendors who are empanelled and listed on the official PM Suryaghar portal. They are mandated to provide 5 years of comprehensive warranty on the system components, including service and repair at no additional cost. Otherwise they get blacklisted. Always verify vendor credentials before proceeding**

10. **Why do some vendors not recommend going for subsidised solar PV systems?**

    Some vendors may discourage installation of solar PV systems through subsidy schemes due to limitations in selection of equipment model and manufacturing, as government approved models mandate the use of domestic content requirement (DCR) panels. The approval process can be lengthy, causing delays in installation and payment. Additionally, compliance requirements, including extra documentation and inspections could complicate the process. Subsidies also limit system size, restricting customization to specific energy needs.

Further, through subsidy schemes, vendors are held accountable to attend to failures and issues arising after the installation of the system for the next 5 years (Warranty period). If they are unable to attend to the complaints during warranty period, they are blacklisted under the PM Surya Ghar scheme. Hence, some vendors might not recommend going for subsidised solar PV systems.

Example:
In PM Surya Ghar scheme, a maximum amount of ₹ 78,000 is provided as subsidy for system size of 3kw capacity and more. Generally, DCR panels are costlier in comparison to non-DCR panels.
When installing a Solar PV system of capacity 5 kW or more, use of DCR panels in the project will increase the cost of the system by more than 78k. Hence, in such cases vendors do not recommend applying for subsidies as applying for subsidies would require the use of DCR panels. This will result in increased upfront investment in comparison to non-DCR panels.

SALES GIMMICK : **Imported panels are cheaper and perform better. Indian DCR panels are expensive and not reliable.**

REALITY CHECK : **Not true. Most Indian panels under DCR policy meet strict BIS / IEC certification standards, ensuring high reliability and durability. Most of the panels come with 25-year performance warranties. Many Indian solar panel brands now meet global quality standards and are actively exported to countries around the world.**

11. What safety precautions should be taken while handling solar PV systems?

When handling solar PV systems, ensure proper grounding to prevent electrical hazards, use insulated tools, and wear protective gear such as gloves and safety glasses. Avoid direct contact with live wires, securely fasten panels to prevent accidents, and follow manufacturer guidelines for installation and maintenance. Always turn off the power before servicing to avoid the risk of electric shock. Never clean panels in day time with water. Never use hard water or strong acids to clean panels. Never walk on solar panels.

12. **Are there any safety certificates required for installing a rooftop solar PV system?**
    Yes. For rooftop solar PV systems with a **capacity above 10 kW**, certain safety-related documents are typically required to ensure compliance with local regulations. These include:

    a. **Building stability certificate** – confirms that the structure is capable of supporting the solar installation.
    b. **Lift safety certificate** (if applicable) – Required if the building is equipped with a lift.
    c. **DG set safety certificate** (if applicable) – Required if a diesel generator (DG) is installed on the premises.

    These certificates help ensure the safe integration of the solar system with existing infrastructure and are often mandatory for grid connection approvals.

13. **For multi-tenement buildings with common service connections under tariff LM 51 or LT-V, are subsidies and net metering available for rooftop solar systems?**
    Currently, consumers in the LT-V tariff category are not eligible for subsidies or net metering for solar installations. Instead, they can opt for net feed-in metering.

14. **Do vendors offer rooftop solar installations for multi-tenement or apartment buildings under the RESCO model?**
    Yes, vendors can provide solar rooftop installations for multi-tenement or apartment buildings under the Renewable Energy Service Company (RESCO) model. This approach enables communities to adopt solar energy without any upfront investment, as the RESCO developer owns, operates, and maintains the system, selling electricity at a predetermined tariff. However, the RESCO model typically applies to projects above 1 MW_p , which may limit vendor interest for smaller projects.

15. **Can a hybrid solar PV system enable our solar rooftop system to operate in conjunction with a diesel generator during power outages?**
    Yes, in a hybrid solar PV system, the diesel generator (DG) can work alongside solar panels to provide backup power during grid outages. The system is designed with a hybrid inverter that intelligently manages solar, battery, and generator power, ensuring an uninterrupted electricity supply.

16. **If the DISCOM delays meter installation beyond a month, is there an official portal to report and resolve the grievance?**
    Yes, if Tamil Nadu's DISCOM delays meter installation beyond a month, you can file a grievance through the Consumer Grievance Redressal Forum (CGRF) on the TNPDCL website (https://www.tnebltd.gov.in/cgrfonline/) or use the Mudhalvarin Mugavari portal (https://cmhelpline.tnega.org/portal/en/signin) for government-related complaints. You

can also check your application status on the TNPDCL portal (https://www.tnebnet.org/awp/login). These platforms help escalate complaints and ensure timely resolution.

17. If a vendor delays installation or service, who is the point of contact for resolving the issue?

If a vendor delays the installation or service under the PM Surya Ghar Muft Bijli Yojana, consumers can take several steps to address the issue.

- The first step is to contact the vendor directly by reaching out to their customer support or assigned project manager for an update.
- If the delay affects net metering or approval, consumers should escalate the matter to their Distribution Company (DISCOM) by registering a written complaint with the section office.
- If the issue remains unresolved, they can register an online complaint with the Consumer Grievance Redressal Forum (CGRF) within their respective DISCOM.
- Additionally, consumers can seek assistance from the Ministry of New & Renewable Energy (MNRE), which oversees the scheme.
- Consumers can also raise grievances through the “PM Surya Ghar: Muft Bijli Yojana” National Portal (https://pmsgg.in/), which will be channelled for resolution within 30 days.

18. What are the different appliances that can be connected to a solar PV system?

Depending on the capacity of installation and whether it is equipped with a battery backup, a solar PV system can support most of the household appliances.

4 FAQ's ON POLICIES AND ADVANCEMENTS IN SOLAR PV SYSTEMS

1. **If the DISCOM removes net metering in the future, will it impact my investment?**
   When you install an on-grid rooftop solar PV system, a formal agreement is signed between you, the prosumer (an individual or entity who both produces and consumes electricity), and DISCOM. This agreement, typically valid for 25 years, includes the applicable metering arrangement — currently, net metering for domestic consumers and common service connections in residential apartments and gated communities.

   If DISCOM modifies or discontinues the net metering policy in the future, such changes will generally apply only to new consumers installing systems after the policy change. Existing prosumers who have already entered into a net metering agreement will continue to enjoy its benefits for the duration of their contract. Therefore, your investment remains protected under the terms agreed upon at the time of commissioning.

2. **What are the latest advancements in solar technology?**
   The latest technology in solar includes the use of high efficiency solar cells such as Heterojunction solar cells, Perovskite, Quantum Dots solar cells and the use of Micro Inverters and Solar Optimisers for power conditioning.

3. **Is there insurance coverage available to protect against solar panel damage or loss?**
   Yes, the solar PV system can be insured to protect from potential risks such as theft, natural disaster and damage.

4. **Will installing solar PV increase heat inside my home?**
   No, installing a rooftop solar PV system does not increase heat inside your home. In fact, solar panels help reduce heat inside homes especially during summers by blocking direct sunlight and cooling the roof.

5. **Is it safe to touch solar panels while they are operating?**
   Yes, it is generally safe to touch solar panels while they're operating, if the system is properly insulated or grounded. The surface of a solar panel is made of glass or plastic, which is generally non-conductive. So touching the glass or the panel itself (without touching the electrical parts) should not pose a direct electrical hazard. However, if there is any visible damage to the panel, wiring, or inverter, avoid touching the system.

Further, it's always a good idea to exercise caution and ensure that the system is turned off or disconnected from the electrical grid before performing any maintenance or working with the system.

6. **Can my solar system pose a shock risk to linemen during grid outages?**
   On-grid solar inverters have an in-built anti-islanding protection. During grid outages, the inverter automatically disconnects itself. This prevents the solar panels from supplying power back into the grid preventing shock risk to the linemen.

5 FAQ's ON SOLAR PV SYSTEM TECHNOLOGIES AND PERFORMANCE

1. **How much energy can a solar PV system generate?**
   Typically a 1 kW solar PV system in India can generate anywhere between 4 to 6 units of electricity in a day.

2. **How do I determine the right capacity for my home?**
   Capacity of solar PV system to be installed can be determined by the following factors,
   - Average energy consumption of the household
   - Available shadow free roof space
   - Sanctioned load from the EB

3. **What are the different types of solar PV systems?**
   Based on configuration and interaction with the grid, there are three types of solar PV systems.
   - On-Grid or Grid connected or Grid Tie PV system
   - Off-Grid system or Standalone PV system
   - Hybrid PV system

4. **What types of solar PV panels are available in the market?**
   Monocrystalline panels (mono - Si), polycrystalline panels (poly - Si), thin film panels, monocrystalline Passivated Emitter and Rear Cell panels (mono PERC), bifacial panels are available in the market.

CONSUMER FOCUS

Mono PERC and TOPCON solar modules are more commonly available solar panel technologies in the market

5. **What are the key components of a solar PV system?**

   A solar PV system typically comprises the Solar PV panel, solar inverter, mounting structure, DC distribution board (DCDB), AC distribution board (ACDB), wires, earthing, lightning and surge protection components, and monitoring system.

   Additional components based on the type of system could include -

   On grid system - Bi-directional meter

   Off grid system - Solar battery

6. **How much space is required for installation?**

   Typically a 1 kW rooftop solar PV system requires approximately 100 ft^2 or 10 m^2 of unobstructed shadow free area on the rooftop. To determine the total space required, multiply the desired system capacity (in kW) by the space required per kW. For example, for a 3 kW system, the required roof space would be 3 kW x 100 ft^2/kW, which equals 300 ft^2.

7. **What is the ideal orientation for solar panel installation?**

   The solar PV panel should be tilted to the latitude angle of the site location facing towards the equator. For example, for any solar project in Chennai, the orientation of the PV panel is 13^o (Latitude of Chennai) facing south.

8. **Will panel efficiency be affected by climatic conditions?**

   Yes, climatic conditions significantly affect the efficiency of solar panels and overall performance. High temperatures reduce efficiency while cooler temperatures improve performance. Most panels lose about 0.3% to 0.5% efficiency per °C above 25°C. Cloudy or rainy weather lowers output, though panels still generate some power from diffuse light. Humidity and coastal air can cause corrosion, so salt-mist-resistant panels are recommended in such areas. Dust, pollution, and snow can block sunlight, reducing efficiency, requiring regular cleaning or self-cleaning coatings. Strong winds and storms may damage panels, making secure mounting essential. To maximize efficiency, choose high-efficiency panels with low-temperature coefficients in hot climates, dust-resistant panels in dry regions, salt-mist-resistant, anti-corrosion panels in coastal areas, and steeper-tilted panels in snowy regions.

9. **Will a nearby tree or shading affect performance?**

   Yes, shading from a nearby tree or building will significantly reduce the performance of the PV system. Solar panels work by converting sunlight into electricity, and more sunlight equals more electricity. Shading can block sunlight and reduce output, but panels still generate some power through diffuse light. Even a small amount of shading on one panel can reduce the efficiency of the entire string (series) of panels. Further,

partial shading can cause hot spots, where shaded cells heat up, potentially damaging the panel. Hence, it is of utmost importance to design the system in such a way that there is no shading on the panels.

10. Do bird droppings impact efficiency?

Yes, bird droppings can impact solar panel efficiency. Unlike dust or dirt, bird droppings are often thick and opaque, preventing light from reaching the solar cells. If a cell is shaded by droppings, it can heat up and form a hotspot that may damage the panel over time, potentially reducing the panel's lifespan. Hence, it is advised to check and clean panels regularly.

11. **Can solar panels work in polluted areas?**

Yes, solar panels can work in polluted areas, but their efficiency may be reduced due to dust, smog, and airborne particles blocking sunlight. Pollutants settle on the panel surface, lowering solar radiation reaching the panels, reducing light absorption and thereby lowering energy output. Regular cleaning of the panels helps solve this issue. Since the panels are tilted at 13° rainwater also washes away most dust. Also mono PERC or bifacial panels can be used in such areas as they perform better in diffused sunlight. While pollution reduces solar efficiency, proper maintenance and strategic panel selection can minimize losses.

12. Does solar work well in coastal areas with salt exposure?

Yes, solar panels can work well in coastal areas. The key is choosing corrosion-resistant components, salt-mist resistant panels and ensuring proper installation. With the right equipment and maintenance, solar panels can efficiently generate power in coastal areas for many years.

13. Can it withstand cyclones and strong winds in Chennai?

Yes, solar panels can withstand cyclones and strong winds with the right design, proper installation and durable components. Choose panels and mounting systems rated for high wind speeds and ensure panels are securely installed to withstand high winds. Make sure that

- mounting structures are designed to withstand the speed for the wind zone of the location where a PV system is proposed to be installed.
- PV array structure design is appropriate with a factor of safety of minimum 1.5.
- suitable fastening arrangements such as grouting and calming are provided to secure the installation against the specific wind speed.
- high-strength aluminum or stainless-steel mounting structures are used.

- roof-mounted panels are firmly anchored with additional brackets to prevent uplift.

14. How can I monitor if my system is working properly?

- Checking the inverter's display panel or companion app can help identify system status, error codes, and power output data.
- Comparing net metering readings with expected generation allows you to detect any irregularities in energy production.
- Regular physical inspections of solar panels for dirt, shading, or damage are essential, as these factors can significantly impact efficiency. Reviewing monthly utility bills ensures that solar energy is effectively reducing grid power consumption.
- If your system includes battery storage, monitoring charge cycles and performance is crucial to maintaining reliability.

15. What maintenance is required, and how often?

Regular maintenance is essential for a solar PV system's efficiency and longevity. Clean panels every 2 to 3 weeks to prevent dust buildup, and inspect for damage or loose wiring every six months. Conduct annual inverter and electrical checks to avoid faults. For hybrid or off-grid setups, maintain batteries every 6–12 months, replacing them as needed. Review net metering and energy output annually to ensure optimal performance. Lastly, schedule professional servicing every 1–2 years for thorough system inspection and maintenance.

16. Are AMCs recommended for solar panels?

An Annual Maintenance Contract (AMC) for solar panels ensures their efficiency and longevity through regular inspections and servicing. Plans typically cover panel cleaning, inverter checks, wiring maintenance, battery servicing (if applicable), and performance assessments to detect energy losses. Investing in an AMC helps prevent unexpected breakdowns, extend system lifespan, and optimize energy output.

17. During maintenance of the solar PV system, what tests are recommended?

During solar PV system maintenance, various tests ensure safety and efficiency. Insulation resistance testing prevents leaks and short circuits, while Voc and Isc tests verify panel voltage and current. I-V curve tracing identifies performance issues, and earth continuity testing ensures proper grounding. Inverter functionality checks confirm DC-to-AC conversion efficiency, while string and module testing detects faults. Thermal imaging scans reveal hotspots, and battery health checks maintain storage system reliability in hybrid setups.

18. What is the lifespan of a solar PV system?

A solar PV system typically lasts up to 25 years, but its actual lifespan depends on the quality of components, maintenance, and environmental conditions. Most panels come with a performance warranty of 25 years. Inverters last 10–12 years, requiring at least one replacement during the system's life. Corrosion-resistant structures last 25+ years in normal conditions and regular maintenance of electrical components prevents damage and extends lifespan.

19. How does ageing affect the performance of the panel?

The performance of the Solar PV panel gradually declines due to material wear and tear, environmental exposure, and degradation of electrical components. Most solar panels degrade at a rate of 0.5% to 1% per year. Even after 25 years, panels typically operate at 80–85% of their original capacity.

20. Can panels be reused after their lifetime?

Yes, solar panels can be reused after their lifetime, though their efficiency decreases over time. After 25–30 years, they still generate power at a reduced capacity and can be repurposed for low-power applications, refurbished for secondary use, or recycled to recover materials like glass, silicon, and metals. Manufacturers and recyclers are improving solar panel recycling to minimize waste and maximize resource recovery.

21. How should solar panels be transported safely?

Safe transportation of solar panels is essential to prevent damage and extend their lifespan. They should be securely packed in original protective cartons with foam padding to absorb shocks. Panels must be handled upright to avoid pressure on the glass. For long-distance transport, they should be stacked vertically, spaced adequately, and secured with non-abrasive straps. If using a truck or container, ensure protection from moisture and extreme temperatures. During installation, proper lifting techniques and handling tools help prevent accidental drops or cracks.

22. What are the environmental benefits of solar PV?

Solar photovoltaic (PV) systems provide significant environmental benefits by reducing reliance on fossil fuels, lowering greenhouse gas emissions, and minimizing pollution.

- Clean and Renewable: Solar PV energy is a clean and renewable energy source. It doesn't produce pollution or greenhouse gases, and it won't run out like fossil fuels.
- Abundant and Available: The sun shines on all parts of the Earth, making solar energy a widely accessible resource.

- Sustainable: Solar PV energy is a key part of a sustainable energy future. It helps us reduce our reliance on fossil fuels and mitigate climate change.
- Environmental benefits of a 1 kW Solar PV system
    - Equivalent to Planting: ~15-20 trees annually.
    - CO_2 Reduction: Prevents approximately 1.5 tons of CO_2 emissions per year
- Less Fossil Fuel Consumption: Saves about 500 kg of coal per year, decreasing mining and air pollution.
- Fossil Fuel Savings: Offsets around 1,000 litres of diesel per year (compared to generators).

6 FAQ's ON ENERGY STORAGE AND BACKUP FOR SOLAR PV SYSTEMS

1. **Are batteries necessary for a rooftop solar PV system?**
   Batteries are used to store the energy generated from solar panels during day time. They form the main component in an off-grid and hybrid PV system. There are no batteries used in on-grid systems.

2. **Can power backup inverter batteries be used as solar storage batteries?**
   To use an inverter battery for solar storage, ensure it is compatible with solar charging and includes a solar charge controller for power regulation. While standard inverter batteries work for basic setups, dedicated solar batteries provide superior efficiency, longevity, and charging cycles.

3. **Can my existing UPS be connected to a solar PV system?**
   Yes, your existing UPS can be connected to a solar PV system if it is compatible and properly configured. Standard UPS units may not support direct solar charging, but those with lead-acid or lithium batteries can work with a solar charge controller to regulate power input. For better efficiency, upgrading to a solar-compatible UPS or hybrid inverter allows seamless switching between solar, battery, and grid supply while optimizing energy management.

4. **Can my solar PV system supply power during outages?**
   Yes, your solar PV system can supply power during outages, depending on its setup. Grid-tied systems without battery backup shut down for safety reasons. Hybrid systems with battery storage can store and provide electricity when the grid is unavailable. Off-grid systems operate independently and always offer backup power.

5. **My area has voltage fluctuations. Will this affect my solar PV system?**
   Yes, voltage fluctuations can affect your solar PV system, particularly the inverter's efficiency and battery health. Frequent instability may cause shutdowns, reduced power conversion, and shortened battery lifespan. To mitigate risks, use a solar inverter with voltage stabilization and install a voltage regulator.

6. **Will water stagnation on the roof affect solar panels?**
   Yes, water **stagnation** on the roof can reduce solar panel efficiency and cause long-term damage. Standing water leads to dirt buildup, affecting sunlight absorption, while excess moisture can trigger electrical faults, corrosion, or panel connection issues.

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