

# FAQ: Grid Connected Solar Rooftop System

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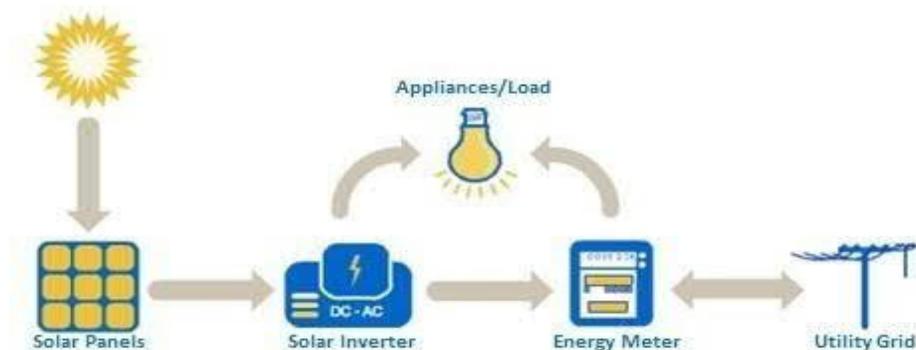
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# 1 About solar rooftop system

## 1.1. What is a Grid Connected Rooftop Solar PV System?

In grid connected rooftop or small solar photovoltaic (SPV) system, the DC power generated from solar panels is converted to AC power using power conditioning unit/Inverter and is fed to the grid. These systems generate power during the daytime which is utilized by powering captive loads and feed excess power to the grid. In case, where solar power is not enough due to cloud cover etc., the captive loads are served by drawing balance power from the grid. Operating modes of grid connected rooftop solar PV system can be explained as under:



## 1.2. What are the main components of a Grid Connected Rooftop Solar PV system?

- **Solar PV Modules/Solar Panels** – The Solar PV Modules/Solar Panels convert solar energy to DC (direct current) electrical energy. They are available in different technologies such as crystalline silicon, thin film silicon, CIGS, CdTe, HIT, etc. Crystalline Silicon Solar PV panels are most commonly used in solar rooftop system. Multiple panels are connected together to form arrays as per the desired capacity of the system.
- **Inverter** – Inverter converts variable DC output of Solar PV Panels into AC power. Inverter also synchronizes with the grid so that generated power from the module can be injected into the grid.
- **Module mounting structure** – The module mounting structure, is the support structure that holds the Solar PV panels in place for full system life and is exposed to all weather conditions. These are normally fixed at a particular angle and orientation in case of solar rooftop system. But these can also be of type that tracks the Sun, called as trackers.

- **Bi-direction Meters** – Meters are used to record the generation or consumption of electricity. Bi-direction (or Net-Meters) are used to keep track of the electricity that solar PV system injects to utility grid and the electricity that is drawn from the utility grid.
- **Balance of System** – These consist of cables, switchboards, junction boxes, earthing system, circuit breaker, fuses, lightning protection system, etc.

### 1.3. How much area is required for a 1 kWp rooftop Solar PV system?

A 1 kWp rooftop system generally requires 10 Sq. meters of shadow-free area. However, actual area requirement may vary depending on the efficiency of solar module and their placement etc.

### 1.4. Why do I need shadow-free area for modules?

Solar modules (and cells within) need uninterrupted sunlight to produce maximum electrical energy. With shadow even on a part of the module, the generation reduces to a great extent thereby wasting installed system capacity. Also, prolonged (regular, though intermittent) shadow on some cells or modules reduces their life substantially and these become useless much before their standard life of over 25 years.

### 1.5. What types of roofs are suitable for Rooftop solar (RTS) system?

Rooftop solar PV systems can be installed on any type of roof having sufficient load bearing capacity.

### 1.6. What is the daily energy generated from a 1 kWp Solar Power Plant?

On a clear sunny day, 1 kWp solar power plant can generate 4 to 5.5 units in a day in Haryana.

### 1.7. Will I get constant / same energy from the RTS all year round?

**No**, the daily energy generation from the RTS shall be dependent on the temperature and solar irradiance among other parameters and these may not be same every day.

### 1.8. What are the factors affecting generation?

- Plant Location
- Quality of equipment used
- No. of sunshine hours
- Workmanship
- PV module tilt angle and orientation
- Module Cleaning
- O&M activities etc.

### 1.9. Will I get same annual energy from the RTS for all 25 years?

**No.** On exposure to sunlight and outside environment, the solar module loses their generation capacity, and this is called degradation.

### 1.10. What are the advantages of Grid-Connected Rooftop Solar System?

- Saving on electricity bill by the consumer.
- Utilization of available vacant roof space, no additional land required.
- Low gestation period.
- No additional requirement of transmission and distribution (T&D) lines.
- Reduces T&D losses as power consumption and generation are collocated.
- Improvement in the tail-end grid voltages and reduction of system congestion.
- Long term energy and ecological security by reduction in carbon emission.
- Better management of daytime peak loads by DISCOM/ utility.
- Meeting of the Renewable Purchase Obligations (RPOs) of obligated entities.

## 2 Cost of system and subsidies

### 2.1 What is the average cost of grid connected rooftop solar systems?

The UHBVN has empanelled a list of vendors and has also fixed cost for different sizes of solar power plants. These are applicable for all residential plants which would like to claim subsidy. The cost fixed by UHBVN covers Design, supply, installation, testing & commissioning including warranty and comprehensive maintenance Contract for 5 years of 1kWp to 500kWp Grid Connected Rooftop Solar system in residential premises and is given as under:

<b>Solar Capacity (kWp)</b>	<b>Price (Rs. /kWp)</b>
1-10	45,780
10-100	41,000
100-500	36,950

The detailed list of empanelled vendors is available on the UHBVN portal:

[https://solarconnection.uhbvn.org.in/empanelled\\_firms.pdf](https://solarconnection.uhbvn.org.in/empanelled_firms.pdf)

MNRE also notifies benchmark cost every year. This can be found on the MNRE website. The link for the latest benchmark price (FY 2020-21) is given below:

[https://www.mnre.gov.in/img/documents/uploads/file\\_f-1595328067505.pdf](https://www.mnre.gov.in/img/documents/uploads/file_f-1595328067505.pdf)

### 2.2 What are the subsidies/capital support available from the Government?

Central financial assistance (or subsidy) is available for residential sector grid connected solar rooftop projects only. For other sectors e.g. Govt., institutional, social, commercial, industrial etc. CFA is not available.

Central Financial Assistance (CFA)\* to Residential sector

- CFA @ 40% of benchmark cost or @40 % of cost fixed by UHBVN (whichever is lower) for capacity up to 3 kWp
- CFA @ 20% of benchmark cost or 20 % of cost fixed by UHBVN (whichever is lower) for capacity beyond 3 kWp and up to 10 kWp
- CFA @ 20% of benchmark cost or @ 20 of cost fixed by UHBVN (whichever

is lower) for GHS/RWA capacity up to 500 kWp (limited to 10 kWp per house and total up to 500 kWp)

For calculation of CFA, the PV plant capacity will be inverter capacity or the PV module capacity, whichever is lower. For availing CFA, the PV module and cell shall be manufactured in India only.

### 2.3 Whether residential consumer has to pay the full cost of the system for residential sector subsidized projects?

**No.** Consumer has to pay to the Empanelled vendor the balance amount after deducting the eligible subsidy/CFA from the project cost fixed by the UHBVN. The subsidy amount will be paid by UHBVN to the Empanelled vendor. The following table illustrates the cost to be paid by consumer for different capacities of Rooftop solar power plant.

<b>Solar Plant Capacity</b>	<b>Total Cost</b>	<b>Subsidy/CFA to be paid by UHBVN</b>	<b>Cost to be paid by Consumer</b>
<i>(kWp)</i>	<i>(INR)</i>	<i>(@40% up to 3kWp and 20% from 3kWp - 10kWp)</i>	<i>(INR)</i>
<b>1</b>	45,780	18,312	27,468
<b>2</b>	91,560	36,624	54,936
<b>3</b>	1,37,340	54,936	82,404
<b>4</b>	1,83,120	64,092	1,19,028
<b>5</b>	2,28,900	73,248	1,55,652
<b>6</b>	2,74,680	82,404	1,92,276
<b>7</b>	3,20,460	91,560	2,28,900
<b>8</b>	3,66,240	1,00,716	2,65,524
<b>9</b>	4,12,020	1,09,872	3,02,148
<b>10</b>	4,57,800	1,19,028	3,38,772

**Note:** The above costs are derived for the solar power plants up to 10 kWp only because subsidy/CFA is available for residential premises up to 10kWp only. The consumers can go for higher solar capacities also, but subsidy/CFA shall be limited to 10kWp only for residential consumers.

Advisory on scheme is also available at

[https://mnre.gov.in/img/documents/uploads/file\\_f-1610949591054.pdf](https://mnre.gov.in/img/documents/uploads/file_f-1610949591054.pdf)

#### **2.4 Can the empanelled vendor demand more than the cost fixed by UHBVN.**

**No.** For subsidized projects, consumers are advised to pay only according to the rates fixed by UHBVN. If any empanelled vendor is charging more price than the rates fixed by UHBVN from domestic consumers, in that case, consumers are advised to inform UHBVN at [cecommercial@uhbvn.org.in](mailto:cecommercial@uhbvn.org.in) or [secommercial@uhbvn.org.in](mailto:secommercial@uhbvn.org.in) so that the UHBVN identify and punish such vendors.

#### **2.5 What if I opt any other vendor that is not empanelled with UHBVN?**

Consumer shall not be eligible for subsidy/CFA. In this case, while applying for net metering connection, consumer shall click on “Others” option in the list of vendors and then write the name of vendor he opted in the designated space.

#### **2.6 Whether MNRE has empanelled any agency for implementation?**

**No.** MNRE is implementing the programme through power distribution companies/DISCOMs of various States. These DISCOMS are responsible for discovery of rates and empanelment of vendors for implementation of the projects.

Consumers can apply online through the portals of these DISCOMS which can be accessed at: [https://solarrooftop.gov.in/grid\\_others/discomPortalLink](https://solarrooftop.gov.in/grid_others/discomPortalLink)

#### **2.7 How should I evaluate vendors offering me RTS? What are the main points of consideration?**

The system price, though important, should never be the only factor for deciding a vendor. Customer should consider at least the following factors:

- Price of the offered system.
- Warranties of system and components.
- Energy generation estimates and guaranties.
- Service backup and arrangements the vendor has in the area.
- Reference installations in the track record of the vendor – along with those customers’ feedback about system performance and service provided by the vendor.

## **2.8 How can I make payment to the Electricity Distribution Company (DISCOM)?**

Since the system is grid connected through net metering, DISCOM will generate bill based upon the reading provided by the net meter installed at the consumer premises. The consumer will have to pay for the net units (total imported units minus exported solar units) only.

## **2.9 Can I make my monthly electricity bill 'zero' by installing RTS?**

This is possible in very rare cases because the consumer shall be required to pay some minimum charges like fixed charges, etc. even if the consumed energy is all self-generated. However, 'electricity charges', a major component of the monthly bill, can be reduced to zero by optimally designing and maintaining the RTS. The monthly electricity bill may come to zero in States which give revenue for surplus power generated.

## **3 Installation of solar rooftop system**

### **3.1 Is there any prescribed application portal?**

Yes. UHBVN has a dedicated online application portal. Interested consumers can apply for SRTPV. Applications for both Net-metering as well as Subsidy approval are processed via this portal. The link for the portal is:

<https://solarconnection.uhbvn.org.in/>

### **3.2 What is the general procedure for installation of Rooftop Solar system for beneficiary?**

The interested beneficiary may install the solar rooftop systems through project developers/system integrators/manufactures etc. empanelled by UHBVN after taking necessary approval from UHBVN within the capacity limit as laid down in the order of Haryana Electricity Regulatory Commission. The procedure for installation of Rooftop solar system is elaborated by UHBVN using a flowchart the link to which is provided below.

<https://solarconnection.uhbvn.org.in/flowchart.pdf>

### **3.3 Whether all consumers are eligible to install solar rooftop systems to avail net metering facility?**

Yes, all the consumers of UHBVN are eligible for net-metering in accordance with the HERC Net Metering Regulations 2019 as amended from time to time.

### **3.4 What is maximum capacity I am eligible to install Solar RTPV systems?**

The maximum rated capacity of rooftop solar system, to be installed by an eligible consumer in his premises, shall not exceed its connected load in case of Low-Tension and contract demand in case of High-Tension electrical connections subject to maximum of 2 MWp.

The minimum rated capacity of rooftop solar system that can be set up under net metering arrangement shall not be less than 1kWp.

Provided further that the eligible consumer is mandatorily to put up 25% battery storage for any incremental capacity from over and above 1MWp and up to 2 MWp. The battery shall be able to store and deliver energy for two hours.

### **3.5 Does Haryana have any notification on mandatory solar installation?**

The State Govt. vide its notification dated 21.03.2016 has mandated installation of solar power plant of minimum 1 kWp or 5% of sanctioned load whichever is higher for categories of all new residential buildings built on a plot size of 500 Square Yards and above. Further details are available at:

[https://uhbvn.org.in/staticContent/documents/circular/SC2016/SC\\_U\\_52\\_2016.pdf](https://uhbvn.org.in/staticContent/documents/circular/SC2016/SC_U_52_2016.pdf)

### **3.6 Can I install Rooftop Solar system if I live in a rented house?**

The RTS under any framework like net or gross metering can be installed by the electricity consumer. So, if you have electricity connection in your name and you pay regularly the electricity bill in your own name and also you have the permission of use the roof for solar rooftop installation from the owner, you can install the RTS.

### **3.7 What kind of system can be installed in Group Housing Society (GHS)?**

With several common rooftops available in a society, there is a great potential for harnessing solar energy through rooftop PV systems. The energy generated from these systems is used to offset the common loads of the society (common lighting, lift, pumps, etc.). A Net Meter shall be provided against, the Single Point Delivery (SPD) common meter of Cooperative Group Housing Society (CGHS). In this, the society ultimately gets benefitted in terms of reduced monthly electricity expenses.

### 3.8 If I shift my residence or office where RTS is installed, what will happen to the RTS?

The system is easy to be dismantled and reassembled elsewhere. So, it can be shifted to your new residence.

### 3.9 Whether solar module should be made of indigenously for subsidised projects?

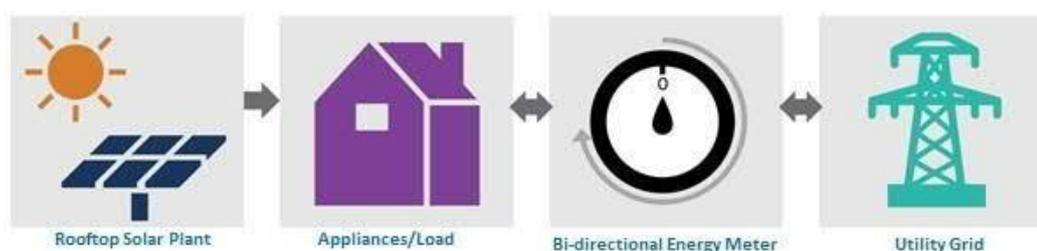
**Yes.** Only indigenously manufactured PV modules with indigenous solar cell can be used in Solar PV systems power plants for **subsidised** sector projects. For reference, as per the ALMM list 10<sup>th</sup> March 2021 Clause 4 IV- *Link:-* ([https://mnre.gov.in/img/documents/uploads/file\\_f-1615380939218.pdf](https://mnre.gov.in/img/documents/uploads/file_f-1615380939218.pdf)).

However, there is **no** such limitation in case the project installed without any subsidy.

## 4 Metering arrangement for solar rooftop

### 4.1 What is net-metering?

All solar PV systems generate power only during daytime when sun is available. In net metered systems, the generated power is utilized for self-consumption, and excess power is exported to the grid as long as grid is available. In case, where solar power is not sufficient due to cloud cover etc., power is drawn from the grid to power the loads. A bi-directional or net meter records the energy flow in both the directions and at the end of billing period net energy used is calculated. The beneficiary has to pay for only the net energy used.



### 4.2 What is Gross Metering?

In gross metering, the power generated from the Rooftop Solar plant is only fed to the grid. The system owner gets paid by the DISCOM for such exported power at a pre-decided tariff.

### 4.3 What is Net billing?

Connections in net billing RTS are similar to net metering. However, at the end of the billing cycle (normally a month) any excess energy in the grid shall not be carried forward like in net metering but shall be purchased by the DISCOM as per pre-decided tariff. Therefore, energy banking in the grid is only within a billing cycle.

### 4.4 Can the RTS be installed for only captive use without being connected to Grid?

**Yes**, the plants which are not connected to the grid are normally called behind the meter plants and MNRE subsidy is not available for such plants even for residential sector. However, it is required to follow rules and regulations specified for this purpose by the state authorities.

## 5 Business model for solar rooftop system

### 5.1 What are the models for implementation of Rooftop PV systems?

**CAPEX Model:** Here, the system is owned by the consumer himself and he bears the cost of the system.

**RESCO Model:** Here, the entire system is owned by the 3<sup>rd</sup> party project developer. The consumer only purchases the generated energy by paying pre-decided tariff on a monthly basis as per Power Purchase Agreement (PPA). Responsibility of O&M for the system lifetime (25 years) is also with the developer.

### 5.2 What is the payback for solar rooftop using various business models?

A simple payback period can be calculated by using rooftop calculator available at following web link: [https://solarrooftop.gov.in/rooftop\\_calculator](https://solarrooftop.gov.in/rooftop_calculator)

## 6 Operation and maintenance of solar plant

### 6.1 What is the minimum warranty period envisaged under the scheme?

Solar PV modules used in solar power plants /systems shall be warranted for its performance for a minimum period of 25 years from the date of commissioning of the project. The PV modules must be warranted for their output peak watt capacity, which should not be less than 90% at the end of Ten (10) years and 80% at the end of Twenty-five (25) years.

The mechanical structures, electrical works including power conditioners/inverters/charge controllers/maximum power point tracker units/distribution boards/digital meters/switch gear/storage batteries, etc. and overall workmanship of the SPV power plants/systems must be warranted against any manufacturing/design/ installation defects for a minimum period of 5 years.

### 6.2 What are the O&M aspects of a grid-connected rooftop solar PV system?

Compared to most other power generating technologies, solar PV systems have very low maintenance and servicing requirements. However, suitable maintenance of a PV plant is essential to optimise energy yield and maximize the life of the system.

Some of the maintenance activities typically may include but not limited to the following:

- Module cleaning is required periodically (dust, bird droppings and other debris can cause decrease in power generation). Periodicity depends on local conditions like dust, birds, air pollution, etc.
- Other items should be checked periodically as stated below:
  - *Checking module connection integrity,*
  - *Checking junction boxes/string combiner boxes,*
  - *Inspecting mechanical integrity of mounting structures,*
  - *Tightening cable connections that have loosened and*
  - *Replacing blown fuses,*
  - *Repairing lightning damage,*
  - *Repairing equipment damaged by intruders or during module cleaning.*

### **6.3 There is presence of monkeys in our area. Would they be damaging the RTS?**

The solar modules are made up of toughened or tempered glass top and so are not easily broken due to monkeys or any falling objects. These can be broken if deliberately someone throws stones. Guarding of module surface with wire mesh is one solution for monkey menace, but not recommended because this regularly casts shadow on the modules.

## **7 General information about solar rooftop**

### **7.1 What is the gross potential of solar power in the country?**

India is endowed with vast solar energy potential. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 3-5 kWh per sq. m per day. Based upon the availability of land and solar radiation, the potential of solar power in the country has been assessed to be around 750 GW.

### **7.2 What is the potential for rooftop solar power in the country?**

National Institute of Solar Energy (NISE), An Autonomous Institute under the Ministry of New and Renewable Energy has estimated a potential of 43 GW for Grid Connected RTS in the country.

### **7.3 What targets has the Government kept for installation of Rooftop Solar Plants in the country?**

Government of India has set the target of installing 40,000 MW of Rooftop Solar (RTS) Power by the year 2022. State-wise tentative targets are available in the website link ([State-wise-and-year-wise-target-for-installation-of-40000MWp-GCRT-systems\\_0.pdf](#) )

### **7.4 What is the State wise breakup of sanctioned capacity under the Phase-II RTS scheme?**

The details on capacity sanctioned under Phase-II of RTS scheme can be seen on the following link:

[https://solarrooftop.gov.in/grid\\_others/phase2SanctionList](https://solarrooftop.gov.in/grid_others/phase2SanctionList)

### 7.5 Which are the States that have Net-metering regulations?

Electricity Regulatory Commissions have notified the regulations for all States /UTs. Amendments, if any, may kindly be seen at the websites of the respective State Electricity Regulatory Commission/Joint Electricity Regulatory Commission.

### 7.6 Approved List of Models and Manufacturers of Solar Photovoltaic Module:

Approved List Models and Manufacturers of Solar Photovoltaic Module (ALMM) is available at [https://mnre.gov.in/img/documents/uploads/file\\_f-1615380939218.pdf](https://mnre.gov.in/img/documents/uploads/file_f-1615380939218.pdf) .

However, ALMM order in respect of List I (Modules) shall be applicable on all such bids whose last date of bid submission is on or after 10.04.2021

### 7.7 Want to know more details on rooftop solar for knowledge purpose?

**Yes.** Ministry of New and Renewable Energy has created a knowledge portal for knowledge dissemination among the Consumers/DISCOM Officials/Bankers/SERCs etc., which can be accessed by using the URL: [https://solarrooftop.gov.in/grid\\_others/knowledge](https://solarrooftop.gov.in/grid_others/knowledge)

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