

AN EMERGING REVOLUTION IN INDIAN SOLAR ECO- SYSTEM: NET METERING

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ABSTRACT

The Indian solar PV market has seen significant growth with the installed solar PV capacity rising from under 40 MW to more than 2,000 MW in the last four years. The total installation capacity of solar power generation is expected to be 12,500 MW by 2016-17, whereas only roof top solar generation is estimated to be 4,000 MW by 2016- 17. It is also expected that distributed generation (rooftop SPV) at the consumer end will drive solar power capacity additions given the acute power shortage scenario in several states along with associated transmission and distribution losses. Globally, PV installed capacity has reached more than 100 GW in 2013. Countries with large capacities in PV installations are Germany, Italy, Japan, USA, China, Spain and Australia. In these countries rooftop SPV installation has major contribution in the total installation. Net metering is a new concept where an instrument which has a special metering and billing agreement between utilities and their customers, facilitates the connection of small, renewable energy-generating systems to the power grid. This new program is being developed to encourage small scale renewable energy systems to ensure that customers always have a reliable source of energy even when their renewable generators are not producing energy, and to provide substantial benefits to the electric power-generating system as well as the environment.

Keywords: *Rooftop SPV, Power Grid, Renewable Energy etc.*

I. INTRODUCTION

Solar powered systems can be categorized in two:

- Grid connected solar power system.
- Stand alone off grid system.

A grid connected system as the name suggests is the one in which your solar power system is connected to the local main grid. In this case, your loads can run on solar power as long as there is sufficient energy available from the sun during the day. Any deficit is taken care by the main utility supply. However, if the solar energy production is in excess as compared to the load requirement at that moment, the excess energy can be either stored in the batteries (if available) or can be sold back to the utility grid. This difference of energy can be tracked using a meter connected to your solar PV system.

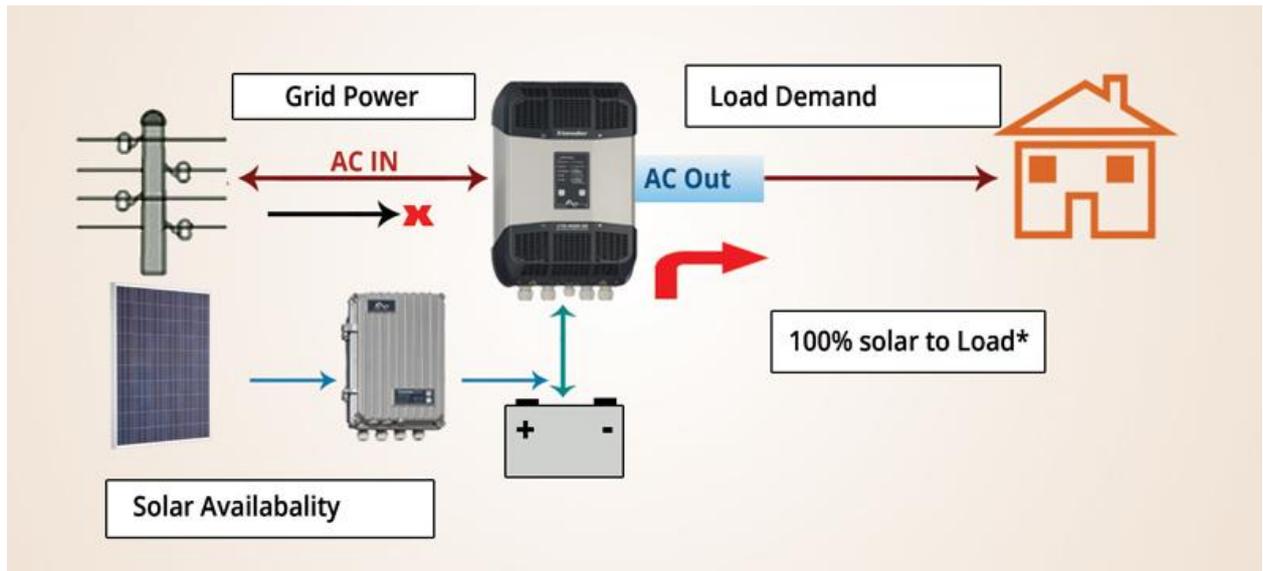


Fig.1 Working of a hybrid solar PV System

When a net metering client’s renewable generator is producing more power than is being consumed, the electric meter runs backward generating credits. Whenever the net metering customer uses more power than is being produced, the meter runs forward normally. Net metering customers are charged only for the net power that they consume from the electricity service provider that has accumulated over a specific period. In other words, if their renewable energy generating systems make more electricity than is consumed, they may be credited or paid for the excess electricity contributed to the grid over that same period. Net metering is also a way to increase the energy in the power grid to keep up with increase in demand during peak power use times, and this is of particular interest to states facing power shortages.

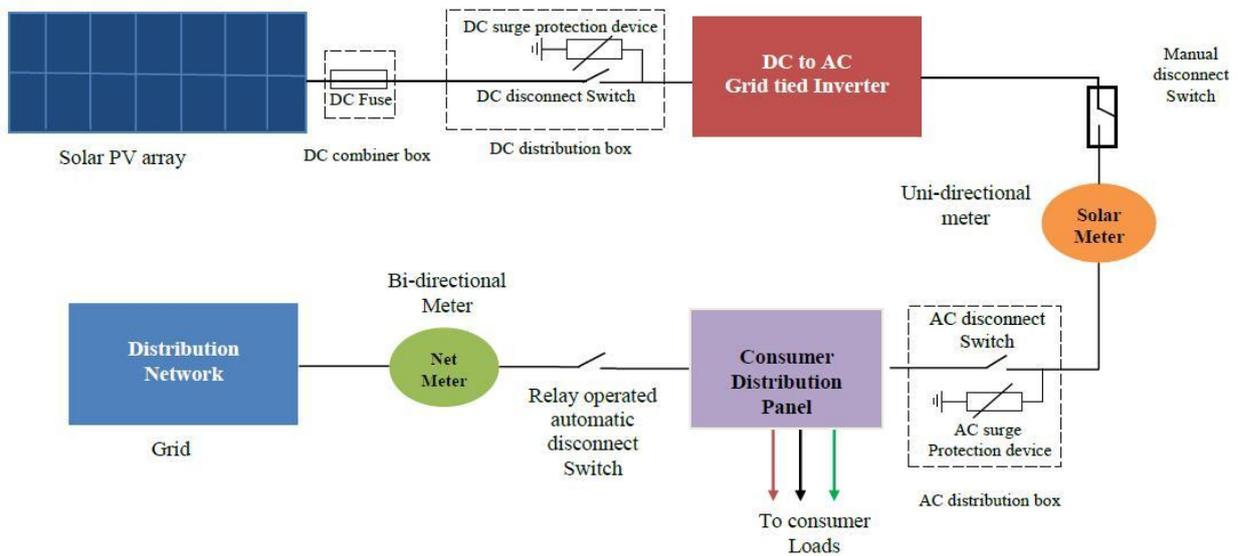


Fig.2 How NET Metering Works?

II. DIFFERENT METERING ARRANGEMENTS

The rooftop SPV system can be installed in two configurations, namely (a) as a standalone system or (b) as a grid interactive system. In urban areas the grid interactive system is more feasible than the standalone system as almost all locations are connected by grid and also grid act as storage for an intermittent source of generation. In the grid interactive system also there can be a number of schemes depending on the reliability of supply to the loads and the consumer needs. Wherever the battery is not envisaged, the solar system can be directly connected to consumer AC bus and the total energy of the solar system will be supplied to consumer/grid depending upon the requirement of the consumers.

2.1 Gross Metering

Gross metering arrangement doesn't affect consumer's existing electrical connections. Electricity generated from rooftop SPV system is directly fed to the grid and consumers get electricity supply from the utility grid. There are two separate energy meters to read solar energy generation and the consumer's electricity consumption from the utility grid.

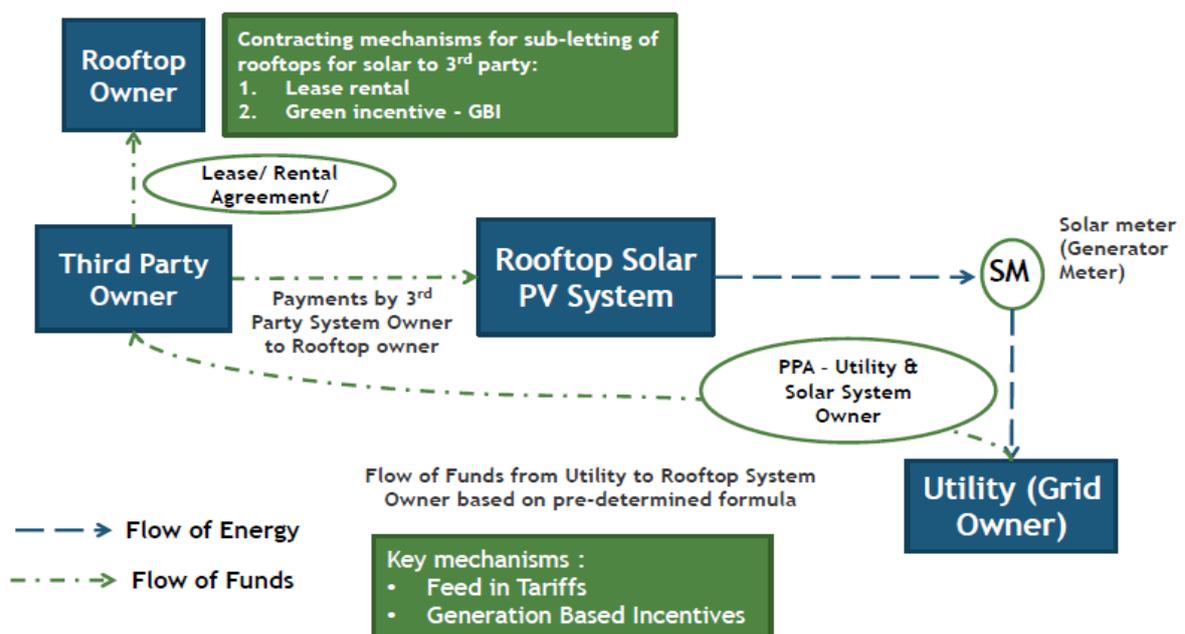


Fig .3 Gross Metering

2.2 Net Metering

Net metering arrangement allows consumers to use solar electricity for meeting end use loads. In this case simple energy meter is replaced by a bidirectional meter. The flow of energy in a grid interactive rooftop SPV system under different operating conditions is given below:

- . AC electrical output of inverter consumed by loads or AC current is fed back to grid
- . For generation > consumption, |PV-Load|= Net Export
- . For generation < Consumption, |PV-Load|=Net Import
- . Feed-in-Tariff (Fit) paid to customer based on Net Export

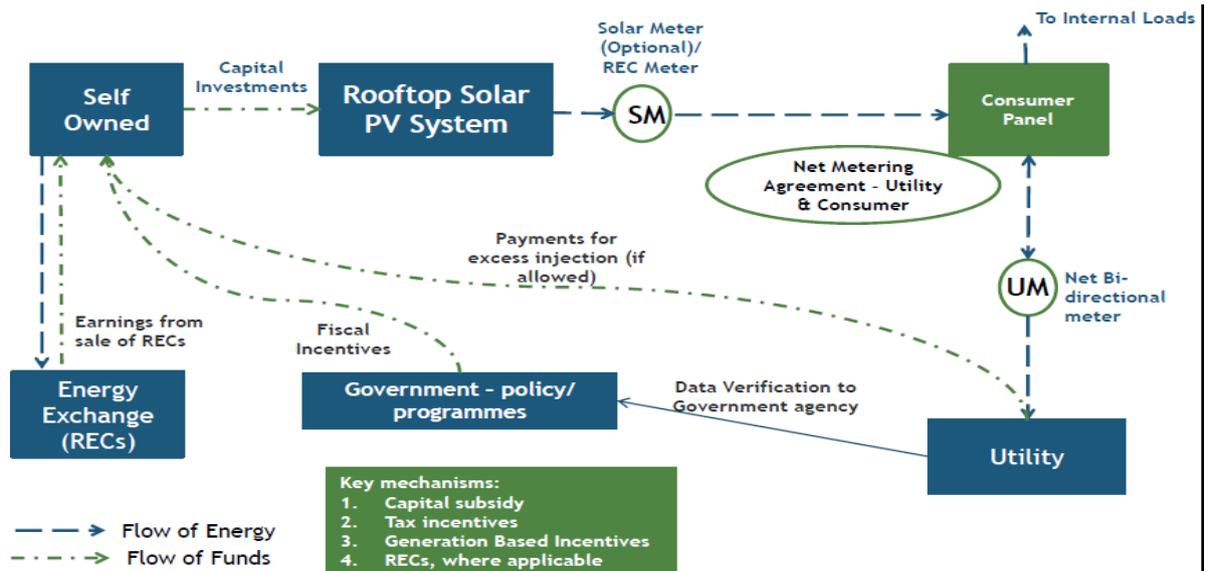


Fig.4 Net Metering

III.WHAT IS NET METERING?

Net metering is an agreement that allows the solar PV system owner to sell excess solar energy to the utility company or buy deficit energy from the utility company using a meter to track this energy exchange. Following two cases take place in this scenario:

Case 1: If at any moment of time, if solar energy generation (kWh) is less than the load requirement at that time, the difference of energy is taken from the main grid and the meter runs forward, as usual. In this case, the system owner is charged for the units (kWh) consumed from the main grid. Eg. During early morning or during late evening/night.

Case 2: If at any moment of time, if solar energy generation (kWh) is more than the load requirement at that time, the excess solar energy is fed back to the main grid and the meter now runs backward. In this case, the system owner gets credit for the units (kWh) fed back to the main grid. Eg. During peak sunshine hours (afternoon)



Fig.5 Net Metering [When you generate extra electricity (more than what you can use)]

3.1 Thus, at the end of the billing period:

If case 1 > case 2, then the owner is charged for the difference of units as per usual retail tariff

If case 1 < case 2, then the difference of units is either carried forward to the next billing period or the owner is paid for the difference of units as per the tariff decided by the concerned utility.

(kindly refer your state policy/utility company policy for more information about tariff)

In short, the owner pays/gains for the 'net' energy used over the designated period of time.

3.2 Meters Used in Net Metering

The use of meters in this case differs from State to State. Some states may require only one meter that reads the 'net' energy consumed by the system owner. However, few other states may require two meters – one to measure solar energy generation and the second to measure the units consumed from the utility grid.

IV. RECENT DEVELOPMENT

The Ministry of New and Renewable Energy (MNRE) undertook a national consultation on net metering for grid-tied PV projects, where officials from central ministries, secretaries of state regulatory commissions and officials from state power departments and distribution companies came together to prepare an action plan with practical solutions for the introduction of net metering. The Ministry has also planned a project which can be tried on a pilot basis in a few cities in India. The MNRE is trying to collaborate with companies, the municipalities and the state governments to agree to this project. The groundwork and seeking consent from the building owners has to be done either by the municipal body or by the distribution company or by any other state government agencies. There will be no extra burden on the distribution company if capital subsidy is provided. Using the net metering system will ensure that the house owner gets assured power supply during the day and this will get cheaper over the long period.

Although net metering system is a new concept in India, this programme is successfully working in countries like Australia, Canada, Italy, Spain, Denmark and United States. In 2002, Thailand was the first country to initiate the first net metering policy in the developing world. The Very Small Power Producer (VSPP)

regulations were aimed at encouraging the use of small scale renewable generation almost under 1 MW. The Thailand Government mandates the purchase of any surplus electricity generated through renewables at rates which are adjusted every three months. The VSPP programme covers production from a variety of sources including Solar Photovoltaic (SPV) and bio-energy. The initial legislation was extended in 2006 and now includes mandates on the purchase of electricity derived from production of up to 10 MW.

Another successful use of the net metering system may be seen in Canada, which started in 2006. The first net metering site for demonstration was chosen in the rural community of Knowlesville near Hartland in 2004. Now Canada has adopted the net metering system and it is available for all. California, US, is also using the net metering systems successfully. Residents of California also have the option to live off-grid and use renewable energy as stand-alone systems instead of incurring expenses for long distance wire connections. Other residents have the additional opportunity to install their own systems that are linked to the grid through net-metering which is also known as grid-intertied.

V. ADVANTAGES OF NET METERING

5.1 The 3 most important advantages of net metering are

- 1. Financial benefit for the system owner**→Since the system owner is charged for the net energy consumed from the utility grid, the owner gets financial benefits. Eg. If energy generation < energy consumed: owner pays just for the net amount. If energy generation > energy consumed: the owner gets credit for excess generation.
- 2. Avoid the use of batteries**→In a grid connected solar pv system, any excess energy generated can be fed back to local utility grid and can be taken back at later stage when required. Thus, there is no need to store the surplus energy in batteries for later use, thus, avoiding the heavy costs of batteries. Also, since batteries are eliminated, the maintenance costs of the system also reduce to a great extent. Batteries may be required only when there are frequent power fluctuations/outages. (please note, in a batteryless grid connected system, if there is an power outage and the grid fails, your solar power system has to stop generating power to ensure safety of the wiremen working on the failed gridlines.)
- 3. Produce more today, use that tomorrow**→Typically, a solar power system produces more energy in summer and comparatively less energy in winter. Eg. If in summer, solar power generates 100 units and load requirement is 80 units, then 20 units can be fed back to the grid. In winter, solar power generates only 60 units and load requirement is 80 units, then 20 units can be taken from the grid. Thus, overall excess generation from solar power system is taken care of and net units consumed from the grid becomes zero.

VI.NET METERING IN VARIOUS STATES ACROSS INDIA

There are a few states in India that have implemented Net Metering policy. Some of them are: Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal and Uttarakhand. Many more states are in process of setting up their policies in India, this concept could be an important incentive for consumer investment in onsite renewable energy generation and also a motivating factor for consumers to utilize renewable energy. The Karnataka Renewable Energy Development Ltd (KREDL) has stated that Karnataka is poised to develop the concept. The West Bengal Renewable Energy Development Agency (WBREDA) has put a 25 kW Grid Interactive Roof Top

SPV Power Plant in place, where the net metering concept has been adopted and a MoU has been signed with the State Electricity Board. The Rajasthan Renewable Energy Cooperation Ltd. (RRECL) is planning to start an Urban Development and Housing Project (UDH) where the net metering system will be used as also the Renewable Energy Agency of Puducherry (REAP). The concept is new and innovative and provides low cost and easily administered methods for encouraging customers to invest in renewable energy technologies. Adopting this technology will herald a new era for India and create an interface that can significantly reduce the rising carbon footprint of the nation.

VII. PERSPECTIVES AND WAY AHEAD

The biggest pulling factor for installation of net-metering systems is the opportunity of reducing electricity charges applicable to the consumer. This feature attains considerable significance in the case of commercial and upper-end domestic consumers who get to step down the electricity tariff applicable to them. Ironically this is also the single biggest pain-point for distribution companies who rely on the tariff arbitrage to cross-subsidize power for rural and low consumption groups. However, taking into account the fact that the additional capacity addition comes at relatively minimal capital spend by the discoms, at the point of consumption and that the power generated can be set off in their RPOs, it seems like the growth of net-metering systems will be unconstrained in the long run. The new government has proclaimed its ambition to address the massive electrification problems in the country through solar programs and bring solar power to every home before 2019. Consequentially, it is safe to assume that the concept of net-metering systems is a significant step towards realization of the goal and we can expect several constructive additions to the policies around them. As a rule of thumb indicator, the extremely quick adoption of the net-metering concept for rooftops throughout 2015-16 by various state governments is a positive sign of things to come in this direction.

REFERENCES

- [1]. <http://www1.eere.energy.gov/solar/pdfs/31687.pdf>
- [2]. <http://www.forumofregulators.gov.in/Data/HomePage/Report.pdf>
- [3]. <http://www1.eere.energy.gov/solar/pdfs/31687.pdf>
- [4]. <http://www.solarcity.com/learn/understanding-netmetering.aspx>