

# Net Energy Metering of Solar Power Generation Systems - A Review

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**Abstract**— Renewable vitality is being seen as a transformative answer for meet vitality and also monetary difficulties, both comprehensively and broadly. There is an expanding concentrate on the improvement of sun oriented vitality in India for an assortment of reasons, including our constrained customary vitality holds, their nearby natural and social effects, vitality security issues, vitality access, and handling the test of environmental change. Sun based photovoltaic (PV) innovation, specifically, is developing as a to a great degree alluring choice, especially with richly accessible sun based assets, measured innovation and zero fuel costs more than 25-30 years of the venture life. This paper exhibits a review on the framework associated sun powered rooftop top photovoltaic frameworks and the net metering of generated vitality which highlights a situation sympathetic point of view.

**Index Terms**— Solar roof top Systems, Grid connected, Net Energy Metering

## I. INTRODUCTION

Indian power sector is confronting phenomenal difficulties with the developing economy; a quick increment in power demand on one hand and supply limitations and expanding expenses of fuels, for example, coal and common gas utilized for force generation combined with developing worries about environmental change and greenhouse gas emanations from the utilization of fossil fills on other. The accessibility of vitality is restricted and known assets of vitality are debilitating quick. Keeping in mind the end goal to ration the accessible assets, it is vital to concentrate on vitality preservation perspectives. With a specific end goal to ration accessible assets, there is a need to move towards renewable vitality.

India is blessed with inconceivable sun based vitality potential. Around 5,000 trillion kWh every year vitality is occurrence over India's territory region with most parts accepting 4-7 kWh per sq.m every day. Consequently both innovation courses for transformation of sun oriented radiation into heat and power, in particular, sun thermal and solar photovoltaic, can adequately be saddled giving tremendous versatility to solar in India. Solar oriented likewise gives the capacity to produce power on a circulated premise and empowers fast limit expansion with short lead times. Considering this, the Government of India has communicated its expectation to accomplish 100 GW of sunlight based limit in the nation by 2020, of which 40 GW is required to be accomplished through decentralized and rooftop solar oriented tasks. Rooftop mounted sunlight based PV frameworks which has inalienable favorable circumstances can assume an essential part in expanding the power generation capacity.

## II. SOLAR PHOTOVOLTAIC POWER GENERATION

PV innovation produces power straightforwardly from electrons liberated by the cooperation of daylight with a solar panel made of semiconductor material. The generated power is direct current (DC) power. The basic building block is known as a Solar cell. Numerous cells set up together are known as a module, and numerous modules gathered together shape a cluster. A PV framework is comprised of various parts. These incorporate PV modules (gatherings of PV cells), which are normally called PV panels; one or more batteries; a charge controller or controller for a stand-alone framework; an inverter for an utility network associated framework and while alternating current (ac) as opposed to direct current (dc) is required; wiring; and mounting equipment or a structure.

### System Components

A grid-connected solar PV system consists of the following main components:

- Solar PV (photo-voltaic) array
- Solar PV array support structure
- Solar grid inverter
- Protection devices– Cables

### TYPES OF SOLAR PV SYSTEMS

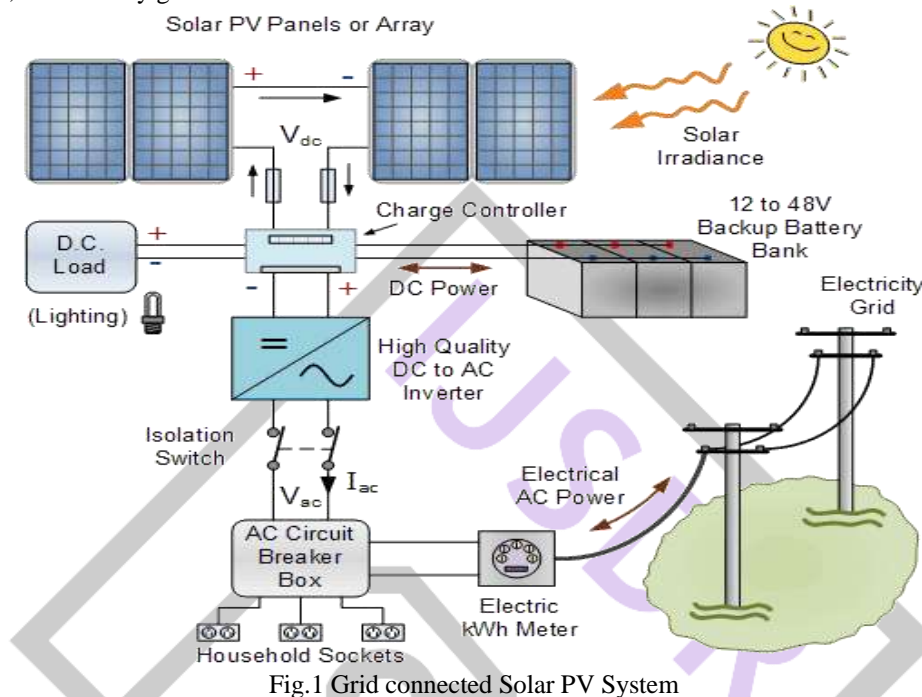
There are basically two solar PV systems:

1. Stand-alone solar PV systems - work with batteries. The solar energy is stored in the battery and used to feed building loads after conversion from DC to AC power with a stand-alone inverter. These systems are generally used in remote areas without grid supply or with unreliable grid supply. The disadvantage of these systems is that the batteries require replacement once in every 3 – 5 years.

- Grid-connected solar PV systems - feed solar energy directly into the building loads without battery storage. Surplus energy, if any, is exported to the grid and shortfall, if any, is imported from the grid.

### III. GRID CONNECTED SOLAR PV SYSTEMS

A grid-connected photovoltaic power system or grid-connected PV system is electricity generating solar PV system that is connected to the utility grid. A grid-connected PV system consists of solar panels, one or several inverters, a power conditioning unit and grid connection equipment. They range from small residential and commercial rooftop systems to large utility-scale solar power stations. Unlike stand-alone power systems, a grid-connected system rarely includes an integrated battery solution, as they are still very expensive. When conditions are right, the grid-connected PV system supplies the excess power, beyond consumption by the connected load, to the utility grid.



#### A. Operation

Residential, grid-connected rooftop systems which have a capacity more than 10 kilowatts can meet the load of most consumers. They can feed excess power to the grid where it is consumed by other users. The feedback is done through a meter to monitor power transferred. Photovoltaic wattage may be less than average consumption, in which case the consumer will continue to purchase grid energy, but a lesser amount than previously. If photovoltaic wattage substantially exceeds average consumption, the energy produced by the panels will be much in excess of the demand. In this case, the excess power can yield revenue by selling it to the grid. Depending on their agreement with their local grid energy company, the consumer only needs to pay the cost of electricity consumed less the value of electricity generated. This will be a negative number if more electricity is generated than consumed. Additionally, in some cases, cash incentives are paid from the grid operator to the consumer.

Connection of the photovoltaic power system can be done only through an interconnection agreement between the consumer and the utility company. The agreement details the various safety standards to be followed during the connection.

#### B. Features

Solar energy gathered by photovoltaic solar panels, intended for delivery to a power grid, must be conditioned, or processed for use, by a grid-connected inverter. Fundamentally, an inverter changes the DC input voltage from the PV to AC voltage for the grid. This inverter sits between the solar array and the grid, draws energy from each, and may be a large stand-alone unit or may be a collection of small inverters, each physically attached to individual solar panels. See AC Module. The inverter must monitor grid voltage, waveform, and frequency. One reason for monitoring is if the grid is dead or strays too far out of its nominal specifications, the inverter must not pass along any solar energy. An inverter connected to a malfunctioning power line will automatically disconnect in accordance with safety rules. Another reason for the inverter monitoring the grid is because for normal operation the inverter must synchronize with the grid waveform, and produce a voltage slightly higher than the grid itself, in order for energy to smoothly flow outward from the solar array.

### C. Advantages

1. Systems such as Net Metering and Feed-in Tariff which are offered by some system operators can offset a customer's electricity usage costs. In some locations though, grid technologies cannot cope with distributed generation feeding into the grid, so the export of surplus electricity is not possible and that surplus is earthed.
2. Grid-connected PV systems are comparatively easier to install as they do not require a battery system.
3. Grid interconnection of photovoltaic (PV) power generation systems has the advantage of effective utilization of generated power because there are no storage losses involved.
4. A photovoltaic power system is carbon negative over its lifespan, as any energy produced over and above that to build the panel initially offsets the need for burning fossil fuels. Even though the sun doesn't always shine, any installation gives a reasonably predictable average reduction in carbon consumption.
5. The roof-top solar PV systems are easy to install and maintain, have long life of 25 years and are modular in nature, capacity can be enhanced in future to meet increased requirement of electricity.

### IV. NET METERING

"Net metering" means an arrangement for measurement of energy in a system under which rooftop solar PV system installed at eligible consumer premises delivers surplus electricity, if any, to the Distribution Licensee after off-setting the electricity supplied by Distribution Licensee during the applicable billing period.

Net-meter (bi-directional meter) is having provision to record energy imported from the grid to meet the load and energy exported to the grid after self-consumption. Both energy imported and exported records in the net-meter. The difference between Export and Import readings is the actual energy consumed/delivered. The net meter records surplus energy exported to DISCOM grid. When system generates less energy than consuming load, the meter records energy imported from DISCOM grid.

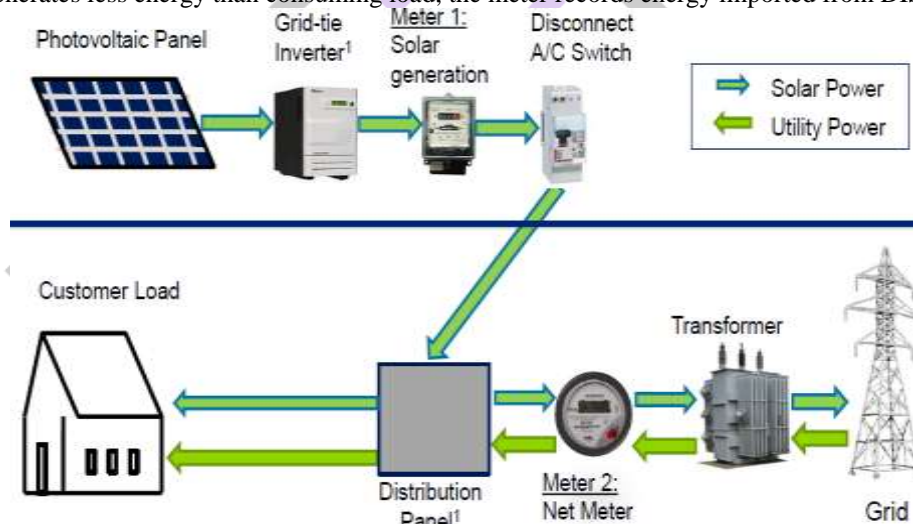


Fig.2 Net Metered Roof Top solar

### Benefits of NEM

- Most important benefit is that excess power generated can be injected from the panels to the grid.
- Net meters also provide information on energy saved by the system.
- It calculates 'power credits' on power injected into the grid.
- It encourages us to save power using 'Time of Use' and other unique features present in modern net-meters.
- It reduces the pressure on the grid.
- Power can be also provided to neighboring homes.
- It reduces transmission losses.
- It makes the user more conscious of energy usage.

### V. GROSS METERING

Gross Metering" means the arrangement of measurement of energy in a system under which entire energy generated from rooftop solar PV system installed at eligible consumer premises is delivered to the distribution system of the Licensee.

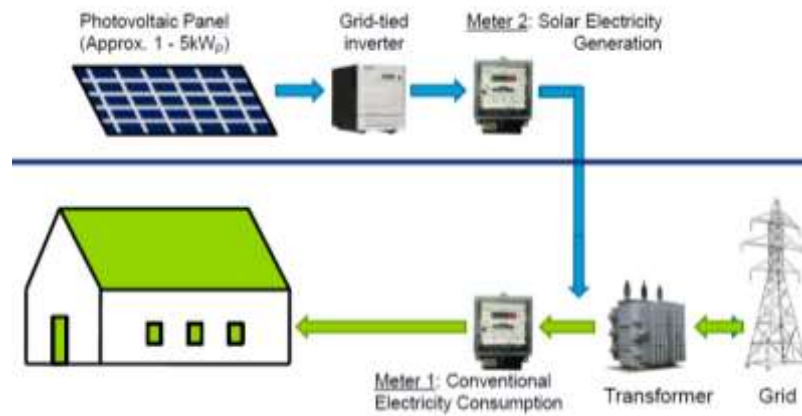


Fig.3 Gross Metered Roof Top System

## VI. CONCLUSION

This paper concludes that solar based photovoltaic, can viably be bridled giving tremendous versatility to sun powered. Solar oriented additionally gives the capacity to produce power on a dispersed premise and empowers quick limit option with short lead times. From a vitality security point of view, solar is the most secure of all sources, since it is bounteously accessible. As there is no emanation of carbon di-oxide and whatever other destructive particles into air, it is ecological cordial furthermore eco-accommodating. In this way lessens a dangerous atmospheric deviation and consequently efficient power vitality.

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