SOLAR ROOFTOP: OPPORTUNITIES AND CHALLENGES

Renewable energy is being seen as a transformative solution to meet growing energy needs, both globally and nationally. India ranks amongst the highest recipients of solar irradiation in the world with average solar irradiation of 5.10 kWh/m^2. Given the high amount of solar irradiation with more than 300 sunny days, solar energy has emerged as a preferred choice to meet the country's increasing energy requirements. There has been increasing focus on development of solar energy in India for reasons such as limited and depleting reserves of conventional energy generating fossil fuels, their impact on environment as well as on economy, apart from issues of high losses in transmission and distribution and need for a diversified basket of energy generation sources. In recent years, particularly with the adoption of the National Action Plan on Climate Change (NAPCC), the Jawaharlal Nehru National Solar Mission (JNNSM), and solar policies by several states, India has taken several steps towards increasing the share of renewable energy in its energy mix. The Government of India has announced a target of 100 GW of solar energy generation capacity by 2022 out of which 40 GW is expected to be achieved through decentralized and rooftop scale solar projects.

SOLAR PHOTOVOLTAIC (SPV) ROOFTOP SYSTEM – INTRODUCTION

An SPV rooftop system consists of solar panels installed on the roof of any residential, commercial, institutional and industrial buildings for generation of electricity. There can be two types of SPV rooftop systems: (i) SPV rooftop system with storage facility and (ii) Grid connected SPV rooftop system.

- **SPV rooftop system with storage facility:** Such rooftop systems use a battery for storage of power. This can be utilized even during night when the sun is not available.
- **Grid connected SPV rooftop system:** In a grid connected rooftop system, the DC power generated from SPV panel is converted to AC power using power conditioning unit and it is fed to the grid. These systems generate power during the day time which is utilized fully for powering captive loads and excess power is fed to the grid. In case solar power is not sufficient due to reasons like cloud cover, the captive loads are served by drawing power from the grid. The grid connected SPV rooftop systems can work on net-metering basis or gross metering.

In a net-metering basis system, surplus power generated after captive consumption is transferred to the grid at a pre-determined tariff. In a Gross metering system, the government offers a tariff for purchase of the entire solar power generated from such plants. However, unit cost of electricity generated from such SPV rooftop systems will be higher compared to large scale projects and hence power purchase from small plants might not be preferred by utilities for fulfilling their renewable power purchase obligations.

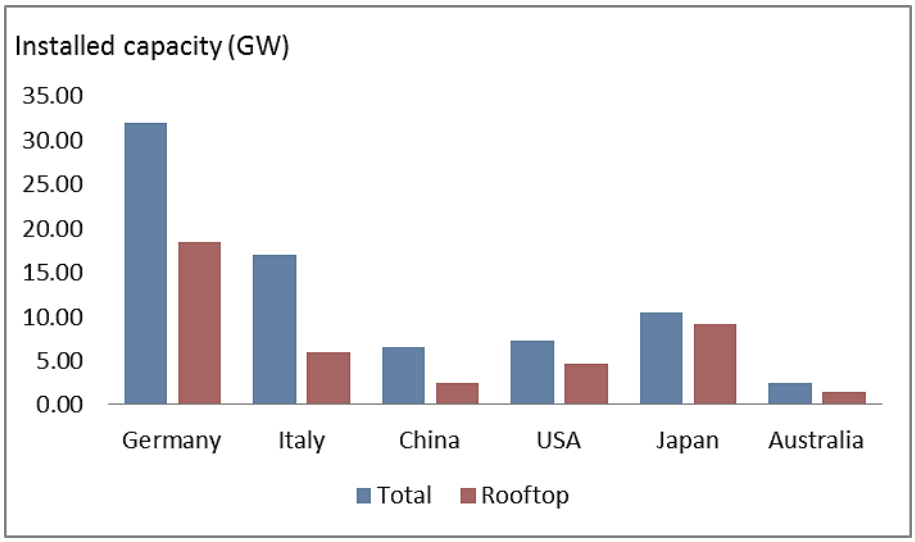
ADVANTAGES OF AN SPV ROOFTOP SYSTEM

- Savings in transmission and distribution loss for power not fed into the grid.
- No requirement of additional land for setting up the solar system
- Self-consumption may result in reduction of system congestion
- Local employment generation
- No storage losses leading to effective utilization of power

GROWTH DRIVERS FOR SPV ROOFTOP SYSTEMS GLOBALLY AND ITS PROSPECTS IN INDIA

The global PV installed capacity reached more than 100GW till 2013 with large capacities of PV installations in countries like Australia, China, Germany, Italy, Japan, Spain and USA. Major SPV installations in countries like Germany, Japan and USA have been on rooftops. As depicted in the graph below, for the six countries with leading PV installations, rooftop installation forms about 56% of the total PV installation.

[SPV installed capacity till March 2013]



Source: The Energy and Resources Institute (TERI)

SPV rooftop installations in these countries have been driven by incentives offered through various schemes leading to faster parity compared with conventional power tariffs which facilitated growth.

[Support schemes for SPV rooftop systems in various countries]

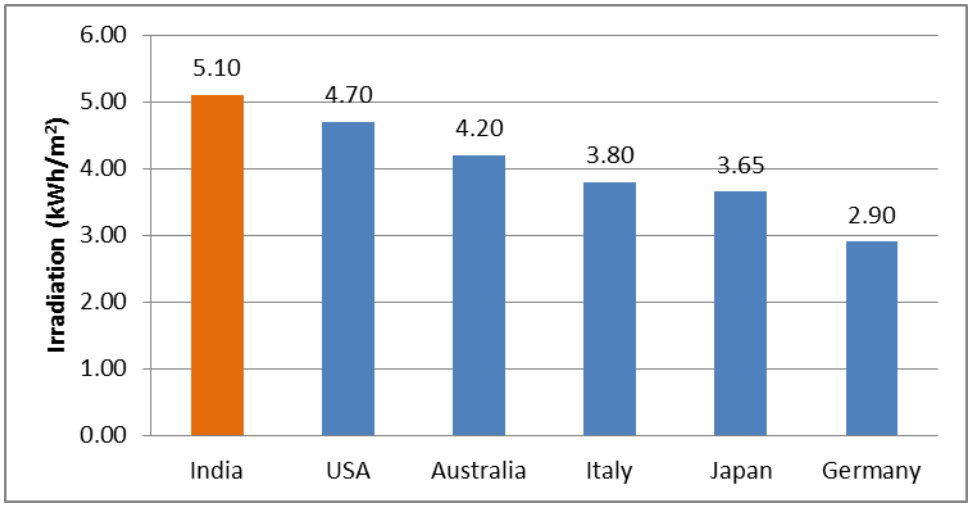
Nature of Schemes	Germany	Italy	USA	Japan	Australia	India
Direct capital subsidy	√	√	√	√		√
Renewable Purchase Obligations (RPO)	√		√	√	√	√
Solar specific RPOs			√			√
Financing scheme	√		√	√	√	√
Tax credits/ tax benefits	√	√	√	√	√	√
Net-metering/net-billing	√	√	√	√	√	√

Source: The Energy and Resources Institute (TERI)

Feed in Tariff (FiT) and capital subsidies have been the dominant schemes offered by various countries. While the FiT scheme facilitated growth of SPV rooftop systems in Germany and Japan, SPV market of USA witnessed accelerated growth largely on account of tax credits and rebates. The Indian SPV rooftop market is relatively at a nascent stage with just under 300 MW of installed capacity till the end of 2014 against targeted installed capacity of 40 GW by 2022.

India has advantage in terms of higher solar irradiation compared to these countries. As per report published by the Ministry of New and Renewable Energy (MNRE), the residential segment in India has a potential for 25,000 MW of SPV rooftop systems considering average rooftop system of 1-3 kW capacity. If we include commercial buildings, shopping complexes and offices, it can further translate in to huge potential for SPV rooftop systems in India.

[Country wise solar irradiation data]



Source: Compiled by CARE

The Government of India launched JNNSM in 2010 to promote solar energy in India and Phase I (2010-13) of it was largely focused on large-scale grid connected solar power projects. But, India has lagged behind in the deployment of SPV rooftop system due to lack of distinct policy framework and infrastructure support to address requirement of small scale decentralized SPV rooftop systems. Subsequently, the Government of India has also recognized the importance to promote SPV rooftop system in Phase II of JNNSM and various states have also announced policy to encourage installation of SPV rooftop systems as discussed in subsequent sections.

CENTRAL GOVERMENT &STATE GOVERNMENT POLICIES

The Government of India initiated JNNSM under the purview of NAPCC with an objective to promote ecologically sustainable growth and at the same time address the country's energy security challenges. Phase I (2010-2013) of JNNSM focused largely on ground-mounted grid connected solar projects where as under phase II (2013-2017), government has put emphasis on off-grid and decentralized solar applications with an

objective to promote grid connected SPV rooftop and small SPV power generating plants among residential, community, institutional, industrial and commercial establishments. Government aims to achieve a target of 40 GW of solar power from SPV rooftop system out of the total expected target of 100 GW solar capacity by 2022, and the final guidelines are being worked out.

The Ministry of Finance has issued an advisory to all public sector banks to encourage home loan/ home improvement loan seekers to install SPV rooftop systems and include the cost of such equipment in their home loan proposals. Eight public sector banks have already issued instructions to its branches for the same.

Salient features of MNRE scheme for off-grid & decentralized solar applications

- Central Financial Assistance (CFA) up to 15% of the benchmark cost (fixed by MNRE on yearly/half yearly basis) will be provided by MNRE for grid connected rooftop and small solar power plants as per revised guidelines issued in January 2015.
- In some special category States/Union Territories like Sikkim, Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Lakshadweep and North Eastern states, CFA up to 70% can be provided.
- Various agencies like state nodal agencies, Solar Energy Corporation of India (SECI) and channel partners (vendors/suppliers of solar equipment, system integrators, project developers, renewable energy service providing companies, etc.) will be involved in program implementation for rapid up-scaling.
- Provisions like accelerated depreciation, tax holiday and concessional import duty/ excise duty exemption are provided by the government for grid connected SPV rooftop projects.
- MNRE has also suggested various business models like solar installations owned by consumer/ owned, operated and maintained by third party/ owned by the utility for smooth operation of rooftop and small solar power plants.
- 360.81 MW of grid-interactive SPV rooftop projects have been sanctioned under MNRE Rooftop Scheme as on April 20, 2015.

State Government Initiatives/Policies to promote SPV rooftop systems

Apart from central government policies, various states have also announced state specific policies and undertaken initiatives for promoting SPV rooftop systems. Some of the initiatives taken by state governments are:

State	SPV rooftop target	Scheme	Metering mechanism	Present solar tariff	Incentive from state*	Target segment
Andhra Pradesh	Not specified	Grid connected	Net metering	Excess energy sold to utility at average pooled purchase cost (APPC).	NA	All 3 phase service consumers
Chhattisgarh	Not specified	Grid connected	Both gross & net metering	FiT rate of Rs.4.35/kWh. Energy banking is allowed	NA	Residential, commercial & industrial rooftops and other installations
Gujarat	30 MW across 6 cities	Grid connected	Gross metering	Rs.9.63/kWh (with accelerated depreciation (AD)), Rs.10.76/kWh (without AD)	Roof owners get lease rental and project developer gets FiT for 25 years	Government, residential, commercial, industrial & institutional buildings
Karnataka	400 MW by 2018	Off grid and grid connected	Both gross & net metering	Rs.9.56 (without subsidy), Rs.7.20 (with subsidy)	NA	All consumers
Kerala	Not specified	Grid connected	Net metering	NA	Rs.10,000/kW capital subsidy from state government	All consumers
Rajasthan	Not specified	Grid connected	Net metering	Rs.7.50/kWh (without AD); Rs. 6.63/kWh (with AD)	NA	All consumers
Tamil Nadu	350 MW by 2015	Grid connected	Net metering	Self-consumption and energy banking for one year	Generation based incentive (GBI) of Rs.2/kWh for first 2 years, Rs.1/kWh for the next 2 years and Rs.0.50/kWh for subsequent 2 years.	50 MW for domestic customers and 300 MW for government buildings &government schemes for rural & urban lighting
Uttarakhand	Not specified	Grid connected	Both gross & net metering	NA	NA	All consumers
West Bengal	18 MW by 2017	Rooftop and small PV installations	Net metering	Consumer tariff applicable to net energy supply. Energy banking allowed for a year	NA	All consumers
Haryana	50 MW by 2017	Off grid and Grid connected	Both gross metering and net metering	(i)Public building: FiT; (ii) cluster of private buildings: FiT; (iii) individual buildings: for captive use. Energy banking allowed for a year	NA	All consumers
Uttar Pradesh	20 MW by 2016-2017	Grid connected	Both gross &net metering	Consumer tariff applicable to net energy supply.	NA	All consumers
Punjab	Not specified	Grid connected	Net metering	Tariff based bidding with tariffs in the range of Rs.7.20/kWh-Rs.8.75/ kWh	NA	All consumers

NA: Not Applicable; *Incentives over and above the capital subsidy from MNRE
Source: MNRE and Various State Policies

KEY OBSERVATIONS FROM STATE POLICIES

- Majority of the states have adopted net metering policy over FiT for SPV rooftop systems as it focuses more on self-consumption and energy banking instead of selling power to utilities.
- Excess generation is either not paid for or is paid at APPC or can be banked for a limited period.
- More than 285 MW of SPV rooftop projects have already been commissioned across various states in India which included 35.9 MW under MNRE scheme.
- Tamil Nadu, Gujarat and Karnataka are the leading states in terms of rooftop installations.
- Commercial power tariffs are higher in states like Tamil Nadu, Andhra Pradesh, Karnataka and Kerala for commercial and industrial user segment and hence the solar power produced at the location of consumption is already at par with commercial tariffs. Furthermore, commercial and industrial users can also avail accelerated depreciation benefits on grid interactive SPV rooftop systems.
- States like Tamil Nadu have witnessed higher SPV rooftop installations due to power shortage, parity of solar power with commercial rates for industrial segment as well as incentives from state government whereas installations in power surplus states like Gujarat are being driven by incentivising tariffs and providing long term Power Purchase Agreements (PPAs) under Public Private Partnership (PPP) model.

CHALLENGES

Despite incentives from central and state governments, many challenges exist for development of SPV rooftop market. Some of these are:

- High upfront cost involved in putting up solar panels on rooftops though PV module prices have declined by about 50% globally since 2011. Cost of PV module forms about 50% of the SPV rooftop cost and presently installation of 1 kW costs around Rs. 1 Lakh without battery back-up and without considering any subsidy. Hence, cost remains higher for many consumers (especially house hold)
- Cost of assembly parts such as batteries, inverters etc. for power storage
- Power from multiple small solar projects poses challenge to grid stability
- Apprehensions in financing solar projects mainly due to limited track record in India
- Limitations in FiT approach due to issues of monitoring & verification to avoid misuse of system from feeding subsidised fuels
- Lack of technical specification like voltage, flicker, and synchronization for net-metering system
- Challenges with respect to grid integration with likelihood of reversal of power flow across the network and erratic behaviour of low voltage protection systems.
- Lack of awareness among consumers

WAY FORWARD

Globally, major PV installations have been on rooftops in countries like Germany, Japan and USA. Given the global trend, high solar irradiation, growing energy demand & power deficit issue and abundance of rooftops for SPV systems installation, SPV rooftop system seems a logical alternative choice to meet India's energy requirements.

Solar power has already achieved parity with commercial power tariffs for industrial and commercial segment in many states in India. However, SPV rooftop installations are at very nascent stage in India as against targeted SPV rooftop installations of 40 GW by 2022 and hence, capital subsidy alone may not be the solution to achieve targeted installations but comprehensive solar solutions is the need of the hour.

Implementation of SPV rooftop systems can be accelerated if solar solutions are easily available and accessible as a complete package; easy financial assistance is available and there is increasing awareness amongst consumers about its economic/environmental benefits. Promoting SPV rooftop for self-consumption could be the most important step towards popularising SPV rooftop. Large participation across the consumer segment may be achieved through creating awareness about benefits supported by synchronisation between stake holders i e Government nodal agencies, consumers and system integrators.

Furthermore, government policies should also put emphasis on encouraging power generation through decentralised SPV rooftop systems at the point of consumption rather than only providing capital subsidy. One of the ways could be through providing generation based incentives for end-users including the house hold segment which can drive growth of SPV rooftop systems without putting any additional burden on distribution and transmission infrastructure while at the same time achieving targets for renewable energy installations.

Contact:

Vishal Joshi
Manager
vishal.joshi@careratings.com
91-79-40265613

Anuja Parikh
Analyst
anuja.parikh@careratings.com
91-79-40265616