

The National Solar Mission: Marching Ahead in Solar Energy

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Power generation through solar will offset conventional power generation, reducing the need to import coal and gas and lead to foreign reserve savings. Revenue to the Government through taxes and duty, etc., from plants in power generation and manufacturing will also increase and solar projects will provide a productive use of abundant wastelands

The National Solar Mission (NSM) launched in January 2010, is a major initiative of the Government of India involving States, R&D institutions, and industries to promote solar energy while addressing energy security and climate change challenges of the country. Thus, it will constitute a major contribution by India to the global effort to meet the challenges of climate change. The Mission is one of the several initiatives that are a part of National Action Plan on Climate Change (NAPCC).

India, with its large population and rapidly growing economy, needs access to clean, affordable, and reliable sources of energy. India lies in the high solar insolation region, endowed with huge solar energy potential with most of the country having about 300 days of sunshine per year with the daily solar radiation incident varying from 4–6 kWh per square metre of surface area depending upon the location and time of the year. The total solar power potential in the country is estimated as approximately 748.98 GW.

Objective of the Mission:

The objective of the Mission is to establish India as a global

leader in solar energy, by creating the policy conditions for its large scale diffusion across the country as quickly as possible, abatement of carbon emissions, and creation of direct and indirect employment opportunities for both skilled and unskilled persons.

Goals and Targets

The Mission had set a target, amongst others, for deployment of grid connected solar capacity of 20,000 MW by 2022 to be achieved in three phases (first phase up to 2012–13, second phase from 2013 to 2017 and the third phase from 2017 to 2022).

The first phase (up to 2013) focussed on promoting scale-up in grid-connected solar power capacity addition of 1,000 MW through the scheme of bundling with thermal power operated through NTPC's Vidyut Vyapar Nigam Ltd (NVVN) for minimizing the financial burden on the Government, and a small component of 100MW with GBI support through the *Indian Renewable Energy Development Agency Limited (IREDA)*.

Recognizing the potential of solar energy to contribute to energy security of the country, and encouraged by the

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falling PV prices and the likelihood of reaching grid parity sooner and rapid increase in solar installation in the country, the Government in July 2015 had enhanced the target to 100 GW solar capacity to be set up by 2021–22. Out of this, 60 GW will come through large scale solar power and 40 GW through Grid Connected Solar Rooftops.

Implementation Strategy

The Ministry of New and Renewable Energy (MNRE) has formulated several schemes for achieving 100 GW by 2022. Few possible options, such as bundling, Generation-Based Incentive (GBI), and Viability Gap Funding (VGF) are being tried. The scheme-wise strategy and achievements are presented below:

Phase-I of the NSM

1,000 MW capacity grid solar projects under Phase-I through NVVN

In the Phase I of the Mission, 950 MW solar power projects (excluding 84 MW selected under migration scheme) were selected in two batches (Batch-I during 2010–11 and Batch-II during 2011–12) through a process of reverse bidding. The resulting tariffs in Batch-I for SPV projects ranged between ₹10.95 and ₹12.76 per unit, with average of ₹12.12 per unit and for solar thermal projects the tariff ranged between ₹10.49 and ₹12.24 per unit, with average tariff being ₹11.48 per unit. In Batch-II, for solar PV projects, the tariff ranged between ₹7.49 and ₹9.44 per unit, with average tariff being ₹ 8.77 per unit.

The power from the plants is being purchased by the NVVN and being sold to distribution utilities/ Discoms after bundling with power from the unallocated quota of power from coal-based stations of NTPC on equal capacity basis, thus effectively reducing the average per unit cost of solar power. A total capacity of 420 MW has been commissioned under these batches by the end of

Phase-I (31.3.2013). In addition, a capacity of 50.5MW under migration scheme, 88.8 MW under IREDA-GBI scheme, and 21.5 MW under old Demonstration scheme has been commissioned, taking the total capacity commissioned during Phase-I to 580.8 MW.

Solar Water Heater Installations:

Over 8 million sq. m solar water heaters have been installed in the country.

Installations of Solar Off-Grid Systems:

Around 320 MW capacity solar off-grid systems have been installed in the country.

Phase-II of the NSM

Solar Parks and Ultra Mega Power Projects:

- The Ministry has rolled out a Scheme to set up at least 25 Solar Parks, each with a capacity of 500 MW and above, thereby targeting around 20,000 MW of solar power installed capacity. These solar parks will be put in place within a span of five years starting from 2014–15. However, smaller parks may be considered in Himalayan regions and other hilly States where contiguous land may be difficult to acquire in view of difficult terrain and in States where there is acute shortage of non-agricultural land.
- The solar parks will be developed in collaboration with the State Governments and their agencies. The choice of implementing agency for developing and maintaining the park is left to the State Government.
- The total budget support required for the Solar Park Scheme is ₹4,050 crore.
- Under the scheme, the Ministry provides Central Financial Assistance (CFA) of ₹25 lakh per solar park for preparation of Detailed Project Report (DPR), conducting surveys, etc. Besides

this, CFA of up to ₹20.00 lakh per MW or 30 per cent of the project cost, including grid-connectivity cost, whichever is lower, is also provided on achieving the prescribed milestones in the scheme. The approved grant is released by SECI as per milestones prescribed in the scheme.

- Till date, 34 Solar Parks in 21 States with aggregate capacity of 20,000 MW have been approved.

Solar PV Power Plants on Canal Banks and Canal Tops

- This Scheme is formulated so as to encourage the State Power Generation Companies/ State Government Utilities/ any other State Government Organizations/ PSUs to set up grid-connected solar PV power plants of 1 to 10 MW capacity with an aggregate capacity of 100 MW; 50 MW on canal tops and 50 MW on canal banks by providing capital subsidy (upto ₹3 crore per MW or 30 per cent of the project cost, whichever is lower, for canal-top solar PV projects and up to ₹1.50 crore per MW or 30 per cent of the project cost, whichever is lower, for canal-bank solar PV power projects). Besides gainful utilization of the unutilized space over canal tops/unutilized land on canal banks for power generation, the plants will also enable the participating States to meet their Renewable Purchase Obligation (RPO) mandates and also provide opportunities to local population.
- Approvals have been given for 50 MW canal-top and 50 MW canal-bank solar PV power projects. Andhra Pradesh, Gujarat, Karnataka, Kerala, Punjab, Uttarakhand, Uttar Pradesh, and West Bengal are implementing this Scheme.

Solar PV Power by Defence Establishments

The Scheme envisages setting up 300 MW of grid-connected solar PV power projects by Defence Establishments under the Ministry of

Defence and Para Military Forces with Viability Gap Funding. The Schemes aim at utilizing land/rooftop available with the defence establishments and also boost domestic manufacturing in the country. The projects would be set up under developer and EPC mode selected through competitive bidding, during the period 2014–19. Out of the above, 150 MW has been allocated to Ordnance Factory Board under the Ministry of Defence.

1,000 MW of Solar PV Power by CPSUs

The above Scheme aims to motivate CPSUs to procure equipment from domestic manufacturers and participate in various Central/State Government Schemes, from time to time, during the period from 2014–15 to 2016–17, for sale of solar power to the State Utilities/Discoms at competitive tariffs. The MNRE has already allocated 924.50 MW capacity to various CPSUs and Central Government Organizations. Balance capacities are being allocated by the Ministry based on the requests received.

3,000 MW solar PV Power : With Unallocated Conventional Power

NTPC is implementing the Scheme and will purchase the solar power from the selected solar PV plants at a quoted tariff determined through bidding and Thermal Power at tariff as determined by the *Central Electricity Regulatory Commission (CERC)* from time to time from the respective thermal power plant from which power was allocated. The bundling of the power would be on 2:1 basis (2 MW of solar power with 1 MW of thermal power), and selling of the bundled power to willing State Utilities under 25 years Power Purchase Agreements at a weighted average tariff. These projects are at various stages of tendering.

2,000 MW Solar PV Power Projects with VGF

The Scheme envisages setting up 2,000 MW of solar PV projects by Solar Power Developers (SPDs) on

'Build, Own, Operate' basis. A VGF shall be given to the selected SPDs based on his bid, with upper limit of ₹1 crore/MW for projects under open category and ₹1.31 crore/MW for projects under DCR category. The levelized tariff for the term of the PPA will be ₹5.79 per kWh, with first year tariff as ₹5.43 per kWh escalated annually @ ₹ 0.05 per kWh for next 20 years and thereafter at a tariff of ₹6.43 per kWh up to end of the term. The projects are under tendering process.

5,000 MW solar PV Power Projects through VGF

The Scheme is same as the earlier one with capacity enhanced to 5,000 MW. The entire capacity shall be implemented in four tranches of 1,250 MW each. The tariff for the first tranche shall be the same as the earlier Scheme. For the balance capacity, the tariff shall be reduced @ ₹ 0.10 per kWh in each subsequent tranches. The projects are under tendering process.

Grid connected Solar Rooftops

The scheme has targeted 4,200 MW solar rooftops through 30 per cent financial incentives for selected categories and some achievements based incentives for government buildings including PSUs and other government organizations. ₹ 5,000 crore have been allocated by the Government. So far, 27 States have notified regulations for the net-metering and connectivity. About 300 MW rooftop capacity have been installed so far.

New Initiatives:

5,000 MW Solar PV power by CPSUs

The Scheme is envisaged to be implemented as Phase-2 of the earlier Scheme with enhanced solar capacity of 5,000 MW with VGF. The tariff payable to the Project Developers would be fixed at ₹4.50 per kWh or as may be specified by the MNRE based on market conditions, for the entire PPA period of 25 years. The projects would be selected through

bidding process. The project would be developed by either developer mode or EPC mode or both, as decided by the MNRE. The Scheme is under approval stage.

Solar Parks and Ultra Mega Power Projects

Keeping in view the success of the solar power park, another 20,000 MW solar parks are being considered for approval. This will make a total 40,000 MW solar parks in the country and probably the largest solar power in the world. The Scheme is envisaged to be implemented as Phase-2 of the earlier Scheme keeping the solar capacity of 20,000 MW.

Solar Power Projects by Defence Establishments

Another 500 MW scheme is under approval.

Support to Existing Manufacturers of Solar Cells and Modules

The Scheme envisages providing Production Subsidy to the existing solar manufacturers for manufacturing of 6,375 MW of solar cells and 15,775 MW of solar modules in the country for supply to project developers for setting up the solar power projects under any Scheme. The Scheme is under approval.

Small Grid-Connected Solar PV Power Projects (1 to 5 MW)

The Scheme envisages setting up 10,000 MW of solar capacity in the country. The Scheme is under approval.

The Way Forward

The solar capacity has grown with a CAGR of 46 per cent since the last five years, taking solar capacity from 1,023 MW in 2011–12 MW to 6,763 MW in 2015–16. India stands among the top six countries in terms of solar capacity, and with the present trend, India may move up in global solar capacity position.

India, with its vast solar-power potential, would be a leading source of electricity ahead of fossil based

Physical Progress (Achievements) As on 31.05.2016

Ministry of New & Renewable Energy			
Programme/ Scheme wise Physical Progress in 2016-17 (& during the month of May, 2016)			
Sector	FY- 2016-17		Cumulative Achievements
	Target	Achievement	(as on 31.05.2016)
I. GRID-INTERACTIVE POWER (CAPACITIES IN MW)			
Wind Power	4000.00	106.40	26932.30
Solar Power	12000.00	559.78	7568.64
Small Hydro Power	250.00	1.80	4280.25
BioPower (Biomass & Gasification and Bagasse Cogeneration)	400.00	0.00	4831.33
Waste to Power	10.00	0.00	115.08
Total	16660.00	670.98	43727.60
II. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN MW_{EQ})			
Waste to Energy	15.00	0.00	160.16
Biomass(non-bagasse) Cogeneration	60.00	0.00	651.91
Biomass Gasifiers	2.00	0.00	18.15
-Rural	8.00	0.00	164.24
-Industrial			
Aero-Genrators/Hybrid systems	0.30	0.00	2.69
SPV Systems	100.00	2.07	325.40
Water mills/micro hydel	1.00	0.00	18.71
Total	186.30	2.07	1341.26
III. OTHER RENEWABLE ENERGY SYSTEMS			
Family Biogas Plants (in Lakhs)	1.10	0.00	48.55

power, which is fast depleting. Growth in competition and scale has led to significant decline in solar tariff, which are very competitive as compared with the conventional power. The latest round of reverse bidding saw the lowest bid dropping to ₹ 4.34 per kWh for a project in Rajasthan.

The conducive policies initiated by the Government of India have helped in bringing about competitive rates through bidding process. The Tariff Policy has been amended to increase the solar power consumption and mentioned that "within the percentage so made applicable, to start with, the SERCs shall also reserve a minimum percentage for purchase of solar energy from the date of notification of this policy which shall be such that it reaches 8 per cent of total consumption of energy, excluding hydropower, by March 2022 or as notified by the Central Government from time to time". The Tariff Policy would mandate the States to buy solar power.

The Government is also coming up with schemes for providing production incentives to encourage growth in manufacturing in solar cells and solar modules. This will help in increase in domestic manufacturing of solar cells and solar modules at competitive rates as the imported solar equipments. Other new initiatives are also being considered.

At the state level too, many state governments are actively promoting the development of solar power through a supportive policy and regulatory framework.

Achievement of 100 GW of solar power will lead to abatement of 170.482 million tonnes of CO₂ over its life cycle. With an enhanced target of 100,000 MW, upto 1 million jobs will be created. More employment and investment opportunities will enhance income. Higher solar power targets will augment power generation in India improving energy security and energy access. Solar manufacturing will also pick

up after visibility on this investment opportunity to support these targets. Power generation through solar will offset conventional power generation, reducing the need to import coal and gas and lead to foreign reserve savings. Revenue to the Government through taxes and duty, etc., from plants in power generation and manufacturing will also increase and solar projects will provide a productive use of abundant wastelands.

Further, there are growing concerns about the viability of the newly bid projects. With project auctions becoming increasingly competitive, margins are coming under pressure and leading players to take increasingly more risks. Increased domestic manufacturing of solar cells and modules capacity may take care of the risk and help in capacity addition programme of the Government of India. □

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