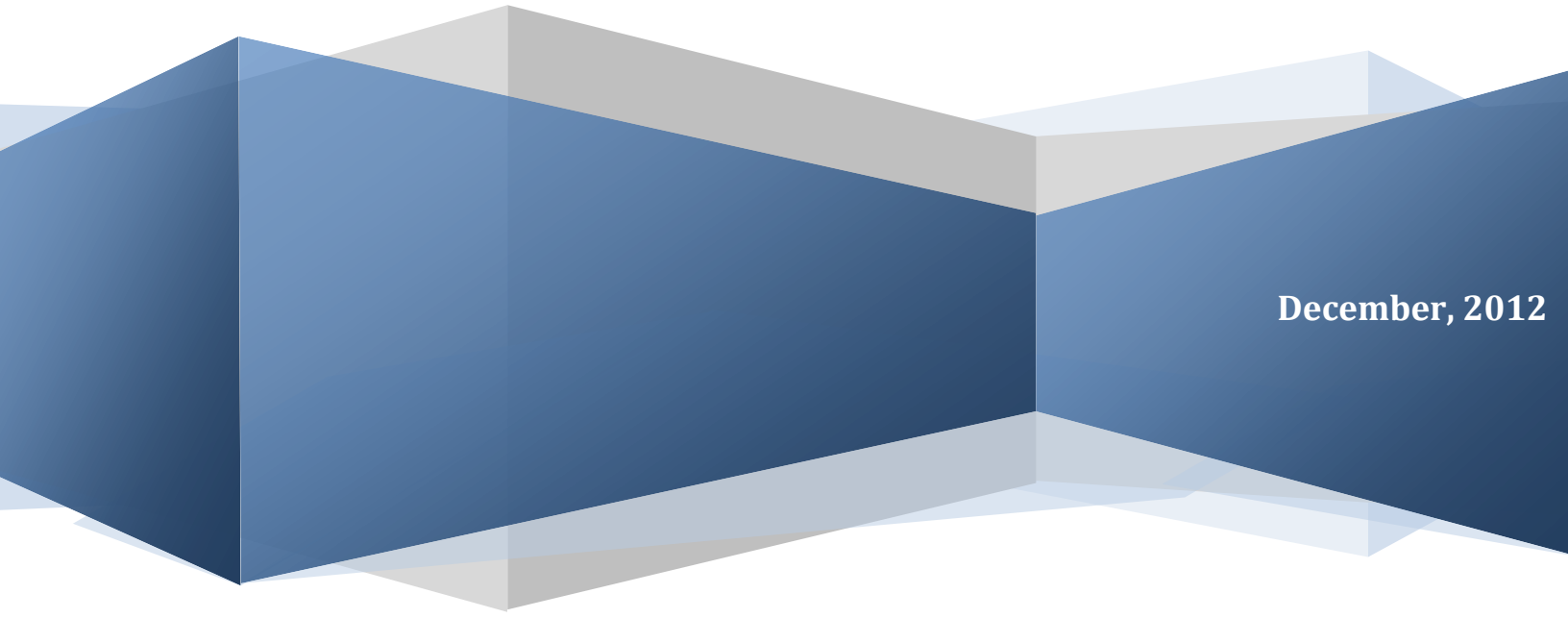
Ministry of New & Renewable Energy

Jawaharlal Nehru National Solar Mission

Phase II – Policy Document



December, 2012

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1 BACKGROUND &INTRODUCTION FOR PHASE-II

1.1 Background of JNNSM

1.1.1 Introduction

Jawaharlal Nehru National Solar Mission is a major initiative of the Government of India with active participation from States to promote ecologically sustainable growth while addressing India's energy security challenge. It plays a major role in India's contribution to fight against the issues of climate change which is a big concern across the globe. Launching India's National Action Plan on Climate Change on June 30, 2008, the Prime Minister of India Dr. Manmohan Singh stated:

> ***"Our vision is to make India's economic development energy-efficient. Over a period of time, we must pioneer a graduated shift from economic activity based on fossil fuels to one based on non-fossil fuels and from reliance on no-renewable and depleting sources of energy to renewable source of energy. In this strategy, the sun occupies centre-stage, as it should, being literally the original source of all energy. We will pool our scientific, technical and managerial talents, with sufficient financial resources, to develop solar energy as a source of abundant energy to power our economy and to transform the lives of our people. Our Success in this endeavor will change the face of India. It would also enable India to help change the destinies of people around the world."***
>
> ***Dr. Manmohan Singh, Prime Minister of India***
>
> ***National Action Plan on Climate Change***

The National Action Plan on Climate Change also points out: "India is a tropical country, where sunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has great potential as future energy source. It also has the advantage of permitting the decentralized distribution of energy, thereby empowering people at the grassroots level".

Based on this vision Jawaharlal Nehru National Solar Mission was launched under the brand name "Solar India".

On October 9th, 2012 during the inaugural speech at International seminar on Energy Excess Hon'ble PM. of India Dr. Manmohan Singh highlighted the importance of developing technologies and supporting framework to provide excess of energy to every household in India. During the speech Dr. Manmohan Singh stated:

> ***"Universalizing access to energy will require innovative institutions, national and local enabling mechanisms, and targeted policies, including appropriate subsidies and financing arrangement. The necessary technologies to mitigate the problem are fortunately, available. These technologies need to be viewed as global public goods. Governments and industry need to be encouraged to engage in international cooperation in this area on an enlarged scale and work for enhancing the technological capability of developing countries."***
>
> ***Dr. Manmohan Singh, Prime Minister of India***
>
> ***Seminar on Energy Access***

1.1.2 Importance and Relevance of Solar Energy in India

India is endowed with abundant solar energy, which is capable of producing 5,000 trillion kilowatts of clean energy. Country is blessed with around 300 sunny days in a year and solar insolation of 4-7 kWh per Sq. m per day. If this energy is harnessed efficiently, it can easily reduce our energy deficit scenario and that to with no carbon emission. Many States in India have already recognised and indentified solar energy potential and other are lined up to meet their growing energy needs with clean and everlasting solar energy. In near future Solar energy will have a huge role to play in meeting India's energy demand. Figure below is showing the pictorial view of Global horizontal solar resource of various parts of India

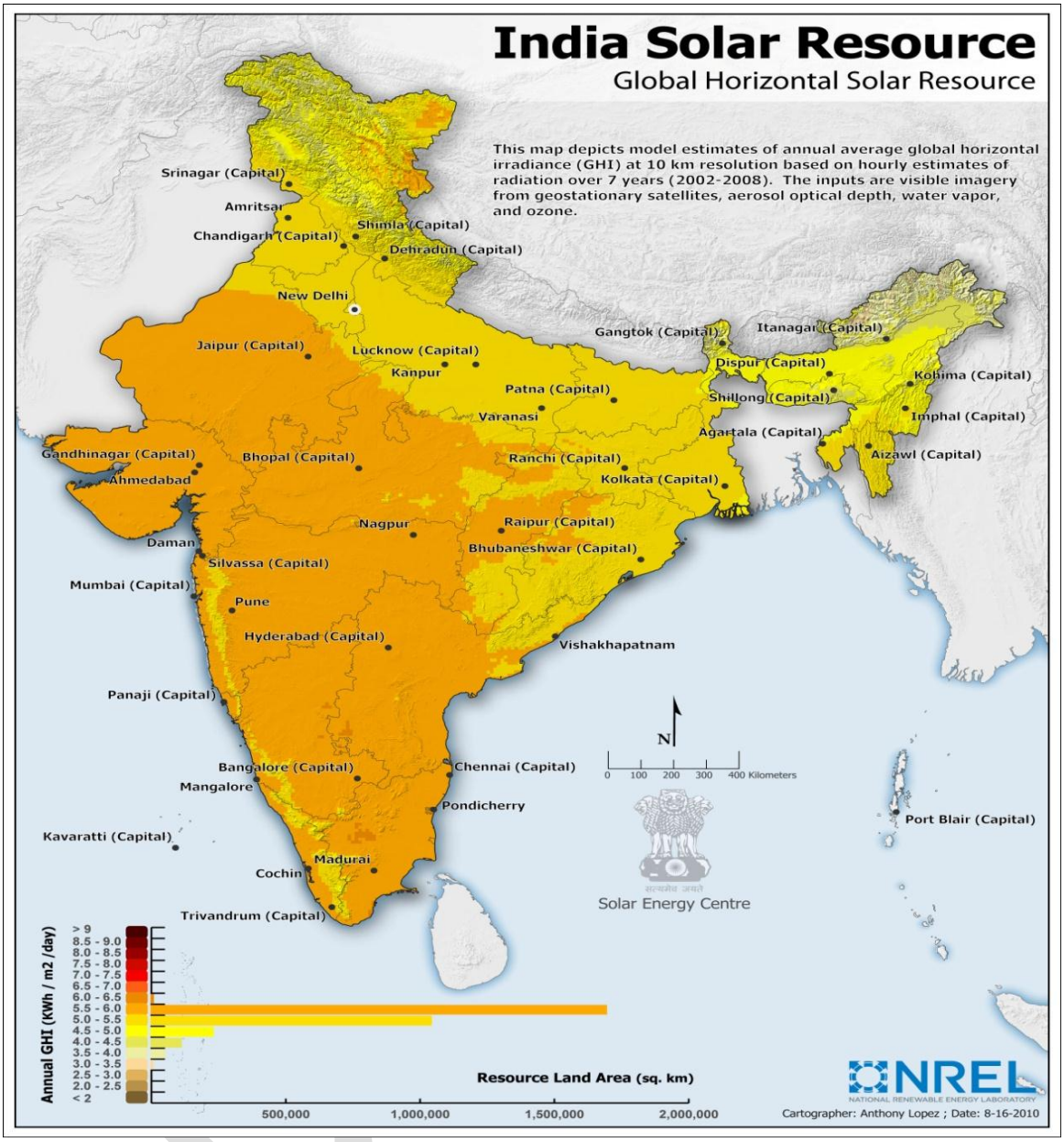

Figure 1-1 India Solar Resource (GHI)[i]

To elaborate more on importance and relevance of solar energy in India some of the key parameters are discussed in this section.

Cost: Solar power is still high on absolute costs compared to other conventional sources of power such as coal. The objective of the Solar Mission is to create conditions, through rapid scale-up of capacity and technological innovation to drive down costs towards grid parity. In the last three years the cost of generation from solar has drastically come down and MNRE anticipates solar power achieving grid parity by 2017-18 and parity with coal-based thermal power by 2025, but this recognizes that cost trajectory will depend upon the scale of global deployment and technology

development and transfer. The Mission also recognizes that there are a number of off-grid solar applications particularly for meeting rural energy needs, which are already cost-effective and provides for their rapid expansion.

Scalability: 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 4-7 kWh per sq. m per day. Hence both technology routes for conversion of solar radiation into heat and electricity, namely, solar thermal and solar photovoltaic, can effectively be harnessed providing huge scalability for solar in India. Solar also provides the ability to generate power on a distributed basis and enables rapid capacity addition with short lead times. Off-grid decentralized and low-temperature applications will be advantageous from a rural electrification perspective and meeting other energy needs for power and heating and cooling in both rural and urban areas. The constraint on scalability will be the availability of space, since in all current applications, solar power is space intensive. In addition, without effective storage, solar power is characterized by a high degree of variability. In India, this would be particularly true in the monsoon season.

3. **Environmental impact**: Solar energy is environmentally friendly as it has zero emissions while generating electricity or heat.

4. **Security of source**: From energy security perspective, solar is the most secure of all sources, since it is abundantly available. Theoretically, a small fraction of the total incident solar energy (if captured effectively) can meet the entire country's power requirements. It is also clear that given the large proportion of poor and energy un-served population in the country, every effort needs to be made to exploit the relatively abundant sources of energy available to the country. While, today, domestic coal based power generation is the cheapest electricity source, future scenarios suggest that this could well change. Already, faced with crippling electricity shortages, price of electricity traded internally, touched Rs 17.46 per unit during peak periods in the month of July 2012. The situation will also change, as the country moves towards imported coal to meet its energy demand. The price of power will have to factor in the availability of coal in international markets and the cost of developing import infrastructure. It is also evident that as the cost of environmental degradation is factored into the mining of coal, as it must, the price of this raw material will increase. In the situation of energy shortages, the country is increasing the use of diesel-based electricity, which is both expensive – costs as high as Rs 15 per unit - and polluting. It is in this situation the solar imperative is both urgent and feasible to enable the country to meet long-term energy needs.

1.1.3 Mission Objectives

The objective of the Jawaharlal Nehru National Solar 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. The Mission adopted a 3-phase approach, spanning the period of the 11th Plan

and first year of the 12th Plan (up to 2012-13) as Phase 1, the remaining 4 years of the 12th Plan (2013-17) as Phase 2 and the 13th Plan (2017-22) as Phase 3. At the end of each plan, and mid-term during the 12th and 13th Plans, there will be an evaluation of progress, review of capacity and targets for subsequent phases, based on emerging cost and technology trends, both domestic and global. The aim would be to protect Government from subsidy exposure in case expected cost reduction does not materialize or is more rapid than expected. The immediate aim of the Mission was to focus on setting up an enabling environment for solar technology penetration in the country both at a centralized and decentralized level. The first phase (up to 2013) focused on capturing of the low hanging options in solar; on promoting off-grid systems to serve populations without access to commercial energy and modest capacity addition in grid-based systems. In the second phase, after taking into account the experience of the initial years, capacity will be aggressively ramped up to create conditions for up scaled and competitive solar energy penetration in the country.

1.1.4 Mission Targets on Capacity Addition

The mission National Solar mission under the brand name "Solar India" set an ambitious target of adding 20 GW of Grid connected and 2 GW of Off-grid capacity by 2022 in three phases. Phase wise target of the mission is presented below

Table 1: JNNSM Capacity Addition Target

SN	Segment	Target for Phase I (2010-13)	Cumulative Target for Phase II (2013-17)	Cumulative Target for Phase III (2017-22)
1	Utility Grid Power including rooftop	1100 MW	10,000 MW	20,000 MW
2	Off Grid Solar Applications	200 MW	1000 MW	2000 MW
3	Solar Collectors	7 million sq mt	15 million sq mt	20 million sq mt

1.2 Status& Achievements of Phase-I

Despite vast solar potential, India's solar power capacity was almost non-existent until recently. Serious development in Indian solar industry came with the announcement of JNNSM in 2010. Before announcement of JNNSM, India's solar power capacity was mare 17.8MW in early 2010. The aim of National Solar Mission is to achieve a wide range of ambitious objectives, with the overall stated goal of establishing India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible

Phase 1 of the Mission was largely focused on grid-connected projects. To achieve 500 MW of PV and 500 MW of solar thermal, the central government conducted two batches of reverse auctions.

These bidding processes offer feed-in tariffs and long-term PPAs to the selected least-cost developers. The feed-in tariffs to developers are complemented by support to power utilities through the bundling of solar power with conventionally produced electricity, reducing the average per-unit cost of solar power.

Table below summarizes result of phase-I of JNNSM including projects allotted under different scheme and price discovery under reverse bidding.

Figure 1-2: Status of Phase-I of JNNSM[ii]

Status of Batch-I								
Schemes		Projects Allotted		Projects Commissioned		CERC tariff (Rs./kWh)	Lowest Tariff discovered (Rs./kWh)	
		No	MW	No	MW			
PV projects through NVVN		30	150	25	125	PV – 17.91	PV – 10.95	
CSP projects through NVVN		7	470	Schedule to commission by 2013		CSP- 15.31	CSP – 10.49	
Migration Scheme	PV	13	54	11	48	-	-	
	CSP	3	30	1	2.5			
RPSSGP (PV)		78	98.5	62	76.55	-	-	
Status of Batch-II								
Schemes		No	MW	Project Commissioned		Min Rs/KWh	Max Rs/KWh	Avg. tariff Rs/KWh	% Reduction in tariff
PV projects through NVVN		28	350	Schedule to commission by 2013		7.49	9.44	8.77	43%

1.3 Progress and Learning from Phase I of JNNSM

Phase I of National Solar Mission was divided into two Batches i.e. batch –I & II. In Batch I, capacity addition of 150 MW of grid connected solar PV plants and 500 MW of grid connected solar thermal plants was envisaged. Whereas in Batch II, the remaining targeted capacity for Solar PV i.e. 350 MW was awarded.

Considering the fact that some of the grid connected solar power projects were at various stages of development prior to launch of JNNSM, In February, 2010 a Migration Scheme was launched to provide these projects an option to migrate from the respective existing arrangement to the one envisaged under JNNSM subject to the consent of distribution licensee, State Govt. and willingness of developer. Resulting solar projects worth 84 MW including 54 MW SPV and 30 MW solar thermal were migrated to JNNSM.

Apart from these grid connected large scale plants, small rooftop plants of capacity less than 2MW each were also allotted under GBI scheme in Rooftop PV and small Solar Power Generation Programme (RPSSGP).

1.3.1 Bundling of Solar power

In order to facilitate grid connected solar power generation under the first phase, without any direct funding by the Government, Government approved NTPC Vidyut Vyapar Nigam (NVVN) as the nodal agency to purchase 1000 MW of solar power from the project developers, bundle it with the unallocated power available from the NTPC coal-based stations and sell this "bundled" power to the Distribution Utilities. Bundling concept was introduced to keep the cost of bundled power approximately Rs 5/kWh. It was decided to select projects of 500 MW capacity each based on solar thermal and solar photovoltaic (PV) technologies. Considering the relatively longer gestation period of Solar Thermal Projects i.e. over two years, the selection of projects for 500 MW was completed in FY 2010-11. The size of solar thermal projects was in the range of 20 MW to 100 MW per project developer.

1.3.2 Projects under Batch-I, Phase-I

The selection of Solar PV projects of 500 MW capacity was decided to be undertaken in two batches over two financial years of Phase 1 i.e., 2010-2011 and 2011-2012. The size of PV projects in the first stage in 2010-11 was fixed at 5 MW per project. Under Migration scheme NVVN started the process of short listing the on-going projects to migrate to the JNNSM. A total of 16 projects of 84 MW capacity were selected. These project developers signed PPA with NNVN in October, 2010 and reported financial closure. The last date for commissioning of 54 MW capacity PV projects was by end of October, 2011. The 30 MW capacity solar thermal projects are to be commissioned by March, 2013.

Later in August 2010, NVVN started the process of selection of new grid solar power projects comprising of 150 MW of Solar PV and 470 MW of solar thermal capacities. This yielded a tremendous response and applications were received for over 5,000 MW capacity. The projects were selected based on tariff discounting. Bidders offered substantial discounts as given below:

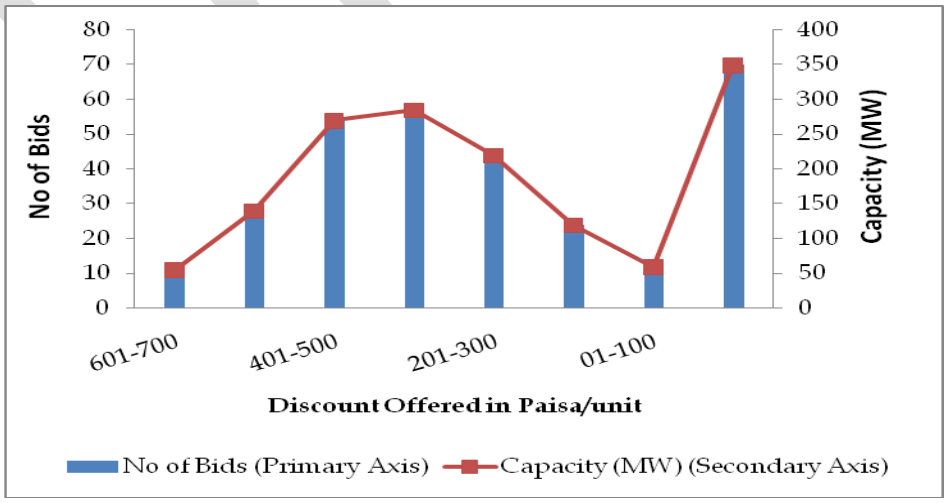

Figure 1-3 Tariff Discount (in paisa/unit) offered in Batch I by SPV Project Developers

Table 2: JNNSM Batch I Bidding Result Summary

Solar PV		Solar Thermal	
CERC Approved tariff for Solar PV (Normal Depreciation)		CERC Approved tariff for Solar Thermal (Normal Depreciation)	
1791 Paise / Kwh		1531 Paise / Kwh	
Max discount offered (Paise)	Min. discount offered (Paise)	Max discount offered (Paise)	Min. discount offered (Paise)
696	515	482	307
Final tariff after discount for Solar PV (Paise / Kwh)		Final tariff after discount for Solar Thermal (Paise / Kwh)	
1095	1276	1049	1224

Total 30 SPV projects were selected after bidding process and subsequently 28 project developers signed PPAs for 140 MW capacity with NVVN. Similarly seven solar thermal projects were selected after bidding process and signed PPA with NVVN. Average tariff for selected SPV projects was 1216 Paise/kWh which was 32% lower than the CERC approved benchmark tariff of 1791 Paise/kWh. For solar thermal projects, average tariff for selected projects was 1141 Paise/kWh which was 25% lower than the CERC approved benchmark tariff of 1531 Paise/kWh for solar thermal plants.

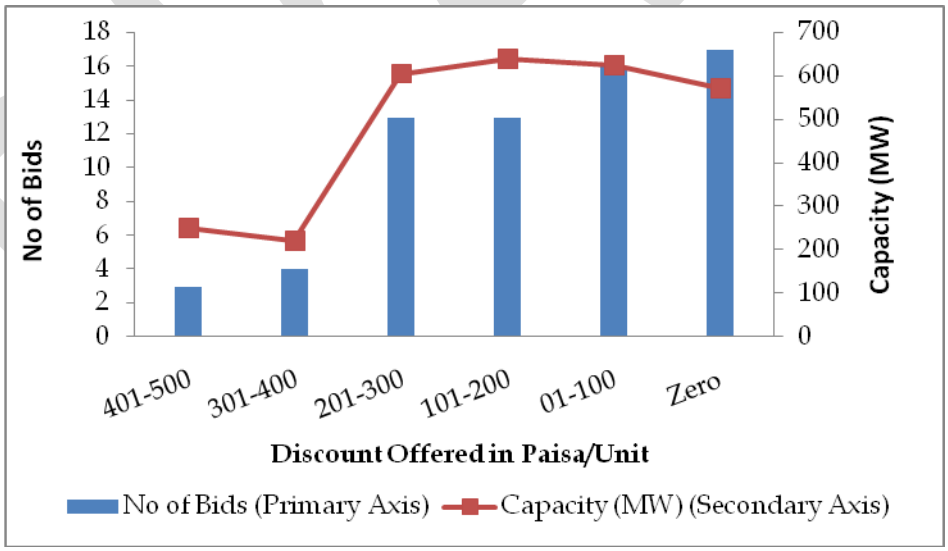

Figure 1-4: Tariff Discount (in paisa/unit) offered in Batch I by Solar Thermal Project Developers

In batch-I, a **total of 704 MW capacity grid connected solar power projects have been selected**, which comprise of 500 MW capacity of solar thermal power projects and 204 MW of PV power projects.

1.3.3 Projects under Batch-II, Phase I

Under Batch II of Phase I, the total aggregate capacity of grid connected Solar Projects was 350 MW for the deployment of Solar PV Power Projects. NVVN had been designated as the nodal agency for procurement of solar power and for carrying out the bidding process. On August 24, 2011, NVVN invited Request for Selection (RfS) from interested developers to develop 350 MW solar PV projects with a capacity in multiple of 5 MW, Minimum capacity 5 MW & Maximum Capacity 20 MW for each project. Total Capacity for each bidder was limited to 50 MW. NVVN received 183 bids from project developers indicating discounts offered by each on CERC approved benchmark tariff of 1539 paisa/kWh. Discount offered by the bidders was in the range of zero paisa to 790 paisa per unit.

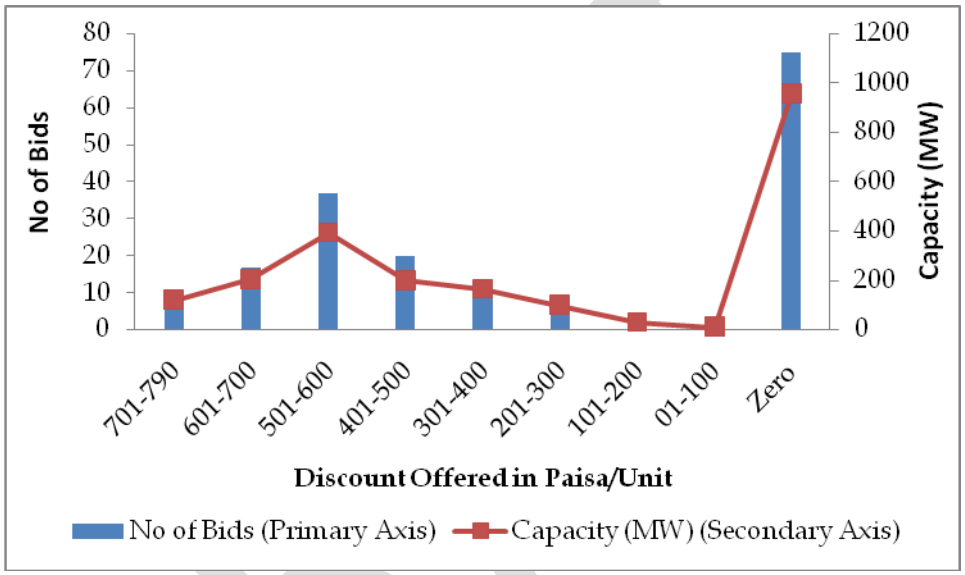

Figure 1-5: Tariff Discount (in paisa/unit) offered in Batch II by SPV Project Developers

SPV projects worth 350 MW were awarded with an average tariff of 877 paise/kWh which was 43% lower than the benchmark tariff approved by CERC.

Table 3: JNNSM Batch II Bidding Result Summary

Batch II: Solar PV	
CERC Approved tariff for Solar PV (Normal Depreciation)	
1539 Paise / Kwh	
Max discount offered (Paise/kWh)	Min. discount offered (Paise/kWh)
790	595
Final tariff after discount for Solar PV (Paise / Kwh)	
749	944

1.3.4 RPSSGP Scheme

MNRE announced the Guidelines for Rooftop and other Small Solar Power Plants connected to distribution network (Below 33 kV) in June 2010. This component of the Mission was designed essentially as a State driven scheme to encourage the States for grid connected projects focusing on distribution network and to strengthen the tail end of the grid. Under this scheme, the state utilities purchase power from any of the generation companies based on the tariff fixed/approved by the respective State Electricity Regulatory Commissions (SERCs). Another purpose of the scheme was to encourage as many States as possible to set up small solar grid connected projects. This would also help to create a database of performance of solar plants under different climatic and grid conditions. This was considered necessary for large-scale replication in future, particularly for meeting rural needs in the next phase of the Solar Mission.

Under these guidelines, a cap of a maximum 20 MW capacity projects per State was put. The project size was limited to a maximum of 2 MW capacity to be connected to distribution grid. The role of the Ministry was limited to providing a fixed generation based incentive (GBI) to the State utilities at a rate equal to the difference of the CERC tariff for 2010-11 (Rs. 17.91 per kWh) and a reference rate of Rs. 5.5 per kWh. The projects were registered with nodal agency IREDA through a web-based process, and **78 projects were selected to set up 98 MW capacity projects from 12 States.**

1.3.5 Technology Pattern for Solar Power Projects

Information as available from various developers indicate the following pattern of technology which will be adopted for setting up solar PV and solar thermal power projects of 802 MW capacity under JNNSM.

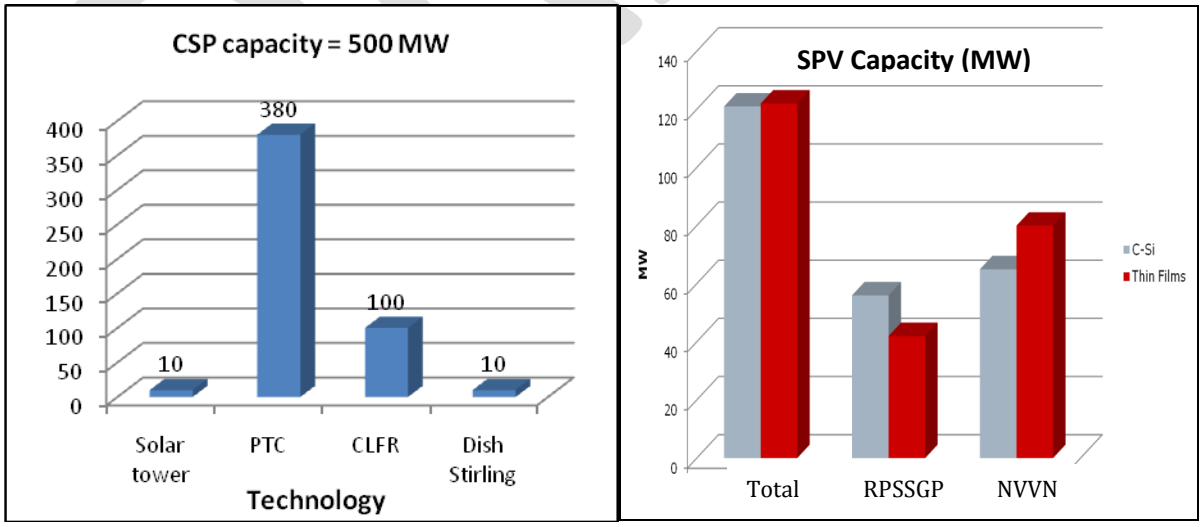

Figure 1-6: Technology Pattern in Solar Projects under JNNSM

1.3.6 Performance of Existing Projects

As per the data collected NVVN from different solar projects, net exportable power for the month of July, Aug, and September 2012 is shown here in tables below

Table 4: Net Exportable Power (July, 2012)

Company Name	State	Capacity (MW)	Net Exportable Power (kWh)
Alex Spectrum Radiation Pvt Limited	RAJASTHAN	5	827668
CCCL Infrastructure Limted	TAMIL NADU	5	785581
Maharashtra Seamless Ltd	RAJASTHAN	5	715300
Mahindra Solar One Private Limited	RAJASTHAN	5	873826
SunEdison Energy India P Ltd	RAJASTHAN	5	695715

Table 5: Net Exportable power (Aug, 2012)

Company Name	State	Capacity (MW)	Net Exportable Power (kWh)
Alex Spectrum Radiation Pvt Limited	RAJASTHAN	5	721259
Azure Power (Rajasthan) Pvt Ltd	RAJASTHAN	5	512040
CCCL Infrastructure Limted	TAMIL NADU	5	747665
DDE Renewable Energy Private Limited	RAJASTHAN	5	592317
Electromech Maritech Private Limited	RAJASTHAN	5	611385
EMC LTD.	UTTAR PRADESH	5	602851
Khaya Solar Projects Pvt Ltd	RAJASTHAN	5	708087
Maharashtra Seamless Ltd	RAJASTHAN	5	666400
Mahindra Solar One Private Limited	RAJASTHAN	5	703795
Newton Solar Private Limited	RAJASTHAN	5	574253
NORTHWEST ENERGY	RAJASTHAN	5	697908

Company Name	State	Capacity (MW)	Net Exportable Power (kWh)
PRIVATE LIMITED			
SunEdison Energy India P Ltd	RAJASTHAN	5	522795
WELSPUN SOLAR AP PRIVATE LIMITED	ANDHRA PRADESH	5	756000

Table 6: Net Exportable power (Sept, 2012)

Company Name	State	Capacity (MW)	Net Exportable Power (kWh)
Aftaab Solar Private Limited	ORISSA	5	638.3
Alex Spectrum Radiation Pvt Limited	RAJASTHAN	5	767109
Amrit Energy Private Limited	RAJASTHAN	5	701409
Azure Power (Rajasthan) Pvt Ltd	RAJASTHAN	5	677819
CCCL Infrastructure Limted	TAMIL NADU	5	787320
DDE Renewable Energy Private Limited	RAJASTHAN	5	641076
Electromech Maritech Private Limited	RAJASTHAN	5	700695
EMC LTD.	UTTAR PRADESH	5	449600
FINEHOPE ALLIED ENERGY PRIVATE LIMITED	RAJASTHAN	5	802327
Indian Oil Corporation Ltd.	RAJASTHAN	5	623995
Khaya Solar Projects Pvt Ltd	RAJASTHAN	5	750601
Maharashtra Seamless Ltd	RAJASTHAN	5	708600
Mahindra Solar One Private Limited	RAJASTHAN	5	792588
Newton Solar Private Limited	RAJASTHAN	5	653831
NORTHWEST ENERGY PRIVATE LIMITED	RAJASTHAN	5	813818
Saidham Overseas Private	RAJASTHAN	5	777309

Company Name	State	Capacity (MW)	Net Exportable Power (kWh)
Limited			
SAISUDHIR Energy Limited	ANDHRA PRADESH	5	11.04
SunEdison Energy India P Ltd	RAJASTHAN	5	714237
VASAVI SOLAR POWER PRIVATE LIMITED	RAJASTHAN	5	750601
WELSPUN SOLAR AP PRIVATE LIMITED	ANDHRA PRADESH	5	763600

Performance of projects under RPSSGP is shown in annexure -1

1.3.7 Current Status of Phase I Projects

Phase I of JNNSM has been a success story with encouraging response from solar project developers. During Phase-I, grid connected solar power projects were selected on the basis of discounts offered by the project developers on CERC approved applicable tariff. This mechanism was found to be very useful in selecting projects in a transparent manner and also leading to a substantial reduction in solar tariffs because of competition.

Table 7: Status of Projects under Phase I of JNNSM

Scheme	Allotted Capacity (MW)	Commissioned as on Sept 05, 2012 (in MW)
Batch I, SPV	140	130
Migration, SPV	54	48
Migration, Solar Thermal	30	2.5
RPSSGP	98	87.8
Batch I, Solar Thermal	470	Scheduled to be commissioned by March 2013
Batch II, SPV	350	Scheduled to be commissioned by March 2013
Total (MW)	**1142**	**268.3**

1.3.8 Status of RPO Targets

As per the provisions under Section 86(1)(e) of the Electricity Act 2003 and notified Tariff Policy, to encourage the development of solar power across the states, State Electricity Regulatory Commission (SERCs) have to specify solar RPO targets in their States and have to notify RPO

regulation to comply with the same to ensure its compliance. The Solar RPO targets specified by various State Electricity Regulatory Commissions are summarized in table below:

Table 8: State RPO Targets

S.No	State	FY 13	FY 14	FY 15	FY 16	FY 17
1	Andhra Pradesh	0.25%	0.25%	0.25%	0.25%	0.25%
2	Assam	0.15%	0.20%	0.25%		
3	Bihar	0.25%	0.50%	0.75%	1.00%	1.25%
4	Chhattisgarh	0.50%				
5	Delhi	0.15%	0.20%	0.25%	0.30%	0.35%
6	Gujarat	1.00%				
7	Haryana	0.05%	0.10%			
8	Himachal Pradesh	0.25%	0.25%	0.25%	0.25%	0.25%
9	Jammu & Kashmir	0.25%				
10	Jharkhand	1.00%				
11	Karnataka	0.25%				
12	Kerala	0.25%	0.25%	0.25%	0.25%	0.25%
13	Madhya Pradesh	0.60%	0.80%	1.00%		
S.No	State	FY 13	FY 14	FY 15	FY 16	FY 17
14	Maharashtra	0.25%	0.50%	0.50%	0.50%	
15	Manipur	0.25%				
16	Mizoram	0.25%				
17	Meghalaya	0.40%				
18	Nagaland	0.25%				
19	Orissa	0.15%	0.20%	0.25%	0.30%	
20	Punjab	0.09%	0.13%	0.19%		
21	Rajasthan	0.75%	1.00%			
22	Tamil Nadu	0.05%				
23	Tripura	0.10%				
24	Uttarakhand	0.05%				
25	Uttar Pradesh	1.00%				
26	West Bengal	0.25%	0.30%	0.40%	0.50%	0.60%

National Action Plan on Climate Change and the notified Tariff Policy, envisage increasing trajectory of solar RPO from 0.25% (by end of Phase-I) to 3% by 2022. However, many States are yet to notify long term solar RPO trajectory as envisaged under the Tariff Policy.

1.3.9 State level Initiatives

In addition to initiatives at national level, there are several policy initiatives and solar power development programmes were announced by State Governments in order to fulfill the Solar RPO targets specified by SERCs and to garner capacity in view of strong interest within the solar industry during Phase-I. The status of various State level programmes and Solar Installed capacity in States is shown in table below:

Table 9: State Initiatives[iii]

S. No	State	Solar Specific Programme
1	Gujarat	Announced – 968.5 MW Commissioned – 690 MW
2	Maharashtra	Announced – 205 MW Commissioned – 40 MW (Setup In Rajasthan)
3	Karnataka	Commissioned – 8 MW, Plans for 600 MW Bids Invited – 80 MW
4	Rajasthan	Announced – 200 MW
5	Odisha	Awarded – 25 MW Announced – 50 MW
6	Madhya Pradesh	Awarded – 200 MW
7	Tamil Nadu	Announced – 3000 MW
8	**Total**	**Announced – 5000 MW (Approx)**

Table 10: Solar Installed capacity in different States

S.No	States/ Union Territory	Solar Power Installed Capacity (MW)
	Andhra Pradesh	21.8
	Chhattisgarh	4
	Gujarat	690
	Haryana	7.8
	Jharkhand	16
	Karnataka	14
	Madhya Pradesh	7.4
	Maharashtra	20
	Orissa	13
	Punjab	9.3
	Rajasthan	201.1
	Tamil Nadu	17.1
	Uttar Pradesh	12.4
	Uttarakhand	5.1
	West Bengal	2.1
	Andaman & Nicobar	0.1
	Delhi	2.5
	Lakshadweep	0.8
	Total	**1044.5**

1.3.10 Key Learning from Phase-I

There is general consensus that Success story of Phase-I should be continued and strengthened. The lessons learnt from Phase-I of the Mission should be imbibed for further fine tuning the mission implementation. Key learning from Phase-I are as under:

- Grid connected solar PV power is now fairly established in terms of availability of required expertise for designing, construction and site preparation etc.
- Grid connected solar thermal power is still to prove its operational prowess as the Phase I projects would be commissioned by March 2013.
- In general, experienced companies are more interested in large size projects. Price reduction is possible if the tender size is big.
- Most of the projects so far have been coming up in few States, like, Rajasthan where high solar energy potential combined with cheap land and favorable State Government policies are in place. Other States need to follow and reap the benefits of solar power.
- Transmission remains a major issue.
- Some assurance regarding regular payments is very important particularly for banks / financial institutions, which have to finance these projects.
- Generation from PV projects so far has been in accordance with the estimates, and higher in many cases.
- Better system designing and construction is required to meet challenges of the local conditions.
- Solar radiation data is an important issue, especially with regard to Direct Normal Irradiance (DNI) data. C-WET has brought out the data policy and data on various sites for the limited period can be obtained from C-WET.
- Provision of requirement of domestic content for setting up solar power projects was kept in the guidelines for Phase-I with a view to develop indigenous capacities and generate employment. It was noted that the production capacities for solar PV cells and modules have expanded in the country.

2 THRUST AREAS FOR JNNSM, PHASE-II

2.1 Targets for Phase II of JNNSM

National Solar Mission envisages installation of around 10 GW utility scale and 1 GW off-grid solar power projects by the end Phase-II. Twelfth five year plan (2012-17) also targets capacity addition of 10 GW of grid connected solar power in India. It is envisaged that out of this 10 GW target, 4 GW would be developed under central scheme and 6 GW under various State specific schemes.

> ***"The immediate aim of the mission is to focus on setting up an enabling environment for solar technology penetration in the country both at centralized and decentralized level"***
>
> **- JNNSM Mission Document**

Table 11: JNNSM Target

SN	Segment	Target for Phase I (2010-13)	Cumulative Target for Phase II (2013-17)	Cumulative Target for Phase III (2017-22)
1	Utility Grid Power including rooftop	1100 MW	4,000- 10,000 MW	20,000 MW
2	Off Grid Solar Applications	200 MW	1,000 MW	2000 MW
3	Solar Collectors	7 million sq mt	15 million sq mt	20 million sq mt

2.2 Scaling up of Grid Connected Projects

One of the main objective of mission is rapid scale up the deployment of Solar projects across the country on the similar lines that Phase –I was built aiming to ramp up grid connected solar energy to 1100 MW by 2013 with participation of both Solar PV and Solar Thermal technology. Capacity allocation was equal for both technology i.e. 500 MW each under Phase-I. Strategically development Phase-I has made India's grid-connected solar energy market grow tremendously, with an increased number of developers, lower prices, and participation from interested financial institutions. India's solar energy market grew from 17.8 MW in early 2010 to 1044 MW cumulative installed capacity as of August31st,2012[iv]of this capacity, 270 MW[v] was commissioned under the

National Solar Mission and other central government schemes. Another 735[vi] MW was deployed under initiatives of various states.

In Phase-II, it is necessary to build on the achievements of phase-I to ensure continued success of National Solar Mission. Large scale solar projects are going to play a huge role in phase-II and for the same reason, it has kept as one of the thrust area under Phase-II. Phase-II is targeting to bring cumulative solar capacity to 10 GW by 2017. Central Government shall provide the required support for development of solar projects under this category. Unlike Phase-I, Phase-II is not entirely dependent on bundling scheme to bring the costs down, as the target capacity under phase-II is high and without confirmation on availability of unallocated quota with central generating stations, Implementation of Phase-II will have to be reply upon combination of various schemes like Generation Based Incentive (GBI), Viability Gap Funding (VGF) and Bundling schemes. Witnessing steep fall in tariff discovered under phase-I, Phase-II is expected to achieve new heights of success while achieving the grid parity before 2017.To make Phase-II another success story wider participation of States is required with development of transmission and distribution network to connect areas with high solar potential. Developing cluster of Solar parks will help reduction in costs further and fair market play will prevail and help in development of various technologies used for achieving phase-II targets.

Objectives for promotion of Grid Connected Solar Power during phase-II are as under:

- To achieve Grid Parity at the earliest
- To facilitate meeting of Solar RPO targets in line with Tariff Policy
- To encourage wider participation of States in NSM
- To facilitate increased connectivity & grid access for solar projects
- To encourage Solar park cluster development
- To promote technology agnostic approach
- To develop domestic technology development capability
- To Encourage large scale deployment of Grid connected rooftop solar
- To encourage Captive and Third party sale of solar power to meet power shortages in Industry
- To Encourage local Manufacturing and
- To support focused R&D initiatives
- Development of REC market
- Development of Storage Systems

2.3 Rooftop PV programme

The whole country including cities, town and villages are experiencing a huge growth in their electricity demand. Distribution Utilities are finding it difficult to manage the peak demand of their

particular areas resulting in severe electricity shortages. With this objective, Phase II would focus on deployment of both off-grid and grid connected rooftop PV systems in the country.

Grid connected rooftop PV system shall be connected to the grid either of 11 KV three phase line or of 220 V single phase line depending on the system installed at institution/commercial establishment or residential complex. Power generated by these systems would be utilized by Industrial and captive loads and feeding excess power to the grid as long as grid is available. The off grid roof top PV systems would be deployed at places which are not connected to the gird or not connected but getting electricity from the grid. The Phase II of JNNSM would target deployment of 1,000 MW of rooftop projects both at off-grid and grid connected levels

"Key Opportunity of solar power lies in decentralized and off grid applications where grid power is not available or not cost effective"

- Mission Document

2.4 Off-Grid Schemes

In India, there are around 400 million citizens who lack access to modern forms of energy. Around 9 crore households are using kerosene for cooking and lighting requirements. The major thrust areas under JNNSM Phase II will be the areas where grid has not reached, or the areas where grid has reached but the electricity is not available. Phase II will also focus on Solar off grid generating systems, solar home lighting systems and various other forms of solar based heating/cooling/thermal applications. Phase II would focus on targets which will be product linked or enhances the income generation activities. It would also focus on various solar PV and solar thermal applications which will be used for heating and cooling requirements, drying purposes, etc. in domestic, commercial and industrial segments. This phase of the programme would also lay emphasis on different types of solar collectors such as flat plate, evacuated tube collectors and other concentrators for meeting the heating requirements.

Thrust Areas for promotion of Off-grid solar during phase-II are as under:

- Improved Energy Access for remote areas
- Heating/Cooling applications needs to be encouraged (such as Cooling, Cold Storage, water purification, Space Heating)
- Replacement of diesel and kerosene
- Distributed Generation : (e.g. rooftop PV applications)

- Industrial process heat applications
- Solar water irrigation pumping systems

2.4.1 Energy Access

Solar Energy is the need for the developing country like India where large section of country's population is primarily located in rural areas and lacks access to electricity. Electricity is vital for a better quality of life - along with reduction in poverty and improvement in education, health and livelihoods. Rural areas in the country mainly lack in distribution infrastructure and itself developing a reliable distribution infrastructure will have a major fixed cost which the utilities presently not in a position to support. With this backdrop, NSM Phase II would focus on standalone solar off grid generating systems which would facilitate the rural consumers to meet their routine requirements of electricity. **During Phase-II, it envisaged that around 20,000 villages/hamlets/basti/padas shall be covered through 'Energy Access' scheme by way of deployment of Off-Grid electricity generation projects.**

2.4.2 Off Grid Lighting Systems

The solar lighting systems include use of solar lanterns in rural areas which is an application of solar photovoltaic technology. Home lighting System is powered by solar energy using solar cells that convert solar energy directly to electricity. The electricity is stored in batteries and used for the purpose of lighting whenever required. Solar street lights are also renowned for outdoor application in un-electrified remote rural areas. With this backdrop, Phase II of the mission would also focus on the off grid lighting systems such as use of solar lanterns, solar home lighting systems, and solar street lighting systems. **Phase II would target for deployment of around ten (10) lakh off grid lighting systems.**

2.4.3 Solar Cities

The Solar City aims at minimum 10% reduction in projected demand of conventional energy at the end of five years, through a combination of enhancing supply from renewable energy sources in the city and energy efficiency measures. Solar City aims to motivate the local Governments for adopting renewable energy technologies and energy efficiency measures. Phase II of JNNSM would focus on development of solar cities and also leads to inclusion of more number of cities.

2.4.4 Solar Water Pumping

Solar PV water pumping systems are used for irrigation and drinking water in India. Solar pumps are constituted by an array of solar panels and are developed to operate on DC power produced by solar panels. No such fuel like diesel or electricity is required, which leads to very little or having the minimal operating costs of the systems. Under Phase I of JNNSM, solar pumps are being provided for irrigation and community drinking water through financial support in the form of capital subsidy and interest subsidy. **Under Phase II of JNNSM, target for deployment of 25000 solar pumps by the end of FY 2017 has been envisaged.**

2.4.5 Telecom Towers

As per Telecom Regulatory Authority of India (TRAI) consultation paper on Green Telecommunication published in March 2011, the telecommunications industry in India uses about 2 billion litres of diesel fuel per annum. Apart from this, fossil fuel is also used for cooling the equipment. If all these cell phone towers use solar energy then it could save a great amount of fossil fuels as well as reduce carbon emissions. **With this backdrop, Phase II of JNNSM would focus on developing special schemes for promotion of solar telecom towers and would target around 25000 solar integrated telecom towers.**

2.4.6 Solar Water Heating Systems

In domestic category, hot water is typically required for bathing while in industrial category; it is used during pre-heating process. In commercial and institutional category, hot water is used for variety of purposes such as bathing, cooking and washing, etc. Depending on the location, terrain, climate profile, economic status, etc quantum as well as quality of hot water requirement varies significantly. Further, source of energy for heating water varies significantly from region to region. Phase II would also have a prime thrust to promote such a useful, efficient and energy saving solar technology in every part of the country. As on 31stAugust 2012, around 5.83 million Sq.m. of collector area for solar water heating has been deployed. The table below presents the year wise cumulative installations and achievements.

Table 12: Cumulative Installation and achievement

Year	Cumulative Installations (Sq.m.)	Year wise achievements (Sq.m.)
2002-03	7,50,000	1,00,000
2003-04	9,00,000	1,50,000
2004-05	11,00,000	2,00,000
2005-06	15,00,000	4,00,000
2006-07	19,00,000	4,00,000
2007-08	23,50,000	4,50,000
2008-09	29,10,000	5,60,000
2009-10	35,10,000	6,00,000
2010-11	45,10,000	10,00,000
2011-12	56,10,000	11,00,000
2012-13 (upto 31 aug 2012)	**58,30,000**	**2,20,000**

The table above depicts that from FY 2010-11 and FY 2011-12, there has been a tremendous achievement in addition of solar collector areas (in sq.m.) It can be inferred that Phase I of JNNSM has played a major role in installation of solar thermal systems in the country. Focus area of JNNSM

Phase II would be to popularize solar water heaters in every part of the country. At present, the maximum deployments of solar water heaters are deployed in few cities & urban centers such as Pune and Bangalore. **Phase II would target at-least 15-20 cities where solar water heaters would become the main source of heating water replacing electric geysers. Keeping into consideration the good progress in Phase I, Phase II would target around 8 million sq.m. of collector area by the end of 2017.**

2.4.7 Solar Cookers and Steam Generating Systems

Dish Solar Cookers is a concentrating type parabolic dish which uses solar energy for cooking applications. These systems use manual tracking to work efficiently and thus it has to be adjusted in15 to 20 minutes during cooking time.

Indoor direct cooking systems have unique feature that it is possible to cook using solar energy within the kitchen itself. Around 7 m. sq. of large reflector standing outside the kitchen reflects the solar rays into the kitchen through an opening in its North wall while a secondary reflector further concentrates the rays on to the bottom of the pot / frying pan painted black. The temperature attained is around 400^0 C that the food could be cooked in a shorter time unlike box solar cooker.
Both the dish and solar cookers are most suitable for N- West, South & Central parts of country where good DNI is available. These cookers are mostly used by individuals, mid day meal schools, tribal areas, aganwadis, army border, posts, road side dhabas etc. for saving mainly LPG/firewood.

Solar steam generating systems are mainly of two types, one is based on fixed receiver E-W automatically tracked concentrating technology and the other on fully tracked receiver on dish technology would be the focused areas for promotion under Phase II. These are mainly used in community kitchens in institutions, hostels, hospitals, hotels, ashrams, para-military/defence establishments, prisons for cooking; industries, hotels, etc for solar cooling, laundry & other applications for saving LPG/Electricity/Diesel etc.

Phase II would target at-least 100 institutions for deployment of solar cookers and around 25000 installations for solar cooking applications in schools for mid day meals. An overall target of deployment of 50000 solar cookers would be set in Phase II of JNNSM.

2.4.8 Industrial Process Heat Applications

There are many applications of CSTs in industries. CSTs basically focus the sunlight at receiver to achieve higher temperatures for various applications. Since these technologies can focus the direct radiation coming from the Sun, they need to be tracked along with the Sun. The technologies can be based on single axis (E-W) tracking as well as dual axis (E-W & N-S) tracking. Depending on their tracking arrangement, they can be put in the category of medium or high temperature applications. Over 15 million tonnes of fuel oil has been estimated to be consumed in industries for application

temperatures below 250^{0}C. Likewise, over 35 million tonnes of fuel oil is consumed for application temperatures above 250^{0}C., which includes core industries such as chemicals, textile, plastics and other hydrocarbon-based industries. CSTs installed in industries along with existing boilers/heaters will save significant amount of fuel oil during the daytime. **Phase II would target at least 400 systems, 250 sq. m. each on an average (100,000 sq. m.) of CSTs for heating applications in industries.**

2.4.9 Air Conditioning / Refrigeration

Cooling through solar is most relevant for India as its' most required when sun is available. Huge amount of fuel oil is being used for cooling through Vapour Absorption Machines in industries/ establishments where power cuts/ electricity tariff are high. Solar Thermal systems at such places can help in significant savings. Solar air-conditioning also has vast scope at places where cooling is required mostly during daytime. This includes office complexes, educational institutions, and commercial establishments like Malls etc. **Phase II would target at least 200 systems, 30 TR each on an average (60,000 sq. m.) for air conditioning / refrigeration systems**.

2.5 Hybrid System

One of the thrust area of Phase-II is to bring development in hybrid technology, for this ministry shall be promoting systems based on hybrid technology with solar as one of the main or secondary source of energy. Focus shall be on promoting new systems based on hybrid technology with solar energy contributing at-least 40% of source of generation. Ministry shall also promote existing projects running in different source of generation to adopt solar hybrid technology even if contribution from solar energy is around 5-10%.

2.6 Manufacturing

A domestic solar manufacturing base to provide solar components is an important part of India's aspirations to become a major global solar player. The mission aims to establish country as a solar manufacturing hub, to feed both a growing domestic industry as well as global markets. The solar mission, while leveraging other government policies, looks to provide favorable regulatory and policy conditions to develop domestic manufacturing of low-cost solar technologies, with the support of significant capital investment and technical innovation. Following table shows the current status of manufacturing capacity of different components.

Table 13: Manufacturing Capacity (MW)

Component	Capacity

Ingots and Wafers	15 MW
Solar Cells	848 MW
Solar Modules	1932 MW

During Phase II, attention shall be given to solar manufacturing capacity building across the value chain covering silicon wafers, cells, modules, thin film modules, panels, balance of systems components such as inverters, power conditioning units, etc. Indigenous manufacturing of low temperature solar collectors is already available; however, manufacturing capacities for advanced solar collectors for low temperature and concentrating solar collectors and their components for medium and high temperature applications need to be built. An incentive package, similar to SIPS, could be considered for setting up manufacturing plants for solar thermal systems/ devices and components.

Thrust Areas for promotion of Solar Manufacturing Capability during phase-II are as under:

- Development of complete value chain for both PV and thermal in India
- Off-grid special products for rural applications
- Manufacturing of solar grade mirrors and glasses
- Developing capacity to develop components and Materials like
    - Heat Transfer Fluid (HTF)
    - Thermal Storage systems
    - Solar Concentrated Glasses
    - Inverters
    - Permanent magnet and other motors for solar pumps

2.7 Focused Research & Development

Solar power cost reduction potential is highly correlated with the advancement in solar technology field. During Phase II of the mission a progressive and focused research infrastructure development has been planned. MNRE has constituted Solar Energy Research Advisory Council (SERAC) to analyze the existing research infrastructure in solar sector and then to set up a framework which would incubate a conducive environment for accelerating research and development activities in the country in alignment with the vision of JNNSM.

Thrust Areas for promotion of Research & Development initiatives during phase-II are as under:

- Development of materials for solar thermal applications
- Development of hybrid and storage technologies
- Development Centers of Excellence for Solar Technologies
- Identification of new areas of solar applications

- Development of high temperature photovoltaic / Concentrated Photovoltaic (CPV)
- Heat cycles for solar thermal with air as heat sink
- R&D in Materials and Components – Receivers for parabolic technology, Advanced power converter modules, self cleaning reflector surfaces, receiver modules for central tower, organic solar cells etc.

2.7.1 Research Infrastructure

National Institute of Solar Energy: Solar Energy Centre, which is working with a status of a Division of the Ministry, is being converted to autonomous institution named as National Institute of Solar Energy (NISE). The campus is at Gwal Pahari, Gurgaon with an area of about 200 acres. The SEC has a long history of supporting national programmes through

- Establishing testing and certification facilities,
- Research and development activities,
- Setting up Technology Validation and Demonstration Projects, and
- National and International training.
- Training for Resource assessment

Main functions of NISE will include R&D, resource assessment, training, and testing/standardization. It will be coordinating with various Centers of Excellence including those by other Ministries/ Organizations, and the R&D projects funded by the Ministry with the aim of facilitating their work, bring about synergistic networking and explore translation of R&D work to commercial deployment. NISE will also have bilateral and multi-lateral co-operation with International Organizations. It is also envisaged to work as the secretariat for the SERAC. As part of its organizational structure, A Governing body will be set up which will have freedom to decide on the functioning structure and activities.

Other large Centers: As a part of JNNSM, the following Centers of Excellence are being supported by the Ministry:

- Centre of Energy Studies at IIT Delhi which was set up in 1978 and covers renewable energy
- IIT Bombay: Research and education in the area of photovoltaic (2009-10)
- IIT Rajasthan: Research and education in the area of solar thermal (2011-12)
- IIM Ahmedabad: Technology incubation and development of entrepreneurship (2010-11)
- CEPT University, Ahmedabad: Solar passive architecture and green building technologies (2010-11)

In addition, proposal from IISc. Bangalore for setting up a Centre of Excellence having focus on decentralized solar thermal power applications is under active consideration.

2.7.2 Specific R&D thrusts with involvement of Universities and R&D institutions

a. Present MNRE R&D Policy has provisions to support projects in Universities, academic institutions, research laboratories and in industries. The type of projects that are covered under the policy include

- ❑ Centre of excellence in thematic areas of research,
- ❑ Applied research,
- ❑ Technology validation and field evaluation,
- ❑ Technology incubation end entrepreneurship development, and
- ❑ Capacity building.

Currently, 18 projects in photovoltaic and 17 in solar thermal areas are under implementation.

b. Implementing institutions include

- ❑ IIT Bombay, IIT Delhi, IIT Kanpur, IIT Rajasthan
- ❑ CSIR laboratories, NPL, NCL, Indian Inst of Chemical Tech
- ❑ Universities: Delhi, Pune, BESU, KIIT, Jain University, Cochin University of S&T,
- ❑ IACS, Indian Institute of Petroleum, TERI
- ❑ Industries : Moser Baer, Maharishi Solar, Sunborne, ATE Pune, Clique Dev, Thermax, Megawatt Solutions,
- ❑ Others: WRST; DST Lakshadweep.

c. Following new and emerging materials are being studied for solar cells:

- ❑ Organic solar cells using organic-inorganic semiconductor hybrid absorber – IIT Delhi
- ❑ Development of high efficiency Si solar cells for use with concentrators – IIT Kanpur
- ❑ Advanced power converter modules for PV – IIT Bombay and BESU
- ❑ Dye Sensitized Solar Cell (DSSC) – IICT, Hyderabad
- ❑ Novel Doped 3-D Nanoporous Oxides for Dye-Sensitized Solar Cells – IIPM, Dehradun
- ❑ Salmon DNA-Conducting Polymer (P3HT) - Quantum Dot (CdSe) - Carbon Nanotube (SWNT) – University of Delhi
- ❑ Titania nano-structured thin film based for developing DSSC – Amrita University, Cochin
- ❑ Design and Development of Organic Solar Cell Sub-Modules – IIT Kanpur

2.7.3 Technology thrusts with involvement of Industry

a. A couple of pilot CSP projects are planned which will be procured on competitive bidding by project developers which will have strong involvement of the industry.

b. Development of more concepts for hybridization.

- ❑ 100 – 500 kW range solar hybrid (PV + bio-methane) with micro grid for rural electrification could be explored.

- ❑ Energy taps (public outlets) for charging batteries of solar lights.

c. Research need to be focussed oncertain high priority areas. The areas which have been considered are as follows:
   - ❑ Temperature and insolation limits in CPV mode
   - ❑ Development of high temperature photovoltaics
   - ❑ Sustainability related topics in Solar energy
   - ❑ Heat Cycles for Solar Thermal with air as heat sink
   - ❑ Materials and components
   - ❑ Accelerated test facilities to study long term effects of thermal cycling, exposure to humidity and UV rays, corrosion, scaling, etc
   - ❑ Polygeneration (heat, cold, water, power, other fuels).
   - ❑ Hybridization (Solar thermal, PV, Biomass)
   - ❑ Policy research for solar energy

2.7.4 Solicit R&D Projects

R&D projects in following areas would be planned:

I. High temperature photovoltaic cells
II. Low cost tracking systems
III. Heat loss reduction in receiver and piping
IV. Reflector development programme addressing issues related to high transmittance, anti-dust self-cleaning coating and characterization facility.

2.8 Solar Resource Monitoring and Assessment

For deployment of solar projects across the nation, accurate and readily available data on resource assessment is very important. Generation of any solar projects largely depends on solar irradiation of that place and hence assessment of solar potential is also considered as one of the thrust areas for phase-II. Solar Data Sharing and Accessibility Policy 2012 ensures creation of a national level solar resource database. As a part of overall strategy, availability of accurate and reliable solar radiation data was considered a key element. Ministry of New and Renewable Energy decided to augment network of solar radiation monitoring stations in the country with a view to cover more areas, especially high potential areas. India Meteorological Department (IMD) of Ministry of Earth Sciences is a statutory body for measurement of weather parameters in the country which includes solar radiation also. At 45 of IMD stations, some facilities for measurement of solar radiations exist. In order to promote investor grade solar radiation data, MNRE sanctioned SRRA project for setting up 51 monitoring stations at sites having high potential of solar power in the country. The project is implemented by Centre for Wind Energy Technology (CWET) located at Chennai, which is an autonomous institution of the Ministry. SRRA project is being supported by Government of Germany through Solmap Project implemented by GIZ.

Each of the SRRA stations is equipped with state-of-art equipments / sensors for measuring solar radiation and associated weather parameters. Configuration of these stations include monitoring of

a) Global solar irradiance
b) Direct normal incidence (DNI) solar irradiance
c) Diffused solar irradiance
d) Wind speed and direction
e) Ambient air temperature
f) Relative humidity
g) Atmospheric pressure and
h) Rainfall

Data is monitored at an interval of one second and averaged over a period of 01 minute. Average data is transmitted through GPRS to a Central Receiving Station set up at C-WET, Chennai. Associated facilities for data quality checks as per international norms and calibration facilities for various equipments / sensors used at SRRA stations have also been set up.

C-WET, an autonomous organization under the administrative control of MNRE, has already implemented the project of setting up 51 ground monitoring stations. In addition to this, 60 more monitoring stations have also been sanctioned to C-WET for installation. List of number of monitoring stations in different States is given below in table:

Table 14: Monitoring Stations in different States

S. No	State	No of Stations
1	Andhra Pradesh	6
2	Gujarat	11
3	Haryana	1
4	Madhya Pradesh	3
5	Karnataka	5
6	Rajasthan	12
7	Chhattisgarh	1
8	Ladakh	1
9	Maharashtra	3
10	Pudducherry	1
11	Tamil Nadu	6
12	**Total**	**51**

During Phase-II, in addition to setting up additional resource monitoring stations, special attention would be given to integrate all resource data generated through various ground stations set up by

"Building innovative systems of financing, tying new funding sources from the financial institutions and accessing long term funds like pension funds for reliable, proven technology options will be the need of the day."

- Project Developer, Oct 2012

C-WET, private developers, IMD, satellite data so that comprehensive resource database is readily available for the country.

2.9 Financing

For development of Grid connected projects, project financing and availability of long term funds is crucial. Phase-I witnessed the difficulties faced by project developers in achieving financial closures due to lack of confidence in Solar projects by funding institutes. Though most of the projects under Phase-I, Batch-I & II achieved financial closure through project financing route but for significantly higher capacity addition targets under Phase-II, financing will remain a thrust area for its successful implementation.

The fund requirements for the Phase-II would be met from the following sources or combinations:

- Budgetary support for the activities under the National Solar Mission established under the MNRE;
- Viability Gap Funding Projects supported through finance from National Clean Energy Fund

International Funds under the UNFCCC framework, which would enable up scaling of Mission targets.

Apart from this other options could be explored as additional measures to assure financing of solar power projects during next phase of implementation of the Mission:

- Raise equity of IREDA/SECI
- Allow IREDA/Banks to raise tax-free bonds
- Allow specific exemption for solar power projects under exposure limits of banks for power sector
- Facilitate international lines of credit
- Involvement of banks/ financial institutes to extend loans to retail sector
- Thrust on micro-financing of solar products

It is also envisaged that a scheme of concessional financing to fund domestic content requirement, if any, would be explored.

2.10 Human Resource Development

> ***"Rapid and large-scale diffusion of Solar Energy will require a concomitant increase in technically qualified manpower of international standard"***
>
> ***- Mission Document***

To achieve and continue the deployment of Solar power across the country for next phase. we need continuous supply skilled manpower, Sector is currently facing challenges in sourcing skilled manpower in many functional areas like manufacturing, production, installation, operation & maintenance, marketing and research & development. As the sector is relatively new and fast growing, there is a shortage of experienced / skilled manpower. To pacify this need, development of Human resource has also been considered as one of the thrust area under phase-II.

Some capacity already exists in the country, though precise numbers need to be established. However, it is envisaged that at the end of Mission period, solar industry will employ at least 100,000 trained and specialized personnel across the skill spectrum. These will include engineering management and R&D functions.

The following steps may be required for Human Resource Development:

- IITs and other premier Engineering Colleges will be involved to design and develop specialized courses in Solar Energy, with financial assistance from Government. These courses will be at Diploma, B. Tech, M. Tech and Ph. D level. Some of the IITs, Engineering Colleges and Universities are covering training programmes in solar energy at graduation and post graduation level. Centre for Energy studies have been set up by some of the IITs and engineering colleges. These initiatives will be further strengthened. In addition, a countrywide training programme and specialized courses for technicians will be taken up to meet the requirement of skilled manpower for field installations and after sales service network.
- Introduction of courses on solar in number of institutes, 100 institutes at various graduate level, 100 Institutes at diploma level and 1000 Institutes at ITI level.
- Provide training of 25,000 Village level technician
- Programmes like fellowship to train engineers / technologies and scientists in Solar Energy in world class institutions abroad will be taken up. This may need to be sustained at progressively declining levels for 10 years. Institution to institution arrangements will also be developed. Fellowships will be at two levels (i) research and (ii) higher degree (M. Tech) in solar energy. MNRE is already implementing a fellowship programme in this regard,

which will be expanded to include students from a larger number of academic institutions. This may be done in consultation with industry to offer employment opportunities.

- Training of energy auditors and managers for solar technologies
- Enhancement of existing manpower in development of skilled manpower via short term courses
- Designing specialized courses at management levels for renewable energy

2.11 Development of Solar Parks

In order to harness the solar potential efficiently and to achieve the objectives of JNNSM, It is required to develop State level Infrastructure solely dedicated to promote solar power generation. One of the way of achieving this is by developing solar parks in a focused manner across different parts of the country.

Solar Park is essentially a concentrated zone of solar development which may consist of a minimum of 250 MW generation capacities on a land area of over 600 hectare with minimum value of annual average global horizontal irradiance (GHI) greater than 5 kWh per sq.m. of area. The concerned State Government may designate and permit one or more blocks of land in close proximity as a Solar Park and prepare the transmission and other necessary infrastructure. Various blocks will be located within a radius of 10 km and such that no end points are separated more than 20 km. Private or public investors will lease the land and construct individual solar plants on the land in a clustered fashion and on a predictable timeline with an overall aim to reduce the development uncertainty through the sharing of common infrastructure including transmission.

Solar Parks would include all required facilities for generation of solar power, which may include evacuation and transmission infrastructure, solar radiation monitoring station, water availability, access roads to the park, interior roads in the park, telecommunication facility, fire station, green belt and security. Other elements of the solar park could be manufacturing facilities, testing and characterization facilities, R&D and demonstration in accordance with the State policy in this regard.

During Phase-II, MNRE would consider Development of Solar Parks at State level as major Thrust Area. To avail support from MNRE for proposed solar parks, following criterion needs to be met

i) The State should have declared policy for solar RPO
ii) The State should have declared tariff for solar power
iii) The minimum land area should be over 600 hectare.
iv) The minimum value of annual average GHI is greater than 5 kWh per sq.m.
v) The land area should be demarcated clearly, and should have clear title.
vi) Availability of water should be over 20,000 liters per MW-capacity per day.

The following items of work will be considered for support for developing solar park:

i) Detailed Project Report (DPR)

This will include work related to site validation and preliminary engineering associated with the development of the solar power projects. The report will provide site corroboration, identify resources such as water, gas, and transmission, and studies related to environment impact assessment. The work will also include GPS mapping and survey work (viz. topography and soil testing), locations for common infrastructure and transmission connectivity.

Support up to 50% of the cost, limited to Rs. 5 crore per park is proposed.

ii) Setting up of Transmission infrastructure

This includes link with CTU/STU (220 kV and above) with a view to evacuate power from solar park to the state/ regional grid, and the transmission infrastructure (33 kV/66 kV) for each of the project in solar park.

Support up to 40% of the cost as per norms of National Clean Energy Fund, based on a detailed and justifiable requirements especially for the solar park is proposed.

iii) Civil Infrastructure development

This will include main road connectivity to the solar park (at least 40 m wide) and internal roads of about 15 m width. This provision will also include construction of common facilities (viz. water reservoir, fire station, and telecommunication facilities), leveling and plotting of land, construction of green belt and security fencing of the solar park.

Support up to 50% of the cost, limited to Rs. 10 crore per park is proposed.

iv) Technical assistance

This will include activities pertaining to dissemination of information, training and capacity building, setting up testing and characterization facilities, and other similar work.

Support up Rs. 1.0 crore per park is proposed based on detailed proposal.

v) Solar radiation monitoring station

Solar radiation monitoring stations, if not installed, will be set up through MNRE programme based on 100% support.

3 IMPLEMENTATION STRATEGIES FOR PHASE-II

Phase I of JNNSM had relatively smaller capacity addition targets and bundling scheme and generation based incentive mechanism proved sufficient and successful for proliferation of solar power in India during initial stage of the Mission. However, Phase II has aimed for significantly higher scale of targets and the Ministry is contemplating all the possible options for implementation of the mission.

3.1 Strategies for Grid Connected projects

In order to benefit from the falling trajectory of prices of solar power, it is recommended that the yearly targets for allocation be evenly spread out to allow sufficient time for installation and commissioning of these projects during Phase II of JNNSM.

There are several strategies MNRE is proposing for implementation of solar power projects under Phase II of the mission.

a) Bundling Scheme
b) Viability Gap Funding
c) Generation Based Incentive

3.1.1 Bundling Scheme

Phase I of the National Solar Mission has introduced the concept of 'bundling' of power in order to facilitate grid connected solar power generation. The mechanism of "bundling" is to bundle relatively expensive solar power with power from the unallocated quota of the Government of India (Ministry of Power) generated at NTPC coal based stations, which is relatively cheaper and sell it to the Distribution Utility at weighted average price. Under NVVN bundling scheme, price of Solar Power is Market determined as Solar Power Developers have given discount on CERC determined tariff. Cost of Conventional Power is regulated as it is sourced from unallocated quota of NTPC power plants. Bundling scheme proved to be a successful implementation strategy during Phase I.

Advantages:

- Successful implementation experience during Phase I of JNNSM
- Weighted Average cost of bundled power is below Rs 5 per unit and utilities are ready to buy power at this rate
- NVVN as the single off-taker of solar power

Disadvantages/Limitation:

- Availability of limited conventional power from unallocated central quota

Applicability in Phase II

Implementation of bundling scheme is dependent on availability of unallocated conventional power. The exact quantum of unallocated power that would be made available for bundling with solar power during Phase II of JNNSM would be ascertained from the Ministry of Power. MoP has the mandate to allocate that unallocated power to high power deficit States. It is unlikely that after allocation of 1000 MW during Phase I, sufficient unallocated power would be available to support the entire capacity of under Phase II of the mission.

At the same time, the 1:1 ratio of solar to thermal capacity (in MW) may not be required now as the solar tariff has fallen substantially during the last two years. As per estimates, bundling of conventional thermal power with solar power could be in the ratio of 1:2 to arrive at a tariff of about Rs. 5.5 to Rs 6 per unit for the bundled power. However, bundling scheme would have limited scope during Phase II of JNNSM due to limited availability of conventional power from unallocated central quota.

3.1.2 Generation Based Incentive

In order to ensure deployment of grid connected solar power on MW scale throughout the country and to give a thrust to rooftop PV and other small solar power plants connected at distribution network at voltage levels below 33 kV were envisaged under Phase I of JNNSM, guidelines for selection of projects under RPSSGP through IREDA were issued on 16th June, 2010. The GBI was equal to the difference between the tariff determined by the Central Electricity Regulatory Commission (CERC) or State Electricity Regulatory Commission (SERC) minus the base rate of Rs 5.50 per kWh (for the Financial year 2010-11) escalated by 3% every year. The projects were selected based on a two tier approach viz. pre-registration by States and thereafter selection through web-enabled process on first-come-first served basis. The projects were selected from 12 States.

Advantages

- Visibility of long term GBI revenue in the form of GBI ensures easy financing of projects
- Incentive is based on generation which encourages high plant performance

Disadvantages

- Long term commitment on higher rates for MNRE in the environment of falling solar power prices.

Applicability in Phase II

The Ministry had received requests from the remaining States for allocation of projects so as to gain experience in MW scale grid solar plants. Aiming at expanding the penetration of RPSSGP scheme

throughout the country, MNRE proposes to launch new programme in Phase II for States which could not be covered in the earlier allocation. Following shall be broad contour of the scheme:

- Only the States which were not covered under batch I scheme would be eligible.
- The Project will be connected to 33 kV grid and below.
- The size of projects will be in the range of 500 kWp to 2.5 MWp and capacity can increase in multiples of 500 kW only.
- Maximum permitted projects from a State can be up to the capacity to meet requirement of solar RPO at a rate of 0.25% of the energy consumption for that State with a minimum and maximum capacities of 1.0 MW and 5.0 MW, respectively.
- States can take benefit of these projects to meet their solar RPO targets.
- Selection of projects would be done by Solar Energy Corporation of India on the basis of discount to be offered by Project Developers on CERC / SERC Approved Applicable Tariff, whichever is lower.
- GBI shall be payable to the purchasing utilities for a period of 12 years from the date of commissioning of the project.
- Solar Energy Corporation of India (SECI) shall be designated as 'Programme Administrator' by the Ministry of New and Renewable Energy for administering the programme.

Taking into account the requirement of solar RPOs at the rate of 0.25% of the energy consumption, a target of up to 60 MW is proposed for support under this scheme. While working out the state-wise targets, the minimum and maximum solar capacity has been kept at 1.0 MW and 5.0 MW, respectively. The targets for the States which were not covered during RPSSGP-Batch-I are as follows:

Table 15: Phase II Targets under RPSSGP

S. No.	State	Demand as per 18th EPS during 2011-12 (MU)	State-wise targets (MW)
1	Arunachal Pradesh	435	1
2	Assam	6,081	5
3	Bihar	13,830	5
4	Delhi	27,029	5
5	JERC (Goa & UT)	3,482	5
6	Gujarat	75,576	5
7	Himachal Pradesh	7,847	5
8	Jammu and Kashmir	19,494	5
9	Karnataka	54,223	5

S. No.	State	Demand as per 18th EPS during 2011-12 (MU)	State-wise targets (MW)
10	Kerala	18,998	5
11	Manipur	554	1
12	Mizoram	455	1
13	Meghalaya	1,817	3.0
14	Nagaland	620	1
15	Sikkim	389	1
16	Tripura	927	1.5
17	West Bengal	46,822	5
	Total		**59.5 or say 60.0 MW**

Preferential tariff for solar PV technology approved by CERC and various SERCs is in the range of Rs 9-11/ kWh.As per the CERC draft tariff order for determination of levellised tariff for solar technology in 2013-14 dated Oct 25, 2012 tariff for solar PV has further come down to Rs 8.75 per unit (or Rs 7.87/unit after considering benefit of accelerated depreciation). Considering base rate of Rs 6/unit, MNRE would need to provide GBI of Rs 2-3 per unit which is quite lower than the GBI provided during Phase I.

3.1.3 Viability Gap Funding

Investment decisions in the infrastructure sector through private sector engagement remains a challenge These are generally characterized by substantial upfront investments, long gestation periods, fixed returns, etc. that make it essential that Government supports infrastructure financing, through appropriate financial instruments and incentives. Capital grant as an instrument of government support to make socially viable projects commercially viable through an efficient and transparent allocation basis is an accepted economic proposition.

With a view to support the infrastructure projects, the Scheme for Support to PPPs in Infrastructure (Viability Gap Funding Scheme) was announced in 2004 and the modalities to operationalise it put in place by 2005. The Scheme aims to ensure wide spread access to infrastructure provided through the PPP framework by subsidizing the capital cost of their access. Meeting the funding gap to make economically essential projects commercially viable would obviate the need for Government funding for such projects and allow private sector participation in the projects, thus facilitating private sector efficiencies in infrastructure development.

The Scheme provides financial support in the form of grants, one time or deferred, to infrastructure projects undertaken through public private partnerships with a view to make them commercially viable. The Scheme provides total Viability Gap Funding up to twenty percent of the total project

cost. The Government or statutory entity that owns the project may, if it so decides, provides additional grants out of its budget up to further twenty percent of the total project cost. Viability Gap Funding under the Scheme is normally in the form of a capital grant at the stage of project construction.

The Guidelines for Financial Support to PPPs in Infrastructure were issued by Ministry of Finance in January 2006. The guidelines essentially flow from the provisions of the Scheme, approved by CCEA in 2005, and prescribe the procedure to be followed for posing proposals for seeking Viability Gap Funding for PPP projects.

Salient features of Viability Gap Funding Scheme:

- VGF is not a pure subsidy scheme for infrastructure projects.
- It seeks to cover PPPs where private sector provides infrastructure services for a fee under a concession agreement
- Concession/Funding Support for development of project is granted on basis of transparent bidding process.
- Bidding parameter as 'Capital Grant' sought.
- Bidder is assured of stable environment through concession agreement.

Advantages of Viability Gap Funding Scheme:

- It addresses the issue of 'affordability' of user fee
- It leverages government grant to improve commercial viability of projects
- It ensures market based selection of promoter
- It promotes concept of developer (in place of contractor) and address project life cycle costs

Viability Gap Funding under Phase II of JNNSM

Capital cost of solar projects is still higher as compared to conventional thermal power and hence, cost of generation is more than the average cost of grid power. Bundling and GBI schemes have very limited scope in Phase II of JNNSM and Viability Gap Funding could be an attractive alternative for supporting solar projects during Phase II of the mission.

VGF on per MW capital cost

- Under this option, bidders would bid for viability gap funding requirement in Rs/MW and the bidder with minimum VGF requirement would be selected.
- Advantages:
    - Procedural simplicity
    - With upfront availability of part of capital cost, cost of financing would be lower

Disadvantages/ Limitations:

- With upfront payment of VGF, long term performance of the projects could be an issue.
- No penalty on lower generation or unsatisfactory performance of selected projects

If VGF is provided as upfront capital assistance, there is a possibility that project developers would bid aggressively ignoring the long term plant performance. This phenomenon would be detrimental for overall success of JNNSM. Therefore, disbursement of VGF would be done in multiple stages from selection of project. VGF payment should be subjected to compliance of strict project performance parameters which would be specified before award of project.

VGF Financing Plan

Under this Implementation Strategy, Central Government would provide viability-gap-funding support for setting up grid connected solar PV power projects capacity upto ___MW (*to be determined, say 750 to 1000 MW*)in the country under JNNSM Phase-II. The projects will be selected based on international competitive bidding for viability gap funding to make available generated solar power at a pre-fixed levelized tariff of Rs____per unit (*to be determined, say, Rs. 5 to 6 per unit*) to DISCOMs. The VGF would be provided on deferred payment basis to ensure completion of project as per guidelines of the scheme.

National Clean energy Fund (NCEF) is proposed to be used for used as a viability gap funding measure of the last resort, ensuring that the minimum possible NCEF funds are made available during the project cash-flow time-lines to ensure project viability for making available solar power at an affordable tariff in the range of Rs 5 to Rs 6 per unit. The projects would be set up by project developers on build, own and operate basis.

It is proposed that the VGF would be provided in three tranches as follows:

- 25% at the time of delivery of at least 50% of the major equipment at the site. This would be based on the cost of total procurement.
- 50% on successful commissioning of the full capacity of the plant
- Balance 25% after one year of operation meeting requirements of generation as per guidelines.

Major Activities

- MNRE shall determine a base tariff at which solar power would be supplied to utilities. CERC, through draft orders on determination of levellised solar tariff for 2013-

14,hasspecified the benchmark rate (paisa/unit) and benchmark capital cost (per MW) for FY 2013-14 on which calculations for VGF requirement would be done by the bidders.

- Bidders can bid for a maximum VGF of 40% of benchmark rate or benchmark capital cost
- Selection of bidders who require minimum VGF support.
- Development of VGF disbursement procedure by SECI

3.2 Strategies for Off-grid projects

Under Phase II of JNNSM, various strategies would be developed in order to promote off grid solar energy systems in the country. The strategies have been discussed in the section below,

3.2.1 Off-Grid and De-centralized Solar application

The scheme for Off-Grid and Decentralized Solar Applications would be continued with minor modifications such as increase in size of the projects up to 500 kW. The Phase II would focus on ease of flow of subsidies with major contribution of capital subsidy schemes instead of interest subsidy schemes. There would be special support provided to individuals' for solar lanterns, solar home lighting systems, power plants upto 3 kWp and pumping systems upto 5 kWp capacity. The scheme will involve RRBS and scheduled commercial banks for solar home lighting systems and solar pumps. The scheme will be modified in order to make it more simplified to operate. There will be involvement of LEDs in phase II which will help the remote household for meeting its lighting needs. Phase II would also provide support for providing solar power packs to individuals and support available for solar charging stations specially for village level entrepreneurs, etc. Focus of phase II would also involve support to SPV power plants for micro/mini grid SPV power plants with storage systems and distribution network.

3.2.2 Energy Access Scheme

Many of the households still lack access to modern forms of energy. Around 9 crore households are using kerosene for cooking and lighting requirements. Under the Remote Village Electrification Scheme, around 9000 villages have been covered so far. There are many areas where grid has reached but electricity is not being provided. With this objective, MNRE, under JNNSM Phase II would develop an Energy Access Scheme to provide electricity mainly to the off grid areas. The scheme will be mainly effective for replacement of diesel and kerosene from the remotely located households where the heating and lighting requirements are presently being met by the use of diesel and kerosene. The scheme shall be more focused towards targets which are product linked and also enhances the income generation activities. The scheme shall encourage replacement of non renewable energy sources like fossil fuels, kerosene and diesel with solar energy to meet the requirements. The scheme would support upto 90 per cent of the cost of systems for generation of electricity in off grid areas. The scheme would replace Remote Village Electrification Scheme of MNRE and would have better coverage.

Two to five light points (around 9 W each) and one to three sockets for operating electronic gadgets to each of the willing households in the village may be provided through mini grid mode (from more than 10 kW to 500 kW per site) or micro grid mode (up to 10 kW) through various renewable energy resources depending upon the availability of resources and load requirement. The new scheme would involve all census un-electrified villages, un-electrified hamlets of electrified census villages and also covering electrified villages and hamlets where power availability is less than 6 hours per day averaged over the year. Special emphasis would also be laid for promotion of mini grids in rural areas.

3.2.3 Scheme for Solar Cities

JNNSM would also focus on the inclusion of Solar Cities programme under Phase II. The program assists Urban Local Governments in preparation of a master plan for increasing energy efficiency and renewable energy supply in the city; setting-up institutional arrangements for the implementation of the master plan; and awareness generation and capacity building activities.The program aims at minimum 10% reduction in projected demand of conventional energy at the end of five years, which can be achieved through a combination of energy efficiency measures and enhancing supply from renewable energy sources. A total of 60 cities/towns were proposed to be supported for development as Solar Cities during the 11th Plan period. Up to Rs. 50.00 Lakhs per city/town is provided depending upon population and initiatives decided to be taken by the City Council/ Administration. The Phase II would focus on inclusion of the programme with funding support available and with inclusion of more number of cities under the said programme.

3.2.4 Benchmarking of Costs

In current mechanism Rs.270 per Wp is the benchmark cost for PV systems. Normally, this cost varies for different sizes and configurations. Phase II will focus on benchmarking of costs every year and subsidies will be calculated linked to such annual benchmark cost values to allow reduction of prices.

3.2.5 Procurement through bidding

Phase II would focus on improvement in quality and wider access to cheaper products. This would be promoted by procurement through bidding process wherever possible. This will encourage larger participation of the private players in the off grid solar sector.

3.2.6 Expansion of Service Network and Visibility in Markets

Phase II would also focus on expansion of service network. This will involve larger number of private players at various levels with spread across regions, zones, block segments. Visibility in the markets will also be increased through long term continuous publicity campaigns and awareness programmes with wide reach. Information about the products / different brands will be available; with this the customers will have choice for better quality and access to cheaper standard products.

3.2.7 Development of Standards

The rapid and large-scale diffusion of Solar Energy will require a concomitant for development of standards for solar products. Phase II would focus on developments of standards for solar devices which will support in high performance of the solar products as well as ease in disbursement of subsidies. To standardize each component used in solar projects International and national level standards shall be allowed to use as per availability and acceptability of Standards in Indian market

3.2.8 Development of Star Rating Systems

At present, there are different types of solar devices available in the market, with different brands and with lots of variation in costs of the products. Every product has a different performance level. With this backdrop, Phase II would focus on development of star rating systems which will facilitate customers in buying efficient products at standard costs.

3.2.9 Expansion of Testing Facilities

As there would be focus of development of standards and star rating systems for solar devices and appliances, this will require large number of testing facilities in order to check the standards and star ratings and even performances of the systems. In this regard, Phase II would focus on expansion of testing facilities of solar devices and would also develop some strategies for testing the devices in fields.

3.2.10 Online Disbursement of Subsidies

At present, the disbursement of subsides is a lengthy process and by the time consumers lose interest in the particular solar product. In phase II, there would be development of online system for disbursement of subsidies for the promotion of off grid solar energy systems.

3.2.11 IT Enabled Monitoring Systems

Information and Communication Technology would form the backbone of monitoring system. Phase II would also focus on development of IT enabled monitoring systems. This would facilitate monitoring and verification of use of subsidies with programme administrators and various channel partners.

4 Role of States

4.1 State Level initiative during Phase-I

The main objective of JNNSM is to bring development of the entire value chain across the country, which requires wider participation of States. During Phase-I, Roles of States was very limited due to smaller target capacity of 1100 MW. Whereas, Phase-II envisage bringing cumulative capacity of solar to 10 GW for which participation of all States is required in a big way. Some of the States have already started their own solar programmes and some states are still focusing on central scheme for development of Solar Industry in their States. Table below is presenting the State wise installed solar power capacity under JNNSM and various State programmes

Table 16: State wise Solar Capacity[vii]

S.No	States/ Union Territory	Solar Capacity (MW)
1.	Andhra Pradesh	24.75
2.	Chhattisgarh	4
3.	Gujarat	698.81
4.	Haryana	7.8
5.	Jharkhand	16
6.	Karnataka	19
7.	Madhya Pradesh	7.96
8.	Maharashtra	21
9.	Orissa	13
10.	Punjab	9.3
11.	Rajasthan	201.65
12.	Tamil Nadu	17.1
13.	Uttar Pradesh	14.38
14.	Uttarakhand	5.1
15.	West Bengal	2.1
16.	Andaman & Nicobar	0.1
17.	Delhi	2.5
18.	Lakshadweep	0.8
19.	Total	1,050 (Approx)

Encouraged from the success of Phase-I of JNNSM, few states initiated their own solar programme. Out of this 1050 MW solar capacity about 290 MW has come under national Programme and over 760 MW capacities has come under States solar schemes. Some of the solar rich states have been the foci of Solar development but slowly and gradually deployment of Solar power is spreading in

each every corner of county. Status of initiatives taken by states to develop solar power via State specific solar programme is shown in table below

Table 17: Status of State Specific Solar Programme[viii]

S. No	State	Solar Specific Programme
1	Gujarat	Announced – 968.5 MW Commissioned – 690 MW
2	Maharashtra	Announced – 205 MW Commissioned – 40 MW (Setup In Rajasthan)
3	Karnataka	Commissioned – 8 MW, Plans for 600 MW Bids Invited – 80 MW
4	Rajasthan	Announced – 200 MW
5	Odisha	Awarded – 25 MW Announced – 50 MW
6	Madhya Pradesh	Awarded – 200 MW
7	Tamil Nadu	Announced – 3000 MW
8	Total	Announced – 5000 MW (Approx)

4.2 Target Setting at State level during phase-II

Although the Tariff Policy has been amended by the Government to require State Electricity Regulators to fix a percentage of energy purchase from solar power with 0.25% (by 2013) with increasing trajectory up-to 3% (by 2022), many States are yet to specify long term solar RPO trajectory. The requirement of solar capacity based on yearly increase in solar RPO by 0.25% works out to be over 9 GW. This implies that if compliance to solar RPO, complimented with robust mechanism of RECs is enforced, it will not be difficult to accomplish cumulative solar power capacity in the country to reach 10 GW by 2017 from present capacity base of just over 1 GW.

Table 18: Demand & Supply Scenario[ix]

States	Solar Capacity Required to fulfill RPO targets (MW)					Installed capacity by Aug,2012	Deficit Capacity for 2012-13
	2012-13	2013-14	2014-15	2015-16	2016-17	MW	MW
Andhra Pradesh	140.80	302.92	488.77	701.03	942.62	24.75	**116.05**
Arunachal Pradesh	0.84	1.66	2.46	3.23	3.97	0.03	**0.81**
Assam	10.05	23.45	41.04	63.85	93.13	0	**10.05**
Bihar	24.11	56.95	100.87	158.82	234.42	0	**24.11**

Chhattisgarh	25.09	58.77	103.23	161.20	235.99	4	**21.09**
Delhi	43.73	100.18	172.13	262.90	376.44	2.55	**41.18**
JERC (Goa & UT)	19.75	43.29	71.17	104.01	142.51	1.7	**18.05**
Gujarat	117.01	256.89	423.02	619.16	849.62	689.81	**-572.80**
Haryana	56.85	122.86	199.12	286.87	387.45	7.8	**49.05**
Himachal Pradesh	12.81	28.18	46.48	68.17	93.72	0	**12.81**
Jammu and Kashmir	20.62	41.81	63.59	85.97	108.96	0	**20.62**
Jharkhand	9.78	21.35	34.96	50.89	69.43	16	**-6.22**
Karnataka	91.69	193.70	306.91	432.26	570.75	19	**72.69**
Kerala	30.02	63.51	100.76	142.10	187.87	0.03	**29.99**
Madhya Pradesh	76.15	163.24	262.47	375.12	502.60	7.96	**68.19**
Maharashtra	208.63	431.51	669.37	922.97	1193.12	21	**187.63**
Manipur	0.90	2.10	3.67	5.69	8.28	0	**0.90**
Mizoram	0.84	2.47	5.46	10.75	19.82	0	**0.84**
Meghalaya	2.17	3.44	4.08	4.30	4.25	0	**2.17**
Nagaland	0.90	2.05	3.48	5.24	7.42	0	**0.90**
Orissa	36.54	81.23	135.45	200.75	278.94	13	**23.54**
Punjab	72.75	164.13	277.75	417.78	589.13	9.33	**63.42**
Rajasthan	77.60	163.98	259.88	366.10	483.50	201.65	**-124.05**
Sikkim	0.58	1.22	1.91	2.66	3.47	0	**0.58**
Tamil Nadu	133.86	293.09	481.30	702.56	961.44	10	**123.86**
Tripura	1.53	3.47	5.89	8.88	12.56	0	**1.53**
Uttarakhand	15.32	31.28	47.91	65.22	83.25	5.05	**10.27**
Uttar Pradesh	123.44	262.55	418.84	593.93	789.56	14.38	**109.06**
West Bengal	60.30	131.78	215.97	314.63	429.71	2.05	**58.25**
Total	1414.66	3053.05	4947.93	7137.02	9663.93	1050.09	**364.57**

As per the table shown above, India's current installed capacity is 1,050 MW by Aug 2012, whereas requirement capacity is around 1,414 MW which shows a deficit of around 26%. Hence states should come forward in more aggressive manner to fulfill the targets set at State as well as at national level

4.3 State action plan and support required during phase-II

It must be recognized that the key element in the overall strategy of capacity additions through RPO route will be as under:

i. Announcement of policy by all the States with targets of annual solar RPOs
ii. Robust enforcement mechanism for compliance of Solar RPO targets

iii. Strengthening of RECs framework
iv. Facilitation and support for Solar project development at State level
v. Ease of Access to infrastructure – land, evacuation, grid access
vi. Off-take arrangements with adequate Payment security mechanism at State level

For successful implementation of Phase-II, States are expected to extend their support in various ways to provide encouragement to solar industry and to make them globally competitive. States could adopt following measures to ensure development of solar power in their States.

a. Providing Fiscal and Financial incentives to Solar projects coming their States
b. Strengthening RPO enforcement and Monitoring to ensure absorption of Solar power generated in the States
c. Developing States specific solar programmes focusing development of entire value chain for Solar Industry
d. Developing Solar parks in their States
e. Providing Incentives to off-grid manufacturers
f. Developing schemes for promotion of Solar manufacturing units
g. Building and Strengthening of transmission and Distribution network
h. Developing skilled manpower by providing specialized courses at various education levels
i. Reducing Duties, Taxes, VAT etc or Providing Concessions on various solar equipments
j. Exemption of Electricity duty for captive use and third party Sale
k. Identification of Land banks
l. Providing land at concessional rates or waiver of Stamp duty and land registration charges
m. Concessional wheeling and transmission charges for solar power
n. Banking provision at concessional charges
o. Appointment of a Nodal Agency to facilitate solar power development in State
p. Approval for purchase of solar power by utilities at grid parity rate
q. Assisting Off-take arrangements from State utilities
r. Promoting measures for timely payment for solar power purchase

Development of State level Action Plans to meet with Solar RPO targets in line with NAPCC and Tariff Policy requirement would be first step towards accomplishment of the Mission objectives. Sharing of best practices and policy measures, State level initiatives across States would be useful in developing such State level Action Plans. MNRE shall provide requisite support and facilitation in in knowledge sharing, stakeholder consultation, capacity building initiatives etc.

5 Proposed Implementation Plan: Central Schemes during Phase-II

5.1 Key Implementation Issue-1: Domestic Content Requirement

National Solar Mission aims at deploying solar power across the country but it also mandates to ensure that development across the entire value chain. Hence, developing domestic manufacturing capacity across value chain is also one of the thrust areas of the Mission. To ensure the development of domestic manufacturing, provision of Domestic content requirement is introduced under the mission. However, there is no significant capacity utilization despite addition of manufacturing capacity as observed during Phase I.

Key Considerations for Domestic Content Requirement during Phase-II are as under:

i. Development of 4-5 GW of manufacturing capacity is one of the objectives of JNNSM
ii. Current manufacturing capacity (SPV): ~1500 MW
iii. Cheaper international loans available with imported components
iv. DCR conditions under schemes entailing direct funding support by Central Government could facilitate development of domestic manufacturing capacity base.

In view of above, there could be following options considered to operationalise domestic content requirement during Phase-II.

a) Option-1: For all PV projects, cells and modules produced in India shall be used
b) Option-2: Price preference for domestic manufactured cells/ modules
c) Option-3: Percentage of domestic content in cost terms (say 50%) for both PV and thermal technologies
d) Option-4: Percentage of cells manufactured in India
e) Option-5: Some batches with 100% domestic content requirement
f) Option-6: For thermal technologies material equivalent to 50% of supply costs (excluding land, taxes, erection, financing, soft costs, etc) should be manufactured in India during Phase II

In order to operationalise domestic content requirement any of the above conditions or combination of above conditions could be used.

5.2 Key Implementation Issue-2: Inter-technology (PV and thermal) targets for Phase-II

During Phase-I of JNNSM, ratio of 50:50 was followed for solar PV and solar thermal capacity addition target. For Solar PV, **58 Projects of 500 MW** capacity were allotted (Batch-I,II) and for Solar thermal **7 Projects of 470 MW** capacity allotted during Phase-I. Further, 13 SPV projects of 54 MW capacity and 3 solar thermal projects of 30 MW capacity were also **migrated to Phase I.**

Lowest tariff discovered was INR 10.95/kWh in Batch-I and INR 7.49/kWh in Batch-II for Solar PV whereas for solar thermal lowest tariff was INR 10.49/ kWh. 25 Solar PV projects of 125 MW allotted during batch-I are commissioned whereas Batch-II SPV projects and solar thermal projects are expected to be commissioned during 2013.

While solar thermal power projects (except 2.5 MW under migration scheme) are yet to be commissioned during Phase-I, the learning, implementation hurdles and operational issues are yet to be gathered which can be incorporated into while devising guidelines for implementation of Solar thermal power projects during Phase-II. On the other hand, there is significant learnings for solar PV implementation and falling costs of solar PV installations, higher share of solar PV project development is proposed during Phase-II.

Proposed share of (Solar PV & Solar thermal) & (Central/State) during Phase-II

Table 19: Inter-technology Targets at Central and State Level

Item Description	Ratio	Central Schemes	State Schemes
Solar PV	70%	40%	60%
Solar thermal	30%	40%	60%

Proposed share of Target Capacity Mix (Solar PV & Solar thermal) & (Central/State) during Phase-II

Table 20: Technology wise Capacity allocation

Item Description	Capacity (MW)	Central Schemes (MW)	State Schemes (MW)
Solar PV	6300	2520	3780
Solar thermal	2700	1080	1620
TOTAL	**9000**	**3600**	**5400**

5.3 Key Implementation Issue-3: Timelines and Implementation Plan

JNNSM Phase-II shall comprise of various strategies for deploying solar power across the various States in India. As the target capacity addition is much higher in comparison to phase-I, it is proposed to spread Phase-II in two batches like phase-I. While devising implementation plan, it is envisaged that selection of project developers and award of contract would be taken up during initial two financial years through a bidding process so as to discover the true price of solar power. For phase-II, share of target capacity under VGF is kept higher in comparison to bundling due to the fact that there is not enough unallocated power available with central govt. to cater the need of higher capacity under bundling with solar power. Bidding process for Solar thermal shall be undertaken during FY2014-15 so that sufficient learnings from implementation and operationalisation of solar thermal projects during Phase-I can be incorporated during Phase-II and sufficient time is available for installation of solar thermal projects by end 2017 during Phase-II.

Proposed implementation plan for development of Solar power under Central Schemes during phase-II shall be as under:

Table 21: Target Capacity Matrix for Phase-II

Item description	2012-13	2013-14	2014-15	2015-16	2016-17	SUM
Rooftop & Small Solar						
- PV		100	100			**200**
Bundling						
- PV		800				**800**
VGF						
- PV		750	770			**1520**
- thermal			1080			**1080**
Total		**1650**	**1950**			**3600**
- PV		**1650**	**870**			**2520**
- thermal			**1080**			**1080**

6 Annexure -1

6.1 Project under RPSSGP

As per the data collected by IREDA for projects under RPSSGP scheme for the month of July, Aug and September, 2012 performance of projects is shown in table below

Table 22: Net Exportable Energy (July, 2012)

Company Name	State	Capacity (MW)	Net Exportable Power (kwh)
M/S. S.N.MOHANTY	ORISSA	1	66960
Adora Energy Private Limited	MADHYA PRADESH	2	169400
AEW INFRATECH PVT LTD	RAJASTHAN	1	134500
APGENCO	ANDHRA PRADESH	1	115550
APIIC	ANDHRA PRADESH	1	108057
B&G Solar Private Limited	TAMIL NADU	1	137947
BHAVANI ENGINEERING	ANDHRA PRADESH	1	97538
C&S Electric Limited	HARYANA	1	110800
CHANDRALEELA POWER ENERGY PRIVATE LIMITED	HARYANA	0.8	88035
Citra Real Estate Limited	MAHARASHTRA	2	138178
Dante Energy Private Limited	UTTAR PRADESH	2	43369
Dhruv Milkose	UTTAR PRADESH	1	76192
DR. BABASAHEB AMBEDKAR SSK LTD	MAHARASHTRA	1	110600
Gajanan Financial Services Pvt Lt	ANDHRA PRADESH	1	250526
H.R. Minerals & Alloys Pvt. Ltd.	HARYANA	1	88776
Kijalk Infrastructure Pvt. Ltd	JHARKHAND	2	104240
Kishore Electro Infra Pvt Ltd	ANDHRA PRADESH	1	93923
KVR CONSTRUCTIONS	JHARKHAND	2	90000

Company Name	State	Capacity (MW)	Net Exportable Power (kwh)
New ERA Enviro Ventures Pvt. Ltd.	JHARKHAND	2	166200
PCS PREMIER ENERGY PVT LTD		2	160600
Premier Solar Systems Pvt. Ltd.	JHARKHAND	2	151200
RAAJRATNA ENERGY HOLDINGS PRIVATE LIMITED	ORISSA	1	71827
Saimeg Infrastructure Pvt. Ltd	JHARKHAND	2	155760
SDS SOLAR PVT. LTD.	HARYANA	1	133021
Sepset Constructions Limited	MAHARASHTRA	2	148920
Singhal Forestry Private Limited	CHHATTISGARH	2	157141
SriPower Generation (India) Pvt Ltd	ANDHRA PRADESH	1	95150
SunEdison Energy India Pvt. Ltd.	RAJASTHAN	1	81386.1
Technical Associates Limited	UTTAR PRADESH	2	203338.3
VIVEK PHARMACHEM (INDIA) LIMITED	RAJASTHAN	1	100496

Table 23: Net Exportable Energy (August, 2012)

Company Name	State	Capacity (MW)	Net Exportable Power (kwh)
M/S. S.N.MOHANTY	ORISSA	1	82890
Adora Energy Private Limited	MADHYA PRADESH	2	152890
AEW INFRATECH PVT LTD	RAJASTHAN	1	118700
APGENCO	ANDHRA PRADESH	1	110010
APIIC	ANDHRA PRADESH	1	112373
B&G Solar Private Limited	TAMIL NADU	1	137803
BHAVANI ENGINEERING	ANDHRA PRADESH	1	120851
C&S Electric Limited	HARYANA	1	87500

Company Name	State	Capacity (MW)	Net Exportable Power (kwh)
CHANDRALEELA POWER ENERGY PRIVATE LIMITED	HARYANA	0.8	68012
Citra Real Estate Limited	MAHARASHTRA	2	163054
Dhruv Milkose	UTTAR PRADESH	1	77598
DR. BABASAHEB AMBEDKAR SSK LTD	MAHARASHTRA	1	119100
Gajanan Financial Services Pvt Lt	ANDHRA PRADESH	1	291518
H.R. Minerals & Alloys Pvt. Ltd.	HARYANA	1	92764
Kijalk Infrastructure Pvt. Ltd	JHARKHAND	2	192680
KVR CONSTRUCTIONS	JHARKHAND	2	109300
MOLISATI VINIMAY PRIVATE LIMITED	JHARKHAND	1	71355
New ERA Enviro Ventures Pvt. Ltd.	JHARKHAND	2	159800
PCS PREMIER ENERGY PVT LTD		2	154100
Premier Solar Systems Pvt. Ltd.	JHARKHAND	2	142400
RAAJRATNA ENERGY HOLDINGS PRIVATE LIMITED	ORISSA	1	85582.5
RV Akash Ganga Infrastructure Ltd.	UTTARAKHAND	2	204725
Saimeg Infrastructure Pvt. Ltd	JHARKHAND	2	135900
SDS SOLAR PVT. LTD.	HARYANA	1	112161
Sepset Constructions Limited	MAHARASHTRA	2	163762
Singhal Forestry Private Limited	CHHATTISGARH	2	177350
SriPower Generation (India) Pvt Ltd	ANDHRA PRADESH	1	108350
SunEdison Energy India Pvt. Ltd.	RAJASTHAN	1	83169
Technical Associates Limited	UTTAR PRADESH	2	210981.1

Table 24: Net Exportable Energy (September, 2012)

Company Name	State	Capacity (MW)	Net Exportable Power (kwh)
M/S. S.N.MOHANTY	ORISSA	1	89650
Abacus Holdings Private Limited	ORISSA	1	93690
Adora Energy Private Limited	MADHYA PRADESH	2	236746
AEW INFRATECH PVT LTD	RAJASTHAN	1	144200
AKR Construction Limited	JHARKHAND	2	169800
Amrit Jal Ventures Ltd.	ANDHRA PRADESH	1	145511.8
APGENCO	ANDHRA PRADESH	1	124740
APIIC	ANDHRA PRADESH	1	116485
B&G Solar Private Limited	TAMIL NADU	1	140853
BHAVANI ENGINEERING	ANDHRA PRADESH	1	118394
C&S Electric Limited	HARYANA	1	115340
CHANDRALEELA POWER ENERGY PRIVATE LIMITED	HARYANA	0.8	93751
Citra Real Estate Limited	MAHARASHTRA	2	213860
Dhruv Milkose	UTTAR PRADESH	1	97752
DR. BABASAHEB AMBEDKAR SSK LTD	MAHARASHTRA	1	121400
Gajanan Financial Services Pvt Lt	ANDHRA PRADESH	1	313694
H.R. Minerals & Alloys Pvt. Ltd.	HARYANA	1	109592.6
JAY ACE TECHNOLOGIES LTD.	UTTARAKHAND	2	224162
Kijalk Infrastructure Pvt. Ltd	JHARKHAND	2	247604
KVR CONSTRUCTIONS	JHARKHAND	2	195930
Lanco Solar Pvt. Ltd	RAJASTHAN	1	125884
M/s RL Clean Power Pvt Ltd.	TAMIL NADU	1	144696

Company Name	State	Capacity (MW)	Net Exportable Power (kwh)
New ERA Enviro Ventures Pvt. Ltd.	JHARKHAND	2	209450
Premier Solar Systems Pvt. Ltd.	JHARKHAND	2	175400
RAAJRATNA ENERGY HOLDINGS PRIVATE LIMITED	ORISSA	1	90750.5
Saimeg Infrastructure Pvt. Ltd	JHARKHAND	2	158600
SDS SOLAR PVT. LTD.	HARYANA	1	147153
Sepset Constructions Limited	MAHARASHTRA	2	216990
Singhal Forestry Private Limited	CHHATTISGARH	2	228770
SriPower Generation (India) Pvt Ltd	ANDHRA PRADESH	1	116175
SunEdison Energy India Pvt. Ltd.	RAJASTHAN	1	112305.4
Technical Associates Limited	UTTAR PRADESH	2	219351.2

ENDNOTES

[i]Source: NREL , dated 16th Aug 2010
[ii]Source: ABPS Analysis
[iii]Source: MNRE: Energy Access Nov, 2012
[iv]Source: MNRE - Cumulative deployment of various Renewable Energy Systems/ Devices in the country as on 31/08/2012
[v]Source: MNRE – June 21,2012
[vi]Source: MNRE – June 21,2012
[vii]Source: MNRE – 31st Aug 2012
[viii]Source: MNRE
[ix] ABPS analysis