Strategic Planning of Solar Parks in Madhya Pradesh, India

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Summary: **Objective is to identify the bottlenecks and assess the pragmatic solutions which catalyze in setting up of 'Solar Parks in Madhya Pradesh'. These Ultra Mega Solar Parks would not help in attaining parity with convectional energy generation sources but would also assist in consolidating India commitment to Climate Change commitments (UNFCCC) like Intended Nationally Determined Contribution (INDC).**

Key words: **Solar Photo-Voltaic Plant, Strategic Planning, Solar Park, Ultra-Mega Solar Power Projects, Renewable Energy, Energy security.**

Abstract: **India will celebrate 75 years of Independence in 2022, to mark this as special occasion; Prime Minister Narendra Modi has set an ambitious target to achieve 100 GW of solar power capacity, this would usher Clean Energy Revolution and overcome dependency on Coal which contributes approximately 60% of generation. Presently India has augmented solar capacity till 8 GW *(as on July 2016)*. Thus, moving from 8.7 GW in October 2016 to 100 GW by 2022 is one of the most ambitious targets globally.**

I. INTRODUCTIONS

India's topographic, geographic and better annual solar isolation advantage, provides a conducive business environment for setting up solar power plant but to overcome the challenges of setting up of individual or smaller capacities of Solar power projects which are scattered at various coordinates in Madhya Pradesh not only incurs significant expenses in developing site(s), procuring water, drawing separate transmission lines from Plant to nearest substation, but also augments the project cost per MW and escalates transmission losses in downstream. ***[MNRE, 2014]***

To overcome the above challenges, Government of India initiated scheme in December 2014 which could aid Solar Power Project Developers (SPPD's) in "Bidding, Erection, Commissioning & Operationalization of Ultra-Mega Solar and Solar Parks Power Projects" at plug-and-play mode.

The scheme envisages to provide a robust momentum to generation of solar energy by encouraging project developers and investors to set up projects of similar nature at various intended location in India, thus improving technology, triggering cost-reductions through economies of scale theory and achieving large scale greenhouse gas emissions reductions. It would also allow States to utilized categorized barren/unused Land, but also divert in investment from National and International agencies, hereby strengthening financial health of Nodal Agency, achieving its solar renewable purchase obligation and create employment for local people.

II. INDIA'S – SOLAR SCENARIO

Power is the most critical infrastructure components for the economic growth and Nation prosperity. For existence, development and sustained growth of the Indian economy it essential to diversify the power generation from conventional sources *(Coal, Lignite, Natural Gas, Oil, Hydro And Nuclear Power)* to Renewable Energy sources *(Wind, Solar, Agricultural, Geothermal heat, sea waves, or bio mass Domestic Waste)* which continuously replenishes itself.

Confident by the growth rate in clean energy sector and with Technological and Financial support from Green Climate Fund, the Government of India has submitted its Intended Nationally Determined Contribution at United Nations Frame Work Convention on Climate Change envisaging that it will restrict its energy generation from convectional fuel to 40 % till 2030.

The tentative break up of cumulative On Grid-interactive & Off-grid renewable energy capacity as 31/12/2016 is as following:-

Sector	FY- 2016-17		Cumulative Achievements
	Target	Achievement (April – December, 2016)	(as on 31.12.2016)
I. GRID-INTERACTIVE POWER CAPACITIES (MW)			
Wind Power	4,000.00	1,922.99	28,700.44
Solar Power	12,000.00	2,149.81	9,012.66
Small Hydro Power	250.00	59.92	4,333.85
Bio-power (Biomass & Gasification and Bagasse Cogeneration)	400.00	101.00	7,856.94
Waste to Power	10.00	7.50	114.08

Total	**16,660.00**	**4,341.22**	**50,017.97**
II. OFF-GRID AND CAPTIVE POWER CAPACITIES (MW_{EQ})			
Waste to Energy	15.00	4.47	163.35
Biomass (non-bagasse) Cogeneration	60.00	0.00	651.91
Biomass Gasifiers -Rural	2.00	0.00	18.34
-Industrial	8.00	4.30	168.54
Aero-Genrators/Hybrid systems	1.00	0.38	2.97
SPV Systems	100.00	98.50	405.54
Water mills (WM)/micro hydel	1 MW + 500 (WM)	0.10 MW + 100(WM)	18.81
Total	**187.00**	**107.75**	**1429.46**

Table 1: On Grid and off Grid interactive Renewable energy Capacity ***[Source: MNRE]***

Major Initiatives taken by Ministry

Government of India has came out with following initiatives Acts and Policies to promote renewable Energy

Acts and Policies

- The Electricity Act 2003 has accelerated the process of co-generation and renewable energy development in the country. And provides guiding frame work for States under Section 63 of the EA-2003 for arriving on a tariff by transparent competitive procurement process.
- The National Electricity Policy 2005 stipulates that distribution companies would increase the share of electricity from non- conventional resources by purchasing a through competitive process.
- National Tariff Policy 2006 announced by Ministry of Power states the Appropriate Commission shall decide a minimum percentage for purchase of energy from non- conventional source according the availability of resources in that region and its impact on retail tariffs.

Solar Power

- Under National Solar Mission, solar capacity has been augmented from 20 GW to 100 GW till 2021-22. For 2016-17, target of 10,500 MW has been decided to a cumulative capacity of 17 GW up to 31/03/ 2017. ***[Year End Review –MNRE, PIB, India 2016]***
- In 21 Indian states, 34 Solar Parks of 20,000 MW capacities had been sanctioned. ***[Year End Review –MNRE, PIB, India 2016]***
- Solar pumps cumulating to 90,710 have been installed throughout the India (as on 31.10.2016). ***[Year End Review –MNRE, PIB, India 2016]***
- INR 67.01 crore has been sanctioned for promoting activities, master plans preparation, solar city units and installing renewable energy projects. ***[Year End Review –MNRE, PIB, India 2016]***
- Under Solar City Programme, INR 24.16 crore has been released. ***[Year End Review –MNRE, PIB, India 2016]***
- SECI has identified central and state government owned buildings/departments and issued a India's largest rooftop solar tender of 1,000 MW capacities. ***[Year End Review –MNRE, PIB, India 2016]***

Solar Rooftop

- Besides the private sector, all key sectors like, *Airports, Railways, Hospitals, Educational Institutions, Government Buildings under Central/State/PSUs* are have been covered under grid connected rooftops solar target of 40 GW . ***[Year End Review –MNRE, PIB, India 2016]***
- Various State/UT Electricity Regulatory Commissions have notified feed-in-tariff mechanism or net-metering regulations under which approximately INR 5000 crore has been approved and till 30.09.2016, solar rooftop capacity of 500 MW have been installed. ***[Year End Review –MNRE, PIB, India 2016]***
- International donors like Asian Development Bank, World Bank, KFW and New Development Bank *(previously referred BRICS Development Bank)* has sanctioned $ 1300 million dollars which would be disbursed at rate of less than 10%. by various Nationalized banks like IREDA, *PNB, Canara Bank* and *SBI.* ***[Year End Review –MNRE, PIB, India 2016]***
- Ministry has tied up with ISRO for Geo tagging of all the Rooftop plants using ISRO's VEDAS Portal. ***[Year End Review –MNRE, PIB, India 2016]***

Wind Power

- During the year 2015-16, highest ever wind power capacity addition of 3.42 GW was made in the country during a single year. Presently India's wind power installed capacity is around 28.28 GW and ranks 4th after China, USA and Germany. . ***[Year End Review –MNRE, PIB, India 2016]***
- India has approximately 20 approved manufacturers with 53 models of wind turbines manufactures up to a single turbines capacity of 3.00 MW. Wind turbines being manufactured in India are of international quality standards and cost-wise amongst the lowest in the world being exported to Europe,

USA and other countries. . ***[Year End Review – MNRE, PIB, India 2016]***

- National Institute for Wind Energy (NIWE) reassesses Wind power potential of 302 GW at 100 meter hub-height. Online wind atlas is available on NIWE website. . ***[Year End Review –MNRE, PIB, India 2016]***
- Indian cabinet has notified **National Offshore Wind Energy Policy** *on 6th October 2015*. For utilizing the offshore wind power projects on its extended coastline. NIWE is in process of assessing the wind resource in coastal areas near Gujarat and Tamil Nadu. . ***[Year End Review –MNRE, PIB, India 2016]***
- Comprehensive Guidelines for Development of **On-shore Wind Power Projects** has been formulated and issued *on 22nd October 2016*. . ***[Year End Review –MNRE, PIB, India 2016]***
- Guidelines for implementation of "**Scheme for Setting up of 1000 MW Inter-State Transmission System (ISTS) - connected Wind Power Projects**" *issued on 22nd October 2016*. ***[Year End Review – MNRE, PIB, India 2016]***
- To promote optimum utilization of wind energy resources, Policy for Repowering of the Wind Power Projects has been released on 5th August, 2016. ***[Year End Review –MNRE, PIB, India 2016]***

III. INDIA'S - SOLAR ENERGY

Bifurcation of India ambitious plans of augmenting renewable energy to 175 GW till year 2022 under National Solar Mission is as following:-

Renewable Energy Source		**Capacity (GW)**	
Solar Power	Rooftop Systems	40	100
	Ground Mounted Grid Connected System	60	
Wind Power		60	
Biomass Power		10	
Small Hydro Power		5	
Cumulative Capacity (MW)		175	

Table 2: Bifurcation of 175 GW

Apart from ambitious roof-top solar installation scheme has been launched by the Ministry, it has also launched other several schemes to achieve 100 GW Solar Power objective are

☼ Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects ***[MNRE, India 2014]***	☼ Scheme for Development of Solar PV Power Plants on Canal Banks/ Canal Tops ***[MNRE-Schemes and Document]***
☼ 34 Solar parks aggregating to 20,000 MW have been approved in 21 States.	☼ 100 MW projects Canal Bank/ Canal Top scheme
☼ MNRE has 'granted' **Viability Gap Funding** for **Central Public Sector Undertakings (CPSUs)** and '**Government Of India Organization** @ INR. 1 crore per MW	
☼ Scheme for setting up 300 MW of Grid connected Solar PV Power Projects by **Defense Establishments** ***[MNRE-Schemes and Document]***	☼ Scheme of setting up 1000 MW of Grid- Connected Solar PV Power Projects by **CPSUs** ***[MNRE-Schemes and Document]***
☼ 15000 MW grid connected Solar Power Projects by National Thermal Power Corporation /NTPC Vidyut Vyapar Nigam	☼ 2000 MW Grid connected solar power through Solar Energy Corporation of India.

Table 3: Capacities under various schemes

I. *SOLAR PARKS IN INDIA*

The solar parks are concentrated zones for developing projects of solar power generation and providing Developers land which is well characterized, with defined infrastructure along with convenient accessibility to amenities and minimizing the risk associated with the projects, For *Example reducing the number of approvals required for developers*, which significantly reduce the time between gestation, erection, commissioning and power evacuation time.

S. No.	**State**	**Capacity (MW)**	**Name of the Solar Power Parks Developer**	**Land identified**
1	Andhra Pradesh	1,500	AP Solar Power Corporation Pvt. Ltd, JVC of SECI, APGENCO and NREDCAP	NP Kunta of Ananthapuramu and Galiveedu of Kadapa Districts
2		1,000		Kurnool District
3		1,000		Galiveedu Madal, Kadapa district
4		500		Talaricheruvu Village, Tadipathri Mandal, Anathapuramu District of Andhra Pradesh
5	Arunachal Pradesh	100	Arunachal Pradesh Energy Development Agency (APEDA)	Tezu township in Lohit district
6	Assam	69	JVC of APDCL and APGCL	Amguri in Sibsagar district
7	Chhattisgarh	500	Chhattisgarh Renewable Energy Development Agency	Rajnandgaon, Janjgir Champa districts

8	Gujarat	700	Gujarat Power Corporation Limited	Radhanesda, Vav, District Banaskantha
9	Haryana	500	Saur Urja Nigam Haryana Ltd (SUN Haryana)	Bugan in Hisar district, Baralu and Singhani in Bhiwani district and Daukhera in Mahindergarh district
10	Himachal Pradesh	1,000	HP State Electricity Board Ltd.	Spiti Valley of Lahaul and Spiti District
11	Jammu & Kashmir	100	Jammu and Kashmir Energy Development Agency	Mohagarh and Badla Brahmana, District-Samba
12	Karnataka	2,000	Karnataka Solar Power Development Corporation Pvt. Ltd	Pavagada Taluk, Tumkur district
13	Kerala	200	Renewable Power Corporation of Kerala Limited	Paivalike, Meenja, Kinanoor, Kraindalam and Ambalathara villages of Kasargode district
14	Madhya Pradesh	750	Rewa Ultra Mega Solar Limited	Gurh, Rewa, MP
15		500		Neemuch and Mandsaur
16		500		Agar and Shajapur
17		500		Chhattarpur
18		500		Rajgarh, Morena
19	Maharashtra	500	M/s Sai Guru Mega Solar Park Pvt. Ltd (formerly M/s Pragat Akshay Urja Ltd.)	Sakri, Dhule district of Maharashtra
20		500	Maharashtra State Electricity Generating Company Ltd. (MAHAGENCO)	Dondaicha, district Dhule, Maharashtra
21		500	M/s Paramount Solar Power Pvt. Ltd. (formerly M/s K P Power Pvt. Ltd)	Taluka Patoda, district Beed, Maharashtra
22	Meghalaya	20	Meghalaya Power Generation Corporation Ltd (MePGCL)	West Jaintia Hills and East Jaintia Hills districts
23	Nagaland	60	Directorate of New and Renewable Energy, Nagaland	Dimapur, Kohima and New Peren districts
24	Odisha	1,000	Green Energy Development Corporation of Odisha Limited	Balasore, Keonjhar, Deogarh, Boudh, Kalahandi and Angul
25	Rajasthan	680	Rajasthan Solar Park Development Company Ltd	Bhadla Phase II, Bhadla, Rajasthan
26		1,000	Surya Urja Company of Rajasthan Ltd	Bhadla Phase III, Bhadla, Rajasthan
27		750	M/s Essel Surya Urja Company of Rajasthan Limited	Villages Ugraas, Nagnechinagar and Dandhu, tehsil Phalodi, district Jodhpur (450 MW) and villages Lavan and Purohitsar, tehsil Pokaran, district Jaisalmer (300 MW)
28		500	M/s Adani Renewable Energy Park Rajasthan Limited	Bhadla Phase IV, Bhadla, Jodhpur Rajasthan
29	Rajasthan (421 MW through support of GoI out of 1,500 MW)	421	M/s Adani Renewable Energy Park Rajasthan Limited	Fatehgarh and Pokaran, Jaisalmer, Rajasthan
30	Telangana	500	Telangana New & Renewable Energy Development Corporation Ltd (TNREDC)	Gattu, Mehboob Nagar District
31	Uttar Pradesh	600	Lucknow Solar Power Development Corporation Ltd	Jalaun, Allahabad, Mirzapur, and Kanpur Dehat districts
32	Uttarakhand	50	State Industrial Development Corporation Uttarakhand Limited (SIDCUL)	Industrial Area, Sitarganj (Phase I), Industrial Area, Sitarganj (Phase II) and Industrial Area, Kashipur
33	West Bengal	500	West Bengal State Electricity Distribution Company Ltd	East Mednipur, West Mednipur, Bankura
34	Tamil Nadu	500	To be finalized	Initially proposed in Ramanathapuram district. Site under revision.
TOTAL		20,000		

Table 4: State-wise Solar Parks [SECI]

II. STRATEGIES INVOLVED IN SOLAR PARK PLANNING

Development of Solar Park involves following phases:

Identification of Project Boundaries

Project boundary is indentified to optimize the cost of developing the solar park infrastructure. For assessing the appropriate project boundary following project parameter need to be analyzed.

1.1. Assessment of Solar Resource

Solar Resource is assessed by determining total amount of inter annual variation shortwave radiation received from above by a surface horizontal to the ground, Global Horizontal Irradiance (GHI) is considered.

$$\text{Global Horizontal (GHI)} = \text{Direct Normal (DNI)} \times \cos(\theta) + \text{Diffuse Horizontal (DHI)}$$

General Thumb rule of solar panel placement in general states that the azimuth of the solar panel should be equal to the latitude of the place or 1 MW requires 5 Acres of land.

1.2. Available land area

The land assigned for plant should have appropriate Pitch angle, inter row spacing so that space for different module technologies using fixed tilt and single axis tracker could ascertained before project implementation so that any escalation in *land cost, excavation, etc* could be taken into account.

1.3. Land use

Issues such as site proximity to defense sensitive zones or historical places should be avoided. Hence land on which plant is proposed to be commissioned should have be appropriate categorized as per barren, rural, forest, commercial, etc so that Cost and environmental sensitivity related for taking prior departmental consent could be taken.

1.4. Topography

India is located in 'Northern Hemisphere', hence land preferred should be Flat or slightly tilted towards South facing so that it is uniquely placed to tap solar radiation with 300 to 330 clear sunny days and average daily solar incidence of 5-7 kWh/m^2/day.***[IJEERT, Volume 2, Issue 7, 2014]***

1.5. Regional climate characteristics

Solar PV panels works efficiently within a temperature range of 25˚C to 45˚C, cells degradation of happens due to high wind velocity, extreme temperatures, shadow on modules and dusting on arrays, thus variation in year wise pattern of local climate is significant criteria which should be incorporated and same could also to be translated during onsite project implementation.***[IJEERT, Volume 2, Issue 7, 2014]***

1.6. Infrastructure and Accessibility

Accessibility of site from highways as it affects the transportation cost and in case of unavailability it may inflate the initial cost of lay roads or extending of new road investment. ***[IJEERT, Volume 2, Issue 7, 2014]***

Apart from onsite accessibility other basis amenities like Security, Boundary walls, Fire fighting, common utility area, stores, office etc also need to be in place for project functioning.

1.7. Grid connection arrangements

Availability or proximity of evacuation infrastructure in upstream and downstream is a key determinant as delay in getting grid connectivity led to project delays in completion timelines, escalation in cost. Besides the above, assessment of inter-state and intra state power evacuation also needs to be consider, which would further account for financial planning of wheeling arrangements for inter-state and intra-state power evacuation.

1.8. Water availability

Depending on plant/ park capacity site should have sufficient reliability/availability of water for cleaning modules and avoid dust particles from traffic, building activity, agricultural activity or dust storms and module soiling due to bird excreta. ***[IJEERT, Volume 2, Issue 7, 2014]***

1.9. Geo technical Feasibility

While assessing the land use pattern it is important to determine soil resistivity, seismic risks, load bearing characteristics and availability of Ground water, PH value at or around the site, so that relevant cost could be considered at the time of budgeting.

1.10. Selection of EPC & equipment supplier

1.11. Experience of the EPC contractor lowers the solar power projects risks. Performance guarantee by EPC & output guarantee by manufacturer plays a pivotal role in future plant performance and long term viability of project.

Solar Park Design

2.1. Technology selection

In accordance to inferences of Phase-I, irradiation & climatic conditions, preferred globally Photovoltaic technology with proven track record should be chosen and 'electric power generation potential per day' for that site should be determined. ***[IJEERT, Volume 2, Issue 7, 2014]***

$$GP = \eta \times CA \times SR \times AF$$

Where,

GP = Electric power generation potential per year (kWh/day)

SR = Annual solar radiation received per unit horizontal area (kWh/m^2/day)

CA = Calculated total area of suitable land (m^2)

AF = the area factor, indicates what fraction of the calculated areas can be covered by solar panels

η = PV system efficiency

PV Technology		Efficiency,η (%)	Maximum area of Highly Suitable land CA (m^2)	Mean annual solar radiation for highly suitable land	SR(kWh/m^2 /day) Generation potential
C-Si	Mono-Si	15-20	180.27×10^6	5.873	111.20-148.20
	Multi-Si	15-17			111.20-125.98
a-Si		6-9			44.50-66.69
CdTe		9-11			66.70-81.52
CIGS		10-12			74.10-88.93
CPV		26.3-29			194.90-214.92

Table 5: Generation potential of different PV technologies [*IJEERT, Volume 2, Issue 7, 2014]*

2.2. Land Use Optimization

For Solar parks projects in Madhya Pradesh, Government has categorized land usage according to the available *shape, size, agricultural, revenue, commercial, barren, waste land etc* and intends to effectively utilize barren land.

During design stage itself, number of unit that may be pooled need to decided. Generally, a plot size of each of 50 MW capacities could be used to optimize the plant layout and design through an efficient evacuation network.

Subsequently while developing Land use for different facilities adequate provisions for simultaneously developing common facilities such as *Roads, drainage system, Power evacuation infrastructure from individual Blocks, Pooling Substation, Water supply arrangement etc.* also needs to be worked out.

2.3. Solar field (block / unit) Layout

Depending on the project location and capacity the assessment of the power evacuation would be laid out, which would include block wise indicative Layout and DC-AC side Single Line Diagram for overall Solar Park. Besides this, Cross section drawings for various utilities decided like Roads, Drainage, Admin building, Main gate and others would also need to be decided in accordance to parameter resolved in Phase-1st.

2.4. Power Evacuation Facilities

Injection of generated solar power into the grid may not be feasible in all areas, especially where transmission lines are missing. Hence indicative Single Line Diagram of 220/33 kV connecting plant and Pooling Substation needs to be designed.

2.5. Details of Materials Quantity and Quality

Depending on the layout and facilities considered Bill of Quantity required for each facility needs to be estimated which acts has preliminary estimate and may change during detailed project implementation.

Financial implication and Business Model

For long term sustainability of the Projects it is important that project needs to be self-reliant, so that it could recover the annual capital and recurring expenditure of solar park through a combination of fixed and variable costs.

3.1. Cost Estimation of Solar Park

Before implementation of park it is crucial to identify cumulative project cost, consultancy cost, materials economics *(Panels, cables, structure, etc)*, so that estimated financially could be used for submission to funding agencies or to discover a appropriate rate by Tender. Since Mega or Giga watt scale solar park project cost is on higher side it would be wise to opt for Tender based approach which not only breaks the monopoly of technology/equipment but also promotes Government of India incentives schemes for "Make in India". The discovered rates could be simultaneously compared with other similar solar park project costs which are implemented in the countries geographic boundary.

3.2. Framework for implementing the project

In 2014, MNRE has designated that any project with capacity of more than 500 MW could be developed as Solar Park. Following financial Grants would be managed and released on behalf of MNRE by SECI, for which SECI would charge 1% as handling fee:- ***[MNRE,2014]***

a) INR 25 Lakhs for preparing DPR of the solar park, conducting surveys etc
b) INR 20 lakhs/MW or 30% of the project cost including grid connectivity cost whichever is lower.

Solar parks are envisaged to be developed in four modes described in section IV of paper. And Implementation agencies may create a Special Purpose Vehicle (SPV) to maintain a thin equity structure and involve Solar Power Project Developer (SPPD) for funding and subsequently operation and maintenance of Solar park projects. . ***[MNRE,2014]***

3.3. Revenue and Tariff Model

Generally implementing framework of solar park charges is based on costs estimate and Annual recurring maintenance and administrative charges which on determination could be recovered from SPPD. With help of these parameters SPPD demonstrate financial cash flow and also estimates the landed tariff charges for generated power supply.

IV. SOLAR PARKS PROJECT IN PIPELINES IN MADHYA PRADESH.

Madhya Pradesh has got approval for establishment of Solar Project (750 MW) at villages of *Teh Gurh, District Rewa*. A joint venture company called Rewa Ultra Mega Solar Project Ltd (RUMSL) has been formed in which MPUVNL (M.P. Urja Vikas Nigam Limited) is having 50% equity and SECI (Solar Energy Corporation of India) is having 50% equity to implement the sanctioned Solar Park in M.P. To ensure viability of its ultra mega solar energy park at Rewa, the Madhya Pradesh government will extend a state guarantee to the flagship project which entails an investment of INR 7,500 crore. The tariff based bidding has already been initiated for

RUMSL and for other Solar Park project related modalities are being the developed. Approximately 1500 Hectare of land would be required for developing RUMSL Project ,Required land Purchase of 97% has been done and remaining patch of private land will be provided within three months of PPA signing be reduced proportionately would be obtained before implementation. ***[Business-standard, 2016]***

Rewa Ultra Mega Solar Limited invited National/International players to participate in the Bid process.

20 Bidders submitted bid for the project. After technical and financial assessment, 18 Bidders qualified for the Reverse Auction process.

Reverse Auction process lasted for more than 33 hours. At the end M/S Mahindra sustain, M/S Acme Solar and M/S Solenergie power beat the other bidders and were selected as the successful bidders for unit 1, 2 & 3 respectively.

Tariff received for the project broke all the previous records of solar tariff received so far in India. Earlier the lowest tariff received for solar project was Rs. 4.34, Rewa Ultra Mega Solar Limited received tariff as under-

Unit	Name of company quoted lowest rate	First year tariff Rs per unit
1.	Mahindra Renewables	2.979
2.	ACME Solar Holdings	2.970
3.	Solengeri Power	2.974

The rate derived after reverse bidding will results in terms of Rs 4100 Crs saving to the state, while DMRC will save Rs 100 Crs/year against electricity bill. This project has established as a model project, for others to follow, due to its unique structure & open access sale out of state to the organization like Delhi metro.

Under the project framework, the first contract year's rate as quoted above by the selected bidder. From the second year, there will be a rise of five paise annually for 15 years, inclusive of all taxes. There would be a three-tier payment security mechanism, comprising a letter of credit of 1.25 times the average monthly billing for 12 months, a Payment Security Fund being approved soon, to be created by RUMS and a state guarantee for MPPMCL payment obligation under the PPA. ***[Business-standard, 2016]***

Project envisage generating 750 MW of which 100 MW would be transmitted to Delhi Metro Rail Corporation (DMRC), rest would managed and traded by Madhya Pradesh Power Management Company Limited (MPPMCL).

World Bank would sanction a Loan of INR 149 Crore and power evacuation system and other necessary RUMSL Infrastructures would be developed through Clean Technology Fund. Power Grid Corporation of India, would constructing a 3 pooling substation and 132/33 kv & 400/220 kv HT line line to connect the project with the interstate transmission system. ***[Business-standard, 2016]***

Apart from administrative and economic feasibility analysis, Environmental and social assessment along with Flood control hydraulic study has been done.

MNRE through its vide letter No. *30/18/2014-15/NSM/Neemuch Dated 13th June 2016* has revised in principle approval for 2000 MW capacity Solar Park to Madhya Pradesh. The detail as follows:

S. No.	Park Name	District	Capacity	Park capacity
1.	Neemuch-Mandsaur	Neemuch Mandsaur	250 MW 250 MW	500 MW
2.	Agar-Shajapur	Agar Shajapur	250 MW 250 MW	500 MW
3.	Chhattarpur	Chhattarpur	500 MW	500 MW
4.	Rajgarh-Morena	Rajgarh Morena	250 MW 250 MW	500 MW
Total			2000 MW	2000 MW

Table 6: Bifurcation of Solar Parks in MP

V. CONCLUSION

One of the major challenges in development of solar parks is the acquisition of land. The lands acquired for solar parks are government land, assigned land, SJ lands and patta land. The other change is matching the timelines between development of solar parks including power evacuation arrangements and setting up of solar projects. However, with active involvement of the state governments, SPPDs, SECI, Power Grid, and STUs these challenges are getting over. Due to excellent response and more demand of solar parks coming from the states, the Ministry is contemplating to enhance the capacity from 20,000 MW to 40,000 MW. ***[PIB,2017]***

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