Success in Scaling-up Solar Energy in Rajasthan, India

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1. Introduction

Solar power is attractive because it is abundant and offers a solution to fossil fuel emissions and global climate change. Earth receives solar energy at the rate of approximately 1,20,000 terawatt[1]. This enormously exceeds both the current annual global energy consumption rate of about 15 TW, and any conceivable requirement in future. **In fact, solar energy is the largest exploitable renewal resource as more energy from sunlight strikes Earth in 1 hour than all of the energy consumed by humans in an entire year.** Use of Solar energy is also requirement of the day because the fossil fuel reserves are rapidly depleting and greenhouse gases and are to be substantially reduced to limit the carbon emission from the power sector in near future.

2. Theoretical potential of solar energy in India

The average intensity of solar radiation received over India is 200 MW/km square (megawatt per kilometer square) with 250–325 sunny days in a year. **Solar energy intensity varies geographically in India, but Western Rajasthan receives the highest annual radiation energy.** India receives the solar energy equivalent of more than 5000 trillion kWh/year. Depending on the location, the daily incidence ranges from 4 to 7 kWh/m^2, with the hours of sunshine ranging from 2300 to 3200 per year. **Recent research has shown that India has a vast potential for solar power generation since about 58% of the total land area (1.89 million km^2) receives annual average Global insolation above 5 kWh/m^2/day. Indeed, given present efficiency**

[1] 1 TW = 1012 watt or 1 trillion watt

levels, 1% of land area is sufficient to meet electricity needs of India till 2031.

3. Current policy, practice and regulations in India

In terms of all renewable energy, currently India is ranked fifth in the world with 15,691.4 MW grid-connected and 367.9 MW off-grid renewable energy based power capacity. Development of alternate energy is administered through India's Ministry of New Renewable Energy (MNRE), National Thermal Power Corporation Vidyut Vyapar Nigam Ltd., (NVVNL) Energy development agencies in the various States and the Indian Renewable Energy Development Agency Limited (IREDA). **In terms of solar, the amount of solar energy produced in India is less than 1% of the total energy produced. It is almost entirely based on PV technology, and about 20% of the capacity is being used for off-grid applications.**

The Government of India's National Action Plan on Climate Change (NAPCC) released in mid-2008, by the Prime Minister's Council on Climate Change identifies eight critical missions, including Nation Solar Mission, National Mission for Enhanced Energy Efficiency and National Mission for Green India. Among these, the Solar Mission would be implemented in 3 stages, finally deploying 20,000 MW Grid Connected Power Plants, and generating 2000 MW of off-grid solar power covering 20 million m^2 with collectors, by the year 2022.

The NAPCC notes that as much as 15% of India's energy could come from renewable sources by 2020. Accordingly, the NAPCC has presently set a target of 5% of power purchase from renewable, which will be increased by 1% each year to reach 15% by 2020.

In addition to the above, the Sanction 6(1) (c) of the Indian Electricity Act, 2003 (EA, 2003) also provide promotion of generation from renewable sources of energy and purchase of electricity from such sources. As per the provision of EA, 2003 and National Electricity Policy and Tariff Policy, the Forum of Regulators constituted by the notification

dated February 16, 2003 has finalized its recommendation on various issues which includes guidelines for specifying percentage for renewable energy procurement, share of different renewable energy sources within overall renewal procurement obligation (RPO) percentage, competitive procurement of renewable energy, introducing of Renewal Energy Certificate (REC) mechanism. The REC mechanism is aimed at addressing the mismatch between availability of renewable energy resources in state and the requirement of the obligated entities to meet the Renewal Procurement Obligation (RPO) in other states. This has resulted faster overall growth of renewable energy sector in last two years in India.

4. Renewable energy scenario in Rajasthan

4.1 Challenges

Rajasthan faces two unique challenges in terms of power generation from the conventional sources. **On the one hand, Rajasthan does not have many hydropower projects due to non-availability of large rivers. On the other, because coal needs to be transported from far-off areas of the country, the transportation alone contributes to 50% cost of energy production.**

4.2 Rajasthan initiatives in renewable energy sector

To resolve the challenges, Government of Rajasthan took important initiatives to promote renewable energy from sources such wind and biomass and issued a Policy on 11th March 1999 which was updated in year 2000, 2003 and 2004. With various policy initiatives including allotment of Govt land at 10% of District Level committee (DLC) rate, till now 1766 MW Wind Farms and 106 MW of Biomass Plants are already in operation.

4.3 State nodal agency

State Govt also created Rajasthan Renewable Energy Corporation in year 2003 to act as state nodal agency for single window clearance of the renewable energy projects. This was also to facilitate the allotment of

revenue land, power evacuation approval, execution of PPAs and coordination with MNRE and State Agencies including State Transmission Utility (STU) and Discoms.

4.4 Strong power evacuation system

Wind farms are mostly located in desert districts such as Jaisalmer, Jodhpur, Barmer, but load centers are far away from these districts. Therefore, a dedicated 400 kV network with associated 220 & 132 kV strong transmission network in Barmer, Jaisalmer, Jodhpur, Bikaner area was created. Indeed, Rajasthan is the only State in India which has established a strong power evacuation network in desert area.

4.5 Initiatives in solar sector in Rajasthan

Rajasthan has about 2,08,110 km^2 of desert land, which is 60% of the total area of the state. Rajasthan receives solar radiation of 6.0-7.0 kWh/ m^2. As the area has low rainfall, about 325 days have good sunshine in a year.

In view of above, even before the creation of National Solar Mission, Govt. of Rajasthan has taken an initiative in 2008 and approved 2 Solar Projects each of 5 MW under Generation Based Incentive Scheme (GBI). To provide encouragement in solar sector, Rajasthan Electricity Regulatory Commission (RERC) issued orders on 2nd April 2008, first time in India, imposing solar specific renewable procurement obligation (RPO) for Discom in Rajasthan. To meet out RPO requirement, the State Government approved Solar Projects of 11 private sector developers for setting up of 66 MW capacity utilizing all available technologies in solar photovoltaic and concentrated solar thermal. After announcement of Jawaharlal Nehru National Solar Mission, Government of Rajasthan permitted these proposals to be migrated to the National Solar Mission. The Seven solar Power plants, each of 5 MW, having Photovoltaic technology are already commissioned under the migration scheme of National Solar Mission, while the Solar Thermal Plants of 30 MW are under implementation.

The Rajasthan Electricity Regulatory Commission (RERC) has also notified the RERC (REC and RPO Compliance Framework) Regulations, 2010 on 23rd December, 2010. **Further, Rajasthan Electricity Regulation Commission has also issued from time to time the RPOs and feed-in tariff for Renewable Energy Projects.**

In the year 2011, Union Ministry of New and Renewable Energy under National Solar Mission selected investors for setting up of solar power plant of 800 MW capacities under the phase I of National Solar Mission. In fact, to offset the higher cost of solar power, the mechanism has been developed to bundle the solar power along with the unallocated portion of the power available with National Thermal Power Corporation. In the competitive bids, the tariff for solar energy came in the range of INR 10.50 to 12.75 per unit, whereas the cost of the unallocated conventional energy was about INR 3. Therefore, per unit cost of the bundled energy has been around INR 4.5 per unit.

Looking to these attractive features and the proactive initiatives the State received large share of 583 MW, including 3 projects of 100 MW each and 2 projects of 50 MW based on Solar Thermal technologies. Presently, 41 MW solar photovoltaic power plants and 2.5 MW solar thermal power plants are already operational in Rajasthan. The projects under implementation of National Solar Mission and Govt of India schemes are 590 MW.

5. Way forward

The potential of Rajasthan in solar energy and facilitating role of the Government of Rajasthan is now being acknowledged. Encouraged by new initiatives such as single window clearance, solar power producers have registered with Rajasthan Renewable Energy Corporation under renewable energy policy 2004 and now Solar Energy Policy 2011. **About 722 reputed companies have registered for setting up of solar power plant in Rajasthan of 16900 MW capacity till date.**

Government of Rajasthan on April 19, 2011 issued Rajasthan Solar Energy Policy, 2011 to promote the Solar Energy. The main objectives of this policy includes leverage maximum benefit from

National Solar Mission, to develop Solar Power Plants for meeting RPO of Rajasthan, to develop Solar Power Plants for meeting RPO of other States, to promote off-grid applications of solar energy and the development of **solar parks**.

In coherence with the Rajasthan Solar policy, Rajasthan state will develop Solar Parks of more than 1000 MW capacity in Jodhpur, Jaisalmer, Bikaner, Barmer and districts in various stages. To begin with, solar park at Jodhpur has been initiated. Clinton Foundation signed a memorandum of understanding (MoU) with the Government of Rajasthan in January 2010 for setting up 3000 MW Solar Parks. Rajasthan solar Park Private Ltd (RSP Ltd), a subsidiary company of RREC will formulate policy and rules for land allotment, selection and qualification of firms, grid connectivity and infrastructure plans, sharing of development cost by the developers and management of solar parks. About 10,000 ha government owned land has already been identified at Bhadlai in Jodhpur district. Solar Park at Bhadla has 5000 ha in zone I and 2500 ha in zone II and III each. Survey and soil testing work of 3000 ha of Zone I has already been completed. The survey and soil testing of additional 5000 ha of solar park is in process. Consultant appointed by Asian Development Bank has already prepared Master plan of Solar Park at Bhadla, Jodhpur.

The State Government has taken other initiatives to create **new Transmission Power Evacuation Network in order to** evacuate power from Solar as well Wind. **RVPN is implementing for Solar Power costing INR 2900 crores (INR 29,000 million) having 400kV GSS at Jodhpur and Jaisalmer Solar Parks associated transmission lines.**

Under the National Solar Mission, Rajasthan received the maximum new allocations in the first phase. Now with the policy thrust and new initiatives, Rajasthan will strive for the maximum allocation in the Batch-2 phase-1 and next phase as well.

Rajasthan will facilitate the renewal purchase obligation (RPO) of other states through the renewal energy certificate (REC) mechanism if other states so desire. In fact Rajasthan was the first state to allow open access for wheeling of solar power to areas beyond Rajasthan. To meet the state specific renewal purchase obligations (RPO) Rajasthan will

identify and sanction more projects through the competitive bidding route.

6. Conclusion

In conclusion, initially the pace of development was slow, mainly because power generation from solar energy is expensive. The cost per megawatt of solar power comes to around INR 11 crore (i.e., INR 110 million), while that of wind power is INR 5 crore (i.e., INR 50 million). **The pace is now likely to get enhanced because of the Rajasthan Solar Energy Policy 2011, and commitment of the Government of Rajasthan to develop the crucial infrastructure such as solar parks and power evacuation system** Hopefully, things will continue to move in the right direction, and Rajasthan is set to harvest the sunshine in a big way. The state is likely to attract an investment of more than Rs. 45,000 crore in the solar energy sector in next two years as it promotes the policy and infrastructure for solar energy.

Overall, Rajasthan Government is fully committed to the promotion of solar energy. We believe that implementation of the Rajasthan Solar Energy Policy 2011 will help develop Rajasthan as a global hub of solar power for 10000-12000 MW capacity over the next 10 to 12 years to meet energy requirements of Rajasthan and other states of India.

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