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Clean Energy Resources and Sustainable Development in Rajasthan

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ABSTRACT: Globally, energy consumption is increasing drastically due to the economic growth, rapid industrialization and increasing domestic comforts. Also energy is now considered to be important criteria for sustainable development of Rajasthan.. Melting of ice caps, overabundance of greenhouse gases, global warming and other drastic climatic changes worldwide, has turned attention towards environmental issues. Exploiting the enormous potential of renewable energy sources could be one of the alternatives of total dependency on the conventional energy resources. In India, the population is sparsely scattered in vast geographic location, because of which the government often cannot provide electric power to the entire citizen through the centralized national grid. In that case, renewable energy is a good option to as it can be used as a stand-alone distributed generation system. In this review, the availability and current status of renewable energy in Rajasthan is summarized. This summary of available resources helps researchers, investors and developers to find probability of improvement in technologies to harness renewable energy and to map out further expansion of renewable energy generation in Rajasthan

KEYWORDS: energy, sustainable, resources, renewable, development, Rajasthan, technologies, consumption

I. INTRODUCTION

Rajasthan Renewable Energy Corporation Limited (RRECL) had been formed by merging erstwhile REDA (Rajasthan Energy Development Agency) and the Rajasthan State Power Corporation Ltd (RSPCL) in August 2002. Corporation is registered under Companies Act 1956. RRECL is working as a State Nodal Agency for promoting & developing Non-conventional Energy Sources in the State and as a State Designated Agency (SDA) for enforcement of provisions of Energy Conservation Act 2001 in the State.[1,2]

TOTAL	19116.80 MW
SOLAR	14454.70 MW
(a) GROUND MOUNTED SOLAR CAPACITY	11821.87 MW
(b) ROOFTOP	814.02 MW
(c) OFF GRID	438.41 MW
(d) SOLAR HYBRID	1380.40 MW
WIND	4537.02 MW
BIOMASS	125.08 MW



The energy demand in India is growing rapidly, and this has major implications for the global energy market. The Government of India has made remarkable progress in providing access to electricity to rural populations, whilst also integrating a high share of renewable energy sources into the grid. Solar energy is particularly important, with India being the third-largest solar market in the world, and in 2018, India's investment in solar energy was greater than in all fossil fuel sources of electricity generation combined. However 74% of electricity still comes from coal power plants, which not only emit CO₂ but also contaminate local water sources and cause long term health issues for employees.[3,4]

This Gold Standard certified project involves the installation of a 20 megawatt solar power project in Rajasthan, northern India. This will generate clean, renewable electricity that will then be exported to the Indian electricity grid. This project will displace 35,951 megawatts per year of electricity from the grid that would otherwise be generated by fossil-fuel based power plants. Therefore it will avoid 35,149 tonnes of CO₂e per annum. The implementation of this solar energy project will also provide job opportunities for local people, during erection, commissioning and maintenance of the solar plant. The electricity supply in the nearby area will also be improved which directly and indirectly improves the economy and lifestyle of the area. Renewable energy sources have a large potential to contribute to the sustainable development of specific territories by providing them with a wide variety of socio-economic and environmental benefits. The present time puts much emphasis on the environmental benefits (including the reduction of global and local pollutants), while socio-economic impacts have not received a comparable attention. These include diversification of energy supply, enhanced regional and rural development opportunities, creation of a domestic industry and employment opportunities. With the exception of the diversification and security of energy supply, these benefits have usually been mentioned, but their analysis has been too general and a focus on the regional and, even more so, the local level, has been lacking. At most, studies provide scattered evidence of some of those regional and local benefits, but without an integrated conceptual framework to analyse them. The dissertation project "Impact of Renewable Energy in Desert District of Rajasthan" aims to impact assessment in the environmental impact assessment in two district of Rajasthan, Jodhpur and Jaisalmer.[5,6] Carbon emission reduction calculation using the resources available for the generation of and data collected commencing the site visit is processed out in effective manner for impact assessment has been studied. The existing renewable energy projects of solar and wind power generation is a step toward the green energy production. The impact assessment is done with the help of Rapid Impact Assessment Matrix and Network Method. Rapid Impact Assessment Matrix is a quantities approach and Network Method is a qualitative approach. RIAM is less time consuming whereas Network Method is a qualitative approach and lengthy and expensive too.

The purpose of the solar power project, Bhadla, Rajasthan, is to generate power using renewable energy source (solar energy) and sell the power generated to the state grid. The project activity generates electricity using solar energy. The generated electricity is exported to the regional grid system which is under the purview of the INDIAN electricity grid of India. The project activity replaces anthropogenic emissions of greenhouse gases estimated to be approximately 779,933 tCO₂e per year, thereon displacing 832,550 MWh/year amount of electricity from the generation-mix of power plants connected to the INDIAN GRID, which is mainly dominated by thermal/ fossil fuel based power plant. The total installed capacity of the current project activity is 400 MW; which involves operation of Solar PV Project in the state of Rajasthan in India. The project activity is a new facility (Greenfield) and the purpose of the project activity is to generate energy electricity by the utilization of renewable Solar energy and further selling the generated energy to the Indian Grid. In this process there is no consumption of any fossil fuel and hence the project does not lead to any greenhouse gas emissions. Thus, electricity would be generated through sustainable means without causing any negative impact on the environment. In the Pre- project scenario the entire electricity, delivered to the grid by the project activity, would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. Contribution to sustainable development Ministry of Environment and Forests, has stipulated economic, social, environment and technological wellbeing as the four indicators of sustainable development. The project contributes to sustainable development using the following ways.[7,8]

Social well-being: The project would help in generating employment opportunities during the construction and operation phases. The project activity will lead to development in infrastructure in the region like development of roads and also may promote business with improved power generation. Economic well-being: The project is a clean technology investment in the region, which would not have been taken place in the absence of the carbon credit benefits the project activity will also help to reduce the demand supply gap in the state. The project activity will



generate power using zero emissions Solar based power generation which helps to reduce GHG emissions and specific pollutants like SO_x, NO_x, and SPM associated with the conventional thermal power generation facilities. Technological well-being: The successful operation of project activity would lead to promotion of Solar based power generation and would encourage other entrepreneurs to participate in similar projects. Environmental well-being: Solar being a renewable source of energy, it reduces the dependence on fossil fuels and conserves natural resources which are on the verge of depletion. Due to its zero emission the Project activity also helps in avoiding significant amount of GHG emissions.

II. DISCUSSION

Tata Power to further expand its business footprint with plans to develop upto 8000 MW of utility scale projects, 1000 MW of solar rooftop, and installing 1,50,000 solar pumps in next five years in Rajasthan ~Tata Power, India's largest integrated utility, today said that the Company plans to expand its business footprint in Rajasthan. Participating in the ongoing Invest Rajasthan summit in Jaipur, the Company said it plans to develop upto 8000 MW of utility scale projects, 1000 MW of solar rooftop and 1, 50,000 solar pumps in next five years in the State. Tata Power, along with its fully-owned subsidiary Tata Power Solar, will expand its presence in the State to generate clean energy through solar power. The Company employs more than 4500 people in the State, and its expansion projects will generate employment for more than 6000-8000 people in the next five years. Dr Praveer Sinha, CEO&MD, Tata Power, said, "Both in terms of potential and what has been done so far, Rajasthan has today emerged as a role model to produce green energy through solar power. I am happy to be here in Invest Rajasthan summit. With its already strong footprint in the State. Tata Power is fully poised to make Rajasthan future ready and realise its full potential and emerge as a Green Power House of the country. We will continue to build on all three business – EPC, Solar Pump and Solar Rooftop, to the benefit of farmers, industries and common citizens of this frontier state." Rajasthan is an important state for Tata Power's renewable business. The Company presently has a portfolio of 4939 MWp. Till date, Tata Power has commissioned 2,066 MW in Rajasthan and around 2,873 MW capacity of solar projects under construction in the State and will be completed in next 12-24 months.[9]

Tata Power plans to have a renewable power portfolio of 10,000 MW in the State in next five years. TP Ajmer Distribution Ltd, a unit of Tata Power, has completed 5 years of operations and has enhanced consumer experience in Ajmer. Tata Power has ensured safe and reliable supply in Ajmer and also achieved AT&C loss reduction from 22% to 9%. With the support and favourable policies of the Government of Rajasthan, we are looking forward to opportunities of power distribution in various other cities of the State under the collaborative Public Private Partnership (PPP) model and to serve the citizens of Rajasthan with quality power supply. With respect to solar pumps, Tata Power plans to set up around 1, 50,000 pumps in next five years in the State. The Company has so far installed nearly 21,600 solar pumps in Jaipur, Hanumangarh, Ganganagar, Jalore and Bikaner. Tata Power through its rooftop services has a cumulative installed capacity of 65 MW in Rajasthan. The Company has been doing extensive work for industrial belts like marble, granite and stone crushing etc in Rajasthan located in regions like Ajmer, Sirohi, Rajsamand, Jalore and Makrana. Through its various rooftop offerings, Tata Power has installed over 20 MW of rooftop for these industries. These installations have resulted in cumulative savings of about Rs 20 crore p.a. for customers who are part of the marble / granite and crushing etc. The Company has also gone beyond just supplying rooftop solutions and also suggested techniques which have benefitted many, especially the stone crushing industry users. Some of the benefits as a result of our offerings to these belts include reduced expenses as a result of business production, reduced power consumption, and efficient use of energy. Rajasthan is a state that usually has high temperatures during the day. Rooftop installations on certain sites have also helped cool down the internal temperature of the site by 4-5 degrees. Tata Power's commitment to their offerings, high quality, and delivery have been some of the standout qualities of our rooftop business. Tata Power is also working towards setting up a robust EV Charging Infrastructure in the state to enable faster transition towards E mobility. Company has installed over 1100 home chargers and 100 public chargers in Rajasthan. In the next few years, Tata Power plans to install 10,000 public EV charging points in the State. Under the Urja programme of the Company has initiated its CSR programme to enable Science, Technology, Engineering, and Mathematics (STEM), and health education as well as teacher-trainings in schools in the State.[10]

III. RESULTS

India: Enel Green 300 MW Solar Project – Rajasthan. The proposed project is being considered alongside IFC and has been prepared in accordance with IFC Sustainability Framework comprising the Policy on Environmental and Social



Sustainability, Performance Standards (PSs), and Access to Information Policy. To ensure a harmonized approach to addressing the environmental and social (ES) risks and impacts of the Project, and as permitted under AIIB's Environmental and Social Policy (ESP), IFC's PSs are applicable for this Project in lieu of AIIB's ESP. AIIB has reviewed IFC PSs and is satisfied that: (i) it is consistent with AIIB's Articles of Agreement and is materially consistent with AIIB's ESP, including the Environmental and Social Exclusion List and relevant Environmental and Social Standards; and (ii) the monitoring procedures that are in place are appropriate for the Project. The Project has been assigned Category "B" in accordance with IFC PSs, which is equivalent to Category B if AIIB's ESP were applicable, due to the potentially limited adverse ES risks and impacts that are generally site-specific, largely reversible, and readily mitigated through implementation of good international industry practices. An Environmental and Social Impact Assessment (ESIA) including an Environmental and Social Management Plan (ESMP) has been developed. An ES due diligence (ESDD) was performed and an Environmental and Social Action Plan (ESAP) has been prepared with time-bound actions together with a tailored monitoring program that the EGP has committed. The ESIA has identified the potential impacts on biodiversity, including loss of habitat, impacts on bird species due to collision and electrocution hazards and heat-related incidents. There are no Protected Areas or Important Bird Areas (IBA) within a 5km radius of the project site. A separate Biodiversity Study was conducted which shows the presence of threatened and migratory species of birds in the study area, but no Critical Habitat values for these species. Other adverse environmental impacts are likely to be localized and temporary. Mitigation measures are proposed in the ESMP to address the potential negative impacts, labor and health and safety issues. The cumulative impacts of this project and other renewable power projects in the same region are not considered significant while some positive socio-economic cumulative impacts are expected. The project is expected to contribute to GOI's renewable energy target. The project is estimated to result in avoidance of GHG emissions of approximately 592,174 tons of CO₂ equivalent annually. Several consultations were conducted as part of the ESIA preparation. An Environmental and Social Review Summary and the ESAP are disclosed on IFC website. A SEECA (Social, Environmental and Economic Context Analysis) study has been prepared in October 2020, including social baseline, stakeholder identification and the distribution of project benefits, as well as a Creating Shared Value (CSV) Action Plan. The contractors will develop site-specific Stakeholder Engagement Plans (SEPs) for the construction and the operation phases.[11]

Grievance Redress Mechanism (GRM). A GRM will be established for project-affected people prior to the first disbursement as required in the ESAP. The information of the GRM will be disseminated via the SEP. The contractors will also develop and implement GRM for workers during the construction and operation phases.
Rajasthan Solar Energy Policy

1. Developing a global hub of solar power of 25,000 MW capacity to meet energy requirements of Rajasthan and India.
2. Contributing to long term energy security of Rajasthan as well as ecological security by reduction in carbon emissions.
3. Providing a long term sustainable solution for meeting energy needs and considerably reducing dependence on depleting fossil fuel resources like coal, oil and gas.
4. Generating direct and indirect employment opportunities In all activities related to the generation of solar power.
5. Envisaging a solar centre of excellence that would work towards applied research and commercialization of nascent technologies to accelerate the march to grid parity.[10]

IV. CONCLUSIONS

Renewable Energy Laboratory

To resolve most daunting challenge of this world—energy needs—and also our nation's heavy reliance on fossil fuels, Renewable Energy Laboratory (REL) promotes rigorous and objective empirical research at IIT Jodhpur on issues related to energy and environment. REL focuses on designing, testing, and disseminating renewable and efficient energy system. The mission of REL is to help these technologies to realize their full potential to contribute to environmentally sustainable development in industrial and developing countries. In the renewable energy field, expert faculty and students at this Laboratory are currently striving to create an innovative system to efficiently harness energy from sunlight and wind power. Recently, a work on solar and wind system for household development has been planned and our research effort at REL draws on ongoing work in variety of fields, including energy engineering, and



environmental risk analysis. REL has computer interfaced systems and approximately 30 students can work at a time. Students are the greatest resource of REL and IIT Jodhpur has made substantial commitment to the area of renewable energy and been providing all required resources to execute a viable plan and innovative research at REL. One aspect of the evolution of REL is the development of collaborative partnership with other academic and industrial groups. In the near future, it will be a hub for training and public-private sector collaboration. Recently, the lab has started a consultancy project, with Panasonic R & D India Pvt. Ltd., on the prototyping of microbial fuel cells. In addition, the lab has started work on data collection, interpretation, and analysis of PV power plants less than 5 MW in Rajasthan and Gujarat.

The Renewable Energy Laboratory uses the following equipment:

1. Wind power of 2KW Charge controller ~12V, Synchronous generator with permanent magnets ~12V, Lamp board ~12V, Off grid inverter,
2. PEM Fuel cell Fuel cell with DC converter, Electronic load, Metal hydride storage cell, Electrolyser, 200W/20V/10A,
3. Advanced Photovoltaics Solar module simulation model 23V/2A, Solar module with solar altitude emulator, Solar charge controller 12/24V, 6A, Solar accumulator 12V, 7Ah, Off grid inverter 230V, 275VA etc., and
4. Combined RF/DC Sputtering Unit for Coatings Applications.[11]

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