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Non-Conventional Energy Resources in Rajasthan: A Study in the Context of Solar Energy

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ABSTRACT: The Rajasthan Policy for Promoting Generation through Non-Conventional Energy Sources was created to promote generation of power from sources including solar power projects, wind energy projects and biomass energy projects. The policy offers direction in the sale of power, grid interfacing, wheeling and banking, power purchase agreements, land acquisition and incentives offered by the state government. Adani Renewable Energy Park Rajasthan Ltd (AREPRL) is a 50:50 Joint Venture Company (JVC) incorporated by Adani Renewable Energy Park Ltd (AREPL) and Rajasthan Renewable Energy Corporation Ltd (RRECL), Government of Rajasthan, under the Companies Act, 2013. The JVC has been formed under the provisions of the MNRE Scheme for development of solar parks and UMPPs 2014, wherein both the parties hold equal shareholding. An MoU has been signed with RRECL, the Government of Rajasthan's nodal agency for the development of non-conventional energy sources, to develop solar parks with a cumulative capacity of 10,000 MW in a phased manner. As part of the first phase Adani Renewable Energy Park Rajasthan Ltd (AREPRL) is developing a 500 MW capacity solar park in Bhadla, Jodhpur and 1,500 MW capacity solar park in Fatehgarh, Jaisalmer.

KEYWORDS: non-conventional, Rajasthan, energy, resources, solar, projects, government

I.INTRODUCTION

In India, the Department of Non-Conventional Energy Sources (DNES) was created in the Ministry of Energy in the year of 1982 to look after all the aspects relating to new and renewable energy. The Department was upgraded into a separate Ministry of Non-Conventional Energy Sources (MNES) in 1992 and was rechristened as Ministry of New and Renewable Energy (MNRE) in October, 2006. As per the information furnished by MNRE, starting with the 9th Plan, there has been consistent increase in pace of renewable energy development. Reportedly, India's renewable energy installed capacity has grown at an annual rate of 23%, rising from about 3900 MW in 2002-03 to about 24000 MW in 2011-12. Energy generated by using wind, solar, small hydro, tides, geothermal heat and biomass is known a non-conventional energy. All these sources are renewable process of energy generation and do not cause environmental pollution. Our country has been endowed with adequate natural resources.[1,2]

Solar Power Generation

Our engineering capabilities help us design cost-efficient projects, which are backed by a thorough analysis of the land, solar radiation, grid connection infrastructure and emerging technologies. Our project design also considers various factors such as the geographical location, climate conditions, temperature and its impact on equipment, local facilities as well as potential maintenance requirements. We thus ensure that all our capital investment projects are carried out after considering and studying the risks involved.

Wind Power

We develop, build, own, operate and maintain utility-scale grid-connected renewable farm projects and generate revenue through the sale of electricity to Central and state government entities and government-backed corporations. For wind project development, we continuously evaluate various regions of the country for wind resource potential. We have already installed many wind-mast in resource-rich areas of the country, enabling us to confirm the site wind resource potential and allowing micro siting.[3,4]

Hybrid Power

Variability in Solar and Wind generation has emerged as a concern in large-scale adoption of renewables, especially after it contributes a major share in the energy mix. Hybridisation of wind and solar plant is developing a solution

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which will reduce this variability due to complementary nature of their generation profile - solar generation is higher during the day, while wind generation can be higher in the night. Hybrid projects would also have much higher capacity utilization, thus removing the intermittency challenge. Such projects also enjoy the additional benefit of a reduction in costs associated with sharing transmission lines. Peak balancing through gas and hydro generation shifting, demand management, smarter grids, electric vehicles as well as storage solutions including battery, pumped hydro and others are expected to further help in smoothing out the variability caused due to the nature of renewable energy supply.

Solar Parks

Adani Renewable Energy Park Rajasthan Ltd (AREPRL) is a 50:50 Joint Venture Company (JVC) incorporated by Adani Renewable Energy Park Ltd (AREPL) and Rajasthan Renewable Energy Corporation Ltd (RRECL), Government of Rajasthan, under the Companies Act, 2013. The JVC has been formed under the provisions of the MNRE Scheme for development of solar parks and UMPPs 2014, wherein both the parties hold equal shareholding.[5,6]

Adani Renewable Energy Park Rajasthan Ltd

An MoU has been signed with RRECL, the Government of Rajasthan's nodal agency for the development of non-conventional energy sources, to develop solar parks with a cumulative capacity of 10,000 MW in a phased manner. As part of the first phase Adani Renewable Energy Park Rajasthan Ltd (AREPRL) is developing a 500 MW capacity solar park in Bhadla, Jodhpur and 1,500 MW capacity solar park in Fatehgarh, Jaisalmer.

Advantages of non-conventional energy technologies-

- Non-conventional/renewable energy is an indigenous source available in considerable quantities to all developing nations and capable, in principle of having a significant local, regional or national economic impact.
- There is a great scope of research and development in non-conventional/renewable energy sectors regarding its future development and scientific utilization.[7,8]
- The power plants based on renewable do not have any fuel cost and hence negligible running cost.
- Renewable have low energy density and more or less there is no pollution or ecological balance problem. Provide energy in environmentally benign manner.
- The use of non-conventional/renewable energy could help to conserve foreign exchange and generate local employment if conservation technologies are designed, manufactured, assembled and installed locally.
- Short gestation period and low investment.

The sustainable economic development and growth of any country are closely related to the development and security of its energy sectors. Concerning the finite and limited reserves of conventional energy sources and their impact on environment, a great emphasis should be given to the development of non- conventional energy sectors and their proper utilization for the benefit and betterment of mankind. Such initiatives would also be helpful to create many employment opportunities at all levels, especially in rural areas. Thus, mainstreaming of non-conventional and renewable energy technologies is becoming very essential for the developing countries. In India, there is great scope for the development of non-conventional and renewable energy sectors. India is the only country that has an exclusive Ministry for New and Non-Conventional Energy Sources. India possesses the largest decentralized solar energy programme, the second largest biogas and improved stove pogrammes, and the fifth largest wind power programme in the world.[9,10]

II.DISCUSSION

Rajasthan has become one of the top states in the country in solar power generation.
"The Rajasthan government has taken steps to promote solar energy and set up solar plants, and as a result today the solar energy generation capacity has touched 16,060 Mw," said a senior state government official.The state government launched the Solar Energy Policy 2018 to make Rajasthan a leading state in the field of "Green Energy-Clean Energy".A solar energy capacity of 30 Gw has been targeted by future.Energy Minister Bhanwar Singh Bhati said Rajasthan had become a model state in the field of solar energy.Besides solar energy, power generation through wind energy is 4,576 Mw, through biomass energy 125 Mw, and through small hydro energy 24 Mw.The world's biggest solar park of 2,245 Mw is in Jodhpur.There is a 925-Mw park and a 750-Mw park in Jaisalmer district.The

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minister said Rajasthan had top position in the country in the Pradhan Mantri KUSUM Yojana. PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan) is aimed at energy security for farmers, along with honouring India's commitment to increase the share of the installed capacity of electric power from non-fossil fuel sources to 40 per cent by 2030 as part of Intended Nationally Determined Contributions (INDCs).[11,12]The first solar plant in the country under this scheme was set up on 3.50 acres Jaipur district at Rs 3.70 crore. Till now, 45 solar plants have been set up under scheme-I of the KUSUM Yojana in the state and currently, 60.5 MW is being generated from them.Rajasthan is fast emerging as the solar hub after becoming the first State to develop 10 GW power capacity. The public sector Rajasthan Renewable Energy Corporation (RREC) has earned a record profit before tax (PBT) of ₹65 crore during 2018.[13,14] Additional Chief Secretary (Energy) Subodh Agarwal said in Jaipur on Monday the RREC's profit was more than two times in comparison with 2018 and more than the profit of ₹20 crore earned in 2018. The State would emerge as the biggest solar hub with the memorandums of understanding and letters of intent signed in the last financial year, he said.Among the agreements signed under the "Invest Rajasthan" campaign, the MoUs and LoIs worth ₹8 lakh accounted for the energy sector alone, said Mr. Agarwal. According to a report released by the Centre, Rajasthan occupies the top position with 10,506 MW share in the country's 49,346 MW solar energy capacity.

Mr. Agarwal said the State was marching ahead in the field of rooftop solar energy production as well. Of the State's 10,506 MW solar power capacity, 9,542 MW is ground–mounted, 668 MW is rooftop and 296 MW has been developed in off–grid sector.Bhadla Solar Park is the largest solar park in the world as of 2018 and is spread over a total area of 5,700 hectares (14,000 acres) in Bhadla, Phalodi tehsil, Jodhpur district, Rajasthan, India.The park has a total capacity of 2245 MW. The park had witnessed the lowest bid for solar power in India as of December 2018 at ₹2.44 (3.1¢ US) per kilowatt-hour. Officially recognized as a sandy, dry, and arid region with an area of about 45 km^2 (17 sq mi), Bhadla is located about 200 km (120 mi) north of Jodhpur and about 320 km (200 mi) west of the state capital Jaipur. The region has been described as "almost unlivable" due to its climate. Normal temperatures in Bhadla hover between 46 and 48 °C (115 and 118 °F), with hot winds and sand storms occurring frequently. The nearest habitation to Bhadla is the village of Bap located about 50 km (31 mi) away, and the closest urban area – a tehsil town called Phalodi – is situated 80 km (50 mi) away. [15,16]

In the first phase, NTPC Limited auctioned 420 MW of capacity split into 6 packages of 70 MW each. The Finnish company Fortum quoted the lowest tariff of ₹4.34/kW·h. Rising Sun Energy and Solairedirect won 2 packages, each quoting a price of ₹4.35/kW·h. Yarrow Infrastructure won the remaining package quoting a price of ₹4.36/kW·h.In December 2016, Solairedirect signed an agreement with Ecoppia, a PV panel cleaning solutions developer, to provide automated cleaning solutions to the project. Due to the park's location in a desert region, it is prone to dust storms. Solairedirect secured a loan of ₹675 crore (equivalent to ₹804 crore or US$100 million in 2018) from IDBI Bank in February 2017 to help finance the project.The Solar Energy Corporation of India (SECI) auctioned 250 MW capacity in the second phase for which 27 firms submitted bids. SECI auctioned 500 MW capacity in the third phase on 11 May 2017. ACME won 200 MW at a price of ₹2.44 (3.1¢ US) per kW·h. SBG was awarded the remaining 300 MW at a price of ₹2.45 (3.1¢ US). ACME commissioned the 200 MW capacity in September 2018. SECI also actioned 500 MW for on December 22, 2017. The Hero Future Energies has been awarded 300 MW and SoftBank Group 200 MW. SECI auctioned 250 MW capacity in the fourth phase on 9 May 2017.South Africa's Phelan Energy Group and Avaada Power[17,18] were awarded 50 MW and 100 MW of capacity, respectively. Their bids of ₹2.62 per kilowatt-hour were the lowest tariffs for any solar power project in India. It was also lower than NTPC's average coal power tariff of ₹3.20 per kilowatt-hour. SBG Cleantech, a consortium of Softbank Group, Airtel and Foxconn, was awarded the remaining 100 MW capacity at a rate of ₹2.63/kW·h.SECI tendered bids for the remaining 750 MW capacity in June 2017.In this way, the entire solar park will be completed by December 2018, and with 2055 MW installed capacity, it will be the one of the world's largest solar parks. On 22 February 2017, NTPC announced that it had commissioned 115 MW of capacity at the park. An additional 45 MW of capacity was commissioned on 8 March, and 25 MW on 18 March. NTPC announced the commissioning of 20 MW capacity at the park on 23 March, and 55 MW on 25 March 2017, taking the total commissioned capacity of the Bhadla park to 260 MW. In September 2018, 1365 MW had been commissioned.[19,20]

After its full capacity became operational, the park became the largest fully commissioned PV project in the world at 2,245 MW, with its investment rising to ₹10,000 crore (US$1.3 billion).[21]

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III.RESULTS

Solar Power project in Rajasthan

The purpose of this project is to generate electricity by utilizing clean solar energy and to reduce greenhouse gas emissions, which otherwise would have been emitted by the existing fossil fuel based power plants connected to the NEWNE grid in India. The NEWNE grid is dominated by coal fired thermal power plants. In the absence of this project activity, an equivalent amount of power would have been generated and supplied by NEWNE grid to which the proposed project is connected. The project activity is expected to reduce on an average 34,261 tonnes of CO2 per year.The company endeavors to make a positive contribution to underserved communities by engaging in a wide range of environmental, educational and health initiatives.

Project impacts and benefits:

#SDG1- No Poverty

- Jakson executed Grid Electrification Program by which 5000 Below Poverty Line households were configured and synced with the Grid.
- Jakson extended a helping hand and donated clothes for the underprivileged people. The donations wrere made to Earth Saviors Foundation - a Delhi-based recognized NGO founded in the year 2008.
- The amazing transformation of Barapitha, Odisha, a small village where Jakson Solar helped ensure uninterrupted electricity for all the 61 families that live here! Life has become easier for the residents of Barapitha village in Odisha, ever since Jakson Solar, in partnership with NALCO and ECCO, has ensured 100% access to solar equipment for the villagers.[22]

#SDG4- Quality Education

- Jakson have adopted 12 government schools in Greater Noida area, 2 Government Schools in Kathua & 1 Government and 4 Anganwari, Kalsar, Gujarat to upgrading School Infrastructure and basic amnesties of students.
- Computer class & Health and hygiene classes were regularly conducted in Primary Government School, Kalsahpur & Government Middle school, Mehtabpur, Kathua on every working Monday & Saturday
- Jakson actively engages in Strengthening Anganbadi, Adoption of Schools, Upgrading School Infrastructure and basic amnesties, Extra Curricular, Activities/Exposure Visit/Science Fair/Bal Mela Health, Drinking Water and Sanitation around project site.

#SDG7: Affordable and Clean Energy

- The purpose of the proposed project is to generate electricity by utilizing clean solar energy and to reduce the greenhouse gas emissions, which otherwise would have been emitted by the existing fossil fuel based power plants connected to the NEWNE grid (currently this NEWNE grid and Southern grid are synchronized and becomes single grid as Indian Grid) in India or the addition of similar kind of fossil fuel based power plants.
- Jakson has three power plants with a total installed capacity of 60MW

#SDG9- Industry, Innovation and Infrastructure

- Solar on Train: India gets its first Solar Powered train installed by Jakson. This is the milestone in the history of Indian Renewable Energy. Jakson showcased its innovative engineering capabilities by successfully integrating solar panels

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on the roof of 50 coaches of Indian Railways. It was a complex design and engineering challenge to integrate solar panels on the roof of coaches that run up-to speeds of 120 km per hour.

- Jakson has undertaken rural electrification projects for Shrawasti, Sitapur and Faizabad in UP and Alwar in Rajasthan covering almost 3000 villages to bring reliable power to unelectrified part of the nation!
- True to Jakson belief in sustainable business practices and environment protection, the Jakson corporate office in Noida is an IGBC Platinum-rated green building that uses smart technology to reduce carbon footprint and contribute towards a greener planet.
- Jakson having the honor to have installed and commissioned solar rooftop plants in some of India's landmark establishments. The most prestigious one is the 508 kW at the President of India building, New Delhi[23]

#SDG13- Climate Action

- The project activity is expected to reduce on an average 34,261 tonnes of CO2 per year. In absence of the project activity, equivalent amount of power would have been generated and supplied by NEWNE grid to which the proposed project is connected. The NEWNE grid is dominated by coal fired thermal power plants.

#SDG17- Partnerships for the Goals

- The project involved complete designing, engineering, procurement, erection, installation and commissioning of first hydro project in Bhutan, which include mechanical work with EOT crane system. Jakson also performed the electrical & communication work with auto start and synchronizing with grid. Jakson DG sets were also used for blackout or black start condition for auxiliaries of hydro turbines.

IV.CONCLUSIONS

In a recently released report of the Ministry of New and Renewable Energy (MNRE), Government of India, Rajasthan has overtaken Karnataka to rank first in the country with an installed capacity of 7737.95 MW of solar power.It is worth mentioning that in the MNRE report, Gujarat has been ranked third with 5708 MW capacity, Tamil Nadu fourth with 4675 MW and Andhra Pradesh with 4380 MW.Despite the adverse circumstances 2348.47 MW of new solar power capacity has been installed in Rajasthan in the last eight months only.Rajasthan has registered unprecedented progress in all areas of solar energy including ground mount, roof top and off grid in the year 2018.In the direction of making Rajasthan a leader in the field of green energy-clean energy, the state's Solar Energy Policy-2018 has been very important for the investors. Also, the provisions of RIPS-2018 have brought a revolutionary change in the field of solar energy in the state. Under this policy, customized investment proposals worth Rs 34,200 crore were approved in the hybrid energy sector in the state in April 2018. Most of these are related to solar energy.As a result of the policies to promote solar energy, Rajasthan has become the preferred destination for investors in this sector from across the country and the world. During this period, a record investment of Rs 10 thousand crores has been made in this sector.Considering the favourable geographical conditions of Rajasthan from the point of view of solar power generation, 142 GW of solar power generation has been estimated in the state. To achieve this goal, an effective plan has been prepared by the state government. Under the plan, an ambitious target of 30 GW of solar power generation has been set by future which will completely change the energy scenario of the country.[24]

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