SECTOR ASSESSMENT (SUMMARY): RAJASTHAN POWER SECTOR

Sector Road Map

1. Sector Performance, Problems, and Opportunities

1. The total installed power capacity in India is 225,793 megawatts (MW)[1] with a peak demand deficit of 6.3% and an energy deficit of 6.0%. India expects to add more than 80,000 MW of capacity over 2012-2017 under the Twelfth Five-Year Plan. The key priorities of the Government of India, as laid out in the National Electricity Policy 2005 , are to increase per capita availability of electricity to over 1,000 kilowatt-hours (kWh) with a minimum lifeline consumption of 1 kWh per household per day. India intends to make greater use of indigenous hydropower and renewable energy resources, particularly solar and wind, in the coming years. It has recognized that the past poor performance of state electricity boards significantly strained public finances. In response it has initiated several programs (including a financial restructuring program in 2012 to support turnaround of state utilities) establish open access, and rationalize the tariff structure. Indian electrical grids today account for 27% of transmission and distribution losses. This inadequacy could become an obstacle to the country's progress in the years to come. Independent central and state regulatory bodies have been established to facilitate energy development and increase competition in this traditionally monopolistic sector.

2. The central government's Ministry of Power guides the sector through the Central Electricity Authority. The public sector central power utilities such as the National Thermal Power Corporation, National Hydroelectric Power Corporation, Nuclear Power Corporation, and Power Grid Corporation of India, engage in generation and interstate power transmission. The Rural Electrification Corporation and Power Finance Corporation are government-owned institutions dedicated to financing activities in the electricity subsector. Power Trading Corporation was established to facilitate power trading; at present, several entities undertake this activity. On technical and economic matters, the Ministry of Power is assisted by the Central Electricity Authority, which is responsible for the technical coordination and supervision of programs and entrusted with a number of other statutory functions. It is also responsible for preparing national electricity plans in accordance with the National Electricity Policy and for updating such plans every 5 years.

3. Rajasthan's state Department of Energy formulates power policy. Rajasthan Rajya Vidyut Prasaran Nigam Limited (RRVPNL) is the state transmission company responsible for intrastate power transmission and evacuation to the interstate network. Rajasthan Renewable Energy Corporation is the nodal agency in charge of developing and promoting renewable energy technologies.

4. The Electricity Act, 2003 provides the legal framework for efficient electricity development. The act is primarily concerned with unbundling state electricity boards and ensuring open access and competition. Its salient provisions are (i) exemption from licensing requirements for electricity generation, (ii) open access in electricity transmission, (iii) licensing for electricity trading, (iv) arranging licenses for laying private transmission lines, (v) promoting the unbundling of monolithic power entities, (vi) promoting competition by allowing consumer service standards, and (vii) establishing tribunals in place of the High Court for appeals against the orders of the Central Electricity Regulatory Commission.

[1] Central Electricity Authority, Ministry of Power, June 2013, New Delhi

5. As most of India is tropical, it receives solar radiation ranging from 4 to 7 kWh/square meter/day across the country. India has the potential to deploy solar technology on a gigawatt scale. In 2010, India launched the Jawaharlal Nehru National Solar Mission (JNNSM) to (i) create an enabling policy framework for deploying 20 gigawatts (GW) of solar power by 2022 and create favorable conditions to enhance solar manufacturing capability. The main phases of the JNNSM are illustrated in Table 1. India has been one of the fastest growing global markets for wind power, with over 16,000 MW installed by 2011. The Ministry of New and Renewable Energy estimated India's wind potential to be over 100,000 MW. The accelerated target of the Ministry of New and Renewable Energy is addition of nearly 40,000 MW of renewable energy between 2012-2018 (including both wind and solar energy). Supporting investments in renewable energy must entail addressing challenges that include the higher cost of electricity from such sources, technical integration issues, resource assessment, and financing.

Table 1: Jawaharlal Nehru National Solar Mission Timelines and Targets

Timeline	Targets	
Phase 1 (2010–2013)	Grid connected:	1,000–2,000 MW
	Off grid:	200 MW
Phase 2 (2013–2017)	Grid connected:	4,000–10,000 MW
	Off grid:	1,000 MW
Phase 3 (2017–2022)	Grid connected:	20,000 MW
	Off grid:	2,000 MW
	Rural lighting:	20 million systems

MW = megawatt.
Source: JNNSM

6. National policy mandates that state regulatory commissions set renewable procurement obligations to be complied with by regulated entities. In 2011, the government amended the tariff policy to encourage states' procurement of solar power with guidance to state regulators that solar power was expected to be 0.25% of the mix in 2013 and 3.00% by 2022, while leaving the details of the trajectory to state regulators.

7. India has used reverse auctions to allot projects to bidders under phase 1 of the JNNSM. This resulted in an average levelized tariff of Rs12.16/kWh for photovoltaic electricity and Rs11.46/kWh for solar thermal during batch 1 bidding, both below the Central Electricity Regulatory Commission benchmark of Rs17.91/kWh for photovoltaic and Rs15.31/kWh for solar thermal. Under batch 2, the tariffs dropped further to Rs7.49/kWh and Rs9.44/kWh. Selected developers have signed power purchase agreements with offtaker NTPC Vidyut Vyapar Nigam. Nearly 80% of the 1,100 MW of solar power projects awarded under phase 1 of the JNNSM are in Rajasthan. Procurement for wind power is currently undertaken using a feed-in tariff.

8. To enable utilities with limited access to solar and wind resources to procure renewable energy, a mechanism using renewable energy certificates has been established for solar and other forms of renewable energy. The Central Electricity Regulatory Commission has specified floor and forbearance prices for credit trading based on the expected cost of such renewable power. Trading in renewable energy certificates has commenced for solar and other sources as generators in regions with resource surpluses, such as Rajasthan and Gujarat, can sell power to utilities and regulated entities seeking to comply with renewable power procurement obligations.

9. The state-owned vertically integrated Rajasthan State Electricity Board was reorganized under the power sector reform program supported by the World Bank in 2000. Responsibility for

electricity generation went to the Rajasthan Vidyut Udpadan Nigam, the role of transmission licensee was taken up by RRVPNL, and distribution was divided among three distribution companies.

10. Rajasthan's generating capacity, including allocations from central generating stations, was 6,734 MW in 2012. In December 2011, the deficit in the state stood at 4.0%, which is lower than the 11.3% recorded in Uttar Pradesh, 21.1% in Bihar, and 7.9% for the country as a whole. Rajasthan's generation currently relies heavily on thermal sources. The state government seeks to develop renewable energy to tap the state's natural resource potential and transform it into a hub for renewable energy. It has announced a program in 2011 to eventually develop 12,000 MW of solar power over a 12 year period. Similarly, distribution companies need to procure 1,200 MW of wind-generated electricity by 2016 to meet their renewable procurement obligations. The private sector will be encouraged to setup renewable generation. Over 2012–2017, the Rajasthan renewable energy investment expects to add about 5,700 MW of solar and wind power in the state, enabling the state to achieve 8,000 MW of renewable energy capacity by 2018. A strong transmission network will be needed to connect these projects to the national grid while addressing the challenges of transmitting intermittent renewable energy.

11. RRVPNL, the state transmission utility responsible for planning, developing, operating, and maintaining the state transmission network, has over 27,160 circuit kilometers of lines. It will be responsible for setting up the transmission and evacuation network in western Rajasthan, including from the Bhadla solar park. The losses of distribution utilities exceeded the national target of 15%, reaching 19% in Jaipur and Jodhpur and 21% in Ajmer. Distribution system improvements have been realized in part by effective feeder segregation of agriculture and other loads and by undertaking measures such as deploying high voltage distribution.

2. Government's Sector Strategy

12. **State government policy to support renewable energy.** With a view to using its natural resources and reducing fossil fuel emissions, the government of Rajasthan launched its solar power policy in 2011. A policy on wind power was also notified in 2012. The government has indicated support for a park approach to setting up renewable energy projects starting with the Bhadla solar park. A policy to support renewable energy manufacturing is being developed. The Clinton Foundation signed a memorandum of understanding with the government of Rajasthan in January 2010 to support setting up gigawatt-scale solar parks. The solar park approach is expected to streamline the process of obtaining various clearances, reduce the time required to develop projects, and provide economies of scale. Rajasthan Solar Park Development, a subsidiary of Rajasthan Renewable Energy Corporation, will formulate policy and rules for land allotment, firm selection and qualification, grid connectivity and infrastructure plans, and the sharing of development costs by the developers and managers of solar parks. At Bhadla in Jodhpur District, 10,000 hectares of government-owned land has been identified for use, and preparatory work, including surveying and soil testing, for 3,000 hectares in phase 1 is completed. The Government of Rajasthan has allocated land banks for the development of renewable energy projects in western Rajasthan. Resource mapping is being undertaken for both wind and solar with central government support.

13. The Rajasthan Electricity Regulatory Commission has mandated 0.5% of electricity to be procured from solar sources in FY2012 and to increase to 1.0% in FY2014. The commission also mandates that 4.5% of procurement come from wind sources in FY2012, expected to rise to 5.7% in FY2014. This mechanism has been applied to all obligated entities in Rajasthan: the distribution licensee, open access consumers, and captive power plants of 1 MW and above.

14. **Technical sustainability.** To stabilize fluctuating power flows generated by renewable energy sources, particularly wind and solar, the Government of India is seeking to develop national technical standards, conduct pilot studies, and develop a long-term road map to support the integration of renewable energy into the grid. In Rajasthan, RRVPNL has developed a road map to address constraints on large-scale renewable energy integration including steps to be taken at the state level. Physical investments required to implement the road map can be supported under future tranches of the Rajasthan Renewable Energy Transmission Investment Program.

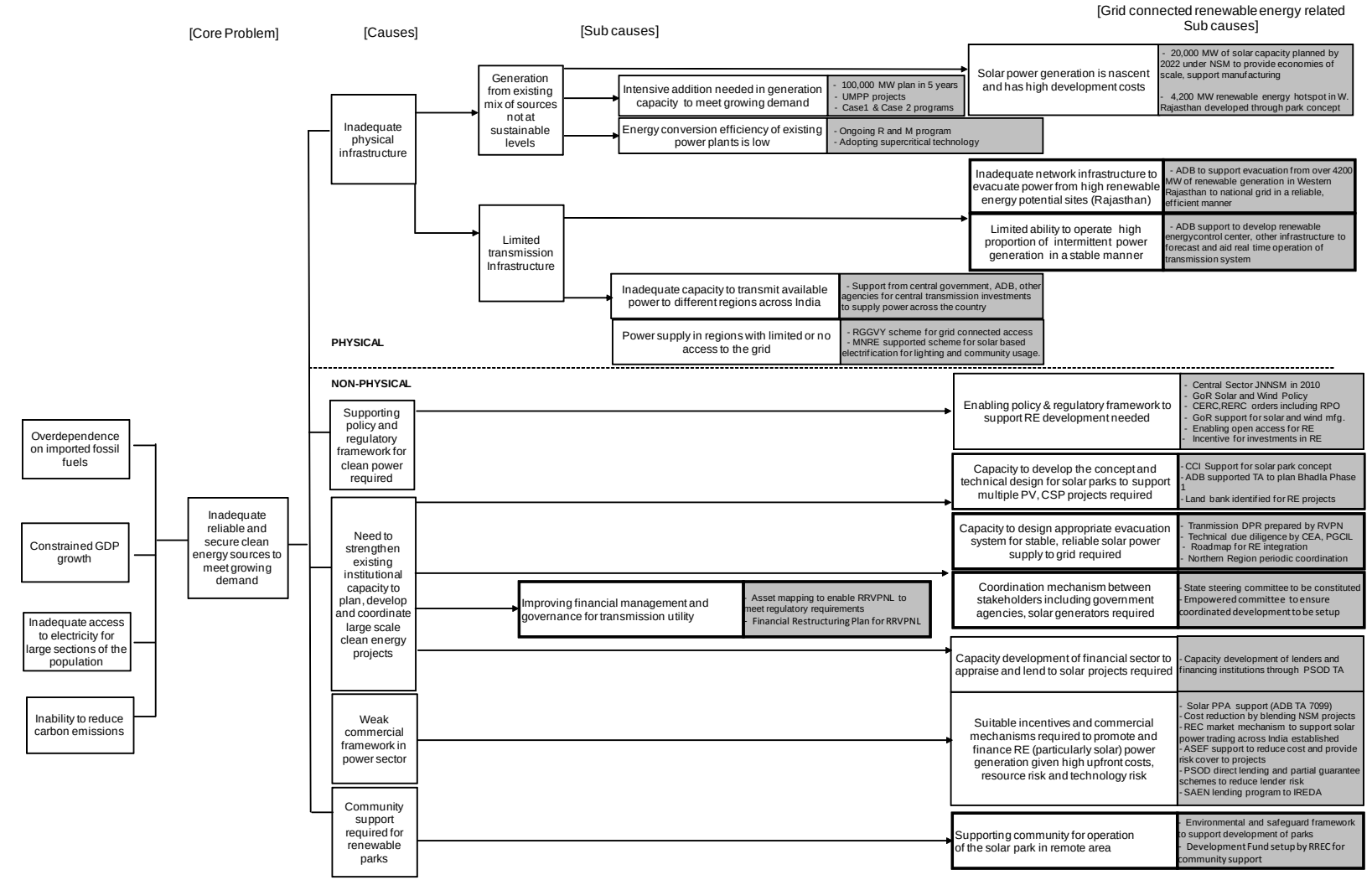
15. **Community support and development.** The area of western Rajasthan near Bhadla lacks basic infrastructure and services, including good-quality water supply, medical facilities, and electricity. Economic activity is weaker than it should be for lack of income-generating opportunities and skills and limited access to markets. Rajasthan Renewable Energy Corporation intends to prepare, as the nodal agency for renewable energy development, a framework for community development in areas adjacent to the renewable energy park. This will be applicable to all parks developed in Rajasthan. Rajasthan Renewable Energy Corporation will set up a fund to finance community development programs to support livelihoods, water supply, and other community needs.

3. Asian Development Bank Sector Experience and Assistance Program

16. The Asian Development Bank (ADB) has supported public utilities in states including Assam, Bihar, Gujarat, Himachal Pradesh, Madhya Pradesh, and Uttarakhand, including transmission and distribution projects, system loss reduction, and hydropower generation. ADB has worked with state governments and utilities on various reform measures and supported regulatory institutions. ADB has also provided financing to central government agencies such as Power Finance Corporation, and central government utilities including National Thermal Power Corporation and Power Grid Corporation of India (Powergrid). ADB's private sector experience has supported wind power projects in Maharashtra, Gujarat, and Karnataka, 40 MW solar photovoltaic and 100 MW concentrated solar power projects in Rajasthan.

16. ADB support in India follows a two-track approach - The first is continued support for investments and capacity development to state utilities to strengthen transmission and distribution networks, reduce technical and commercial losses and improve their financial health. The second track provides continued support for low carbon initiatives including renewable energy and energy efficiency using new technologies and innovation. This includes support for enabling private sector participation in renewable energy projects through renewable energy parks and working with the government to mobilize long term concessional financing from sources such as the Clean Technology Fund to finance innovative elements of the transmission network.

RAJASTHAN RENEWABLE ENERGY TRANSMISSION PROJECT - PROBLEM TREE



LEGEND: ADB= Asian Development Bank, ASEF = Asia Solar Energy Forum, ASEI = Asia Solar Energy Initiative, CCI = Clinton Climate Initiative, CERC = Central Electricity Regulatory Commission
GDP = Gross Domestic Product, RERC = Rajasthan Electricity Regulatory Commission, GOR = government of Rajasthan, ISGAN = International Smart Grid Action Network
JNNSM = Jawaharlal Nehru National Solar Mission, PPA = power purchase agreement, PSOD = Private Sector Operations Department, R and M = renovation and modernization
RE = Renewable Energy, RGGVY = Rajiv Gandhi Grameen Vidyutikaran Yojana, RPO = renewable procurement obligation, RREC = Rajasthan Renewable Energy Corporation,
SARD = South Asia Regional Department, UMPP = ultra mega power project

Problem - Intervention

Problem

Project related aspects

Problems and Interventions on the right are those relevant to RE in India. The problems and interventions marked in bold are directly relevant to this Project.

Sector Results Framework (Energy, 2013–2017)

Country Sector Outcomes		Country Sector Outputs		ADB Sector Operations	
Outcomes with ADB Contribution	**Indicators with Targets and Baselines**	**Outputs with ADB Contribution**	**Indicators with Incremental Targets**	**Planned and Ongoing ADB Interventions**	**Main Outputs Expected from ADB Interventions**
Increased and efficient use of energy including renewable energy	Aggregate technical and commercial losses reduced to 20% in 2017 (2011 baseline: 26%) Percentage of electrified villages increased to 100% in 2017 (2012 baseline: 93.8%) Share of new and renewable energy in total installed capacity increased to 25% by 2017 (2012 baseline: 12%) Transmission capacity for inter-regional power flows increased to 65,550 MW by 2017 (2012 baseline = 27,750 MW) 11,000 MW of savings achieved through demand-side management and energy efficiency during the 12th Plan (baseline = 0)	Energy system expanded, improved, and well managed	Non-renewable generation capacity (including hydropower) increased by 88,537 MW during the 12th FYP as compared with 11th FYP Hydropower generation capacity increased by 10,897 MW during the 12th FYP as compared with 11th FYP Grid-connected renewable power generation capacity increased by 30,000 MW during the 12th Plan as compared with 11th Plan - Wind power generation capacity increased by 15,000 MW during the 12th FYP as compared with 11th FYP - Solar power generation capacity increased by 10,000 MW during the 12th FYP as compared with 11th FYP - Small hydropower generation capacity increased by 2,100 MW during the 12th FYP as compared with 11th FYP - Biomass and other generation capacity increased by 2,900 MW during the 12th FYP as compared with 11th FYP 110,340 ckm of power transmission lines installed or upgraded by 2017 compared with 11th FYP 1.3 million ckm of power distribution lines installed or upgraded during the 12th Plan as compared with 11th Plan[a] 46,825 MW of non-renewable generation capacity (private sector) installed during the 12th FYP as compared with 11th FYP	(i) Planned key activity areas • solar power (20% of funds) • hydro-power (15% of funds) • other renewable (10% of funds) • electrical power transmission (40% of funds) • electrical power distribution (15% of funds) (ii) Pipeline projects 13 projects amounting to $1,948 million for 2013-2015 (including 4 projects categorized as EGM) (iii) Ongoing projects 26 ongoing loans amounting to $3,682 million as of 31 December 2012 (including 2 projects categorized as EGM)	(i) Planned key activity areas Approx. 1,500 MW of solar power; hydro power, wind power installed/ upgraded; transmission investments totaling approx. $1.75 billion; and distribution investments of about $1 billion (ii) Pipeline projects 1,250 MW of solar power; hydro power, wind power installed/ upgraded; $1.5 billion transmission system investments; $970 million of distribution system investments (iii) Ongoing projects 885 MW of hydro power being installed; 7,760 ckm of transmission lines being installed/ upgraded; 104,481 ckm of distribution lines being installed/ upgraded

ADB = Asian Development Bank, AT&C = aggregate technical and commercial, ckm = circuit kilometer, CSP = concentrated solar power, GWh = giga-watt hours, IREDA = Indian Renewable Energy Development Agency, kV = kilovolt, km = kilometer, LV = low voltage, MFF = multitranche financing facility, MW = megawatt, MVA = megavolt amperes, PV = photovoltaic, T&D = transmission and distribution.
Source: Government of India and ADB estimates.
[a] This includes 135000 ckm of 33KV lines, 560000 ckm of 11 KV lines and 610000 ckm of LV lines.