

Rajasthan's Renewable Energy Market Landscape

August 2022



WORLD
RESOURCES
INSTITUTE

About the Organisations

Centre for Energy, Environment & People (CEEP)

Founded in 2018, Centre for Energy, Environment & People (CEEP) is a research and policy advocacy initiative working at the intersection of energy, governance, environment, and people. Through critical research and democratic coalitions, we seek to transform energy and climate governance to preserve the fundamental rights of human, animal and ecological systems.

CEEP believes that policy decisions and outcomes manifest from complex interactions between individuals, institutions and communities. The behaviour and motivations of each are a vector of social, political, economic and technical factors. CEEP seeks to develop a critical conceptual understanding of these factors to facilitate democratic dialogues and participative decision-making for informed policy action. CEEP fosters and advocates the principle of Justice: economic, environmental, and climate.



WRI India

WRI India is a research organisation that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being. WRI envisions an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, businesses, and communities combine to eliminate poverty and sustain the natural environment for all people.

WRI starts with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Once tested, WRI works with partners to adopt and expand their efforts regionally and globally.



About the Authors



Priyanka Goel is a Senior Research Associate at CEEP. Her work includes policy research in the domain of environmental sustainability, energy transition and climate governance. She is a first-generation lawyer and holds a B.A. LL.B. (Hons.) from National Law University, Delhi. She practiced law in the Delhi High Court and the Supreme Court of India for a few years before finding her interest in policy research and advocacy. During her study of law, she built her interest in political economy, human rights, and environmental law.

Prior to joining CEEP, she worked as a Legal Consultant in the Coastal Regulation Zone Division, Ministry of Environment, Forest, and Climate Change (MoEF&CC). She firmly believes that understanding gaps in the governance structure is imperative to bringing effective change.



Manideep Gudela is a multidisciplinary researcher specialising in energy policy and leads the Energy Transition work at CEEP. He advocates for equitable policies that integrate economic growth with environmental sustainability. His work focuses on promoting socio-economic and political justice in the transition to a low-carbon economy.

With a background in electrical engineering and public policy, he brings expertise in distribution utility operations, independent research, and stakeholder engagement.



Simran Grover is a public policy professional who found his calling in energy sector. His explorative professional journey in the domain of development and clean energy culminated in the founding of CEEP – an initiative for energy equity and climate justice.

At CEEP, he envisions creating a meaningful environment for critical learning and evolutionary consciousness which empowers individuals and communities. In the process, he is committed to fostering leadership within the organisation and support leadership at the grassroots.

About the Report

Rajasthan's renewable energy transition roadmap has unique strengths and opportunities. The state has a high potential 142 GW for solar energy and land tracts available for deployment. An ambitious state policy seeks to accelerate its deployment, shaping a spatial shift of local electricity generation from eastern Rajasthan to desert regions of western Rajasthan. While this seeds the demand for new power infrastructure and invigorates the economic activities in western Rajasthan, it also collides with the challenges of environment preservation, acknowledgement of rights of local communities and creation of dignified secure jobs.

As an electricity consumer, Rajasthan has limited capacity to leverage its renewable energy potential. The average daily requirement of 245.76 MUs and a peak load of 15,752 MW as of 2022* is far less than the overall potential of 269 GW (solar and wind) and the targeted deployment of 37 GW by 2025. The unique characteristics of Rajasthan position it as a net exporter of renewable energy, especially to neighbouring states of Punjab, Haryana and Delhi, which have fertile and high-value land.

Source

- Data Rajasthan Solar Energy Policy, 2019
- NRLDC Monthly Report 2021-22

The power sector in Rajasthan suffers from severe distribution challenges and fiscal stress. Thus, it becomes imperative that Rajasthan's clean energy transition roadmap is carefully plotted. The role of regulator, state institutions and scientific planning shall be central to optimising transition costs and maximising benefits. This report serve the purpose of providing a snapshot of the political economy of the renewable energy landscape of Rajasthan and key factors shaping the renewable energy landscape in Rajasthan.

This report captures policy developments and insights into the verticals of electricity generation, transmission and distribution to present key drivers shaping power sector in Rajasthan and its clean energy transition journey. The report includes the following key chapters:

- Electricity Generation Landscape in Rajasthan
- Electricity Transmission Landscape in Rajasthan
- Electricity Distribution Landscape in Rajasthan
- Electricity Demand Landscape in Rajasthan
- Renewable Energy Policy Landscape in Rajasthan

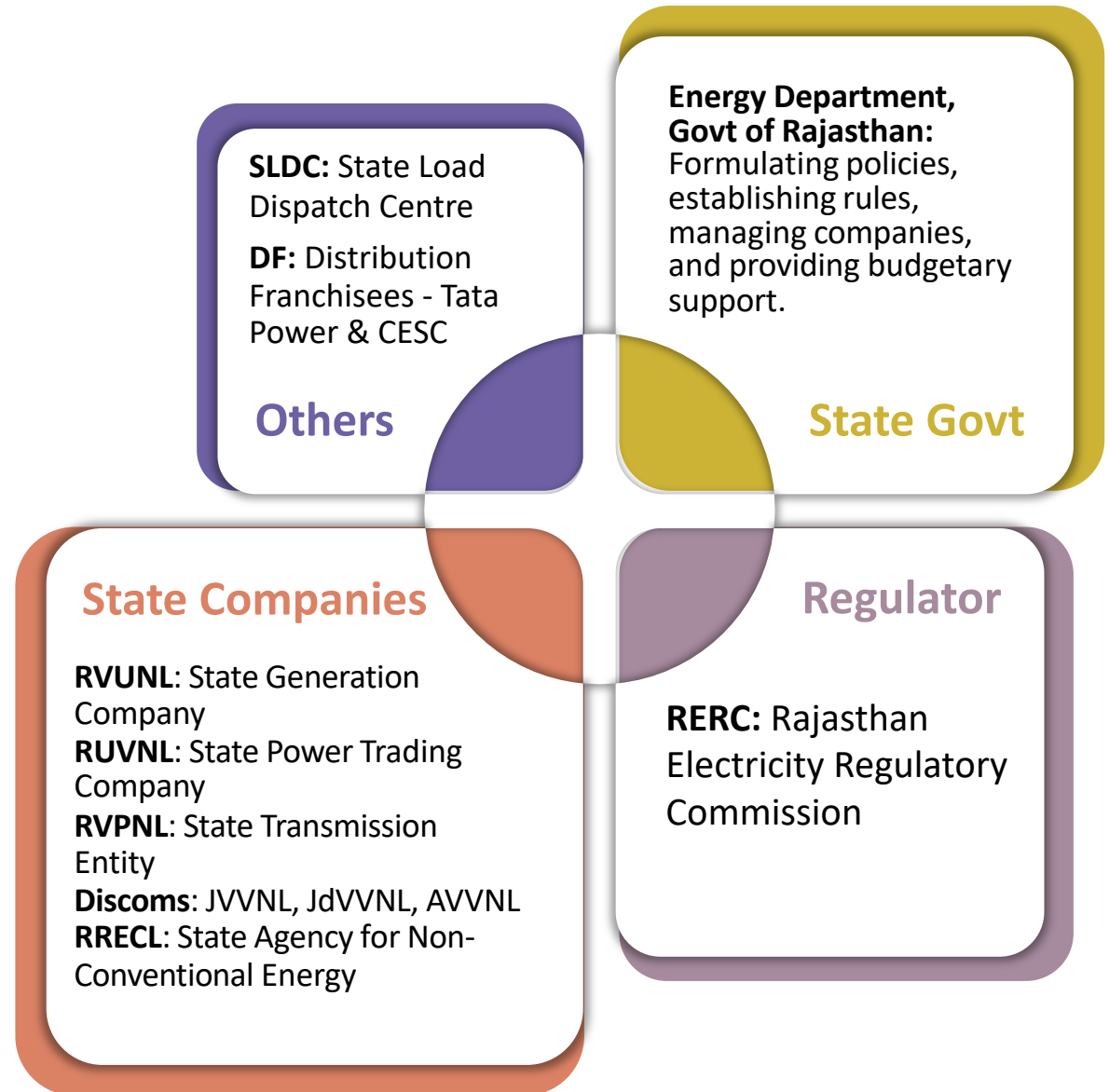
List of Contents

1.	Rajasthan Power Sector at a Glance	1
2.	Electricity Generation Landscape of Rajasthan	2
3.	Thermal Power Landscape of Rajasthan	3
4.	Renewable Energy Landscape of Rajasthan	5
5.	Key Developments in the Sector	6
6.	Generation Related Policy Announcements.....	7
7.	Transmission Landscape	8
8.	Distribution Landscape of Rajasthan.....	10
9.	Open Access Landscape of Rajasthan.....	13
10.	Rajasthan Demand Landscape.....	14
11.	Potential Drivers of Electricity Demand.....	16
12.	Summary.....	18
13.	Bibliography.....	19

Glossary

ACoS	Average Cost of Supply
AVVNL	Ajmer Vidyut Vitran Nigam Limited
ARR	Average Revenue Realised
CEA	Central Electric Authority
CGS	Central Generation Station
DF	Distribution Franchisee
EPS	Electric Power Survey
GDP	Gross Domestic Product
GHG	Green House Gas
IPP	Independent Power Producer
JdVVNL	Jodhpur Vidyut Vitran Nigam Limited
JVVNL	Jaipur Vidyut Vitran Nigam Limited
LTOA	Long-Term Open Access
MU	Million Units (Million-kilowatt hour)
MW	Megawatt
NDC	Nationally Determined Contribution
NPCIL	Nuclear Power Corporation of India Limited
NTPC	National Thermal Power Corporation
RE	Renewable Energy
RJ	Rajasthan
RERC	Rajasthan Electricity Regulatory Commission
RES	Renewable Energy Sources
RIPS	Rajasthan Investment Promotion Scheme-2019
RPO	Renewable Purchase Obligation
RRECL	Rajasthan Renewable Energy Corporation Limited
RSEB	Rajasthan State Electricity Board
RVPNL	Rajasthan Rajya Vidyut Prasaran Nigam Limited
RUVNL	Rajasthan Urja Vikas Nigam Limited
RVUNL	Rajasthan Rajya Vidyut Utpadan Nigam Limited
SGS	State Generation Station
SLDC	State Load Dispatch Centre

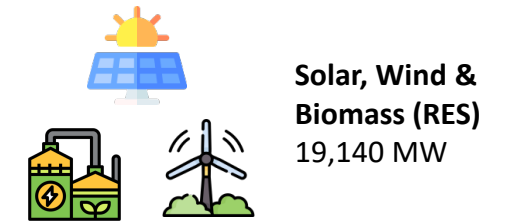
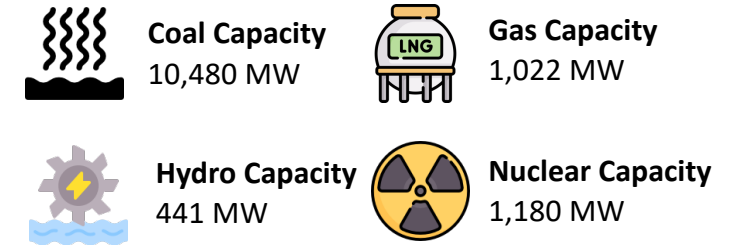
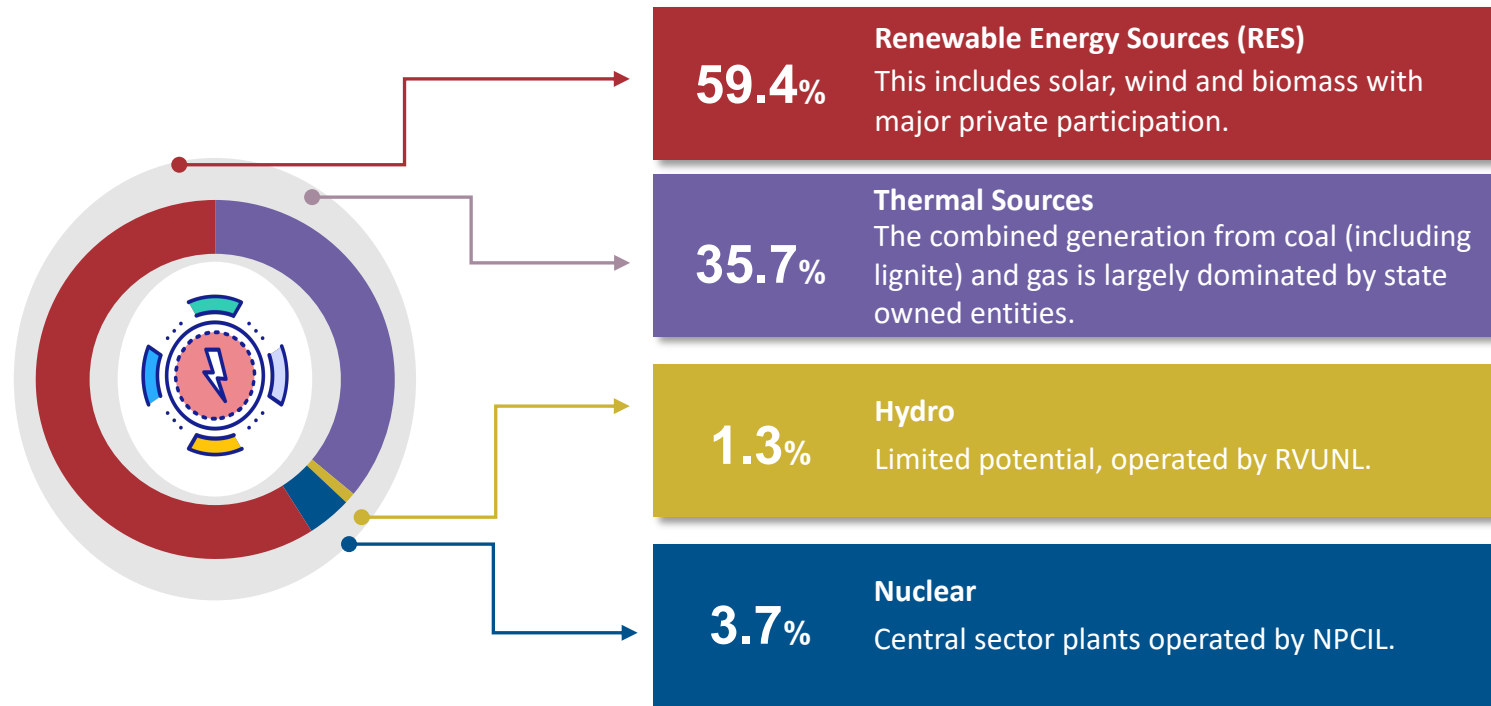
Rajasthan Power Sector at a Glance



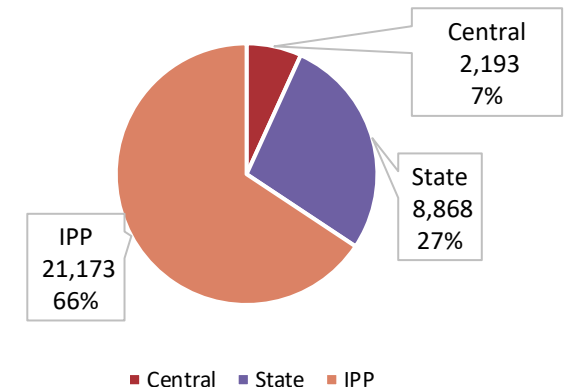
Electricity Generation Landscape of Rajasthan

Overall electricity generation landscape has been rapidly shifting towards renewable energy. As of July 2022, renewable energy constituted 59% of installed generation capacity, followed by thermal power generation at 36%. The shift to renewable energy is also reshaping the role of market players, with IPPs owning close to 66% of installed capacity as of July 2022.

Fuel-wise installed generation capacity in Rajasthan (as of July 2022)



Sector-wise generation capacity installed in Rajasthan as of Jul 2022 (MW, %)



Source

National Power Portal data

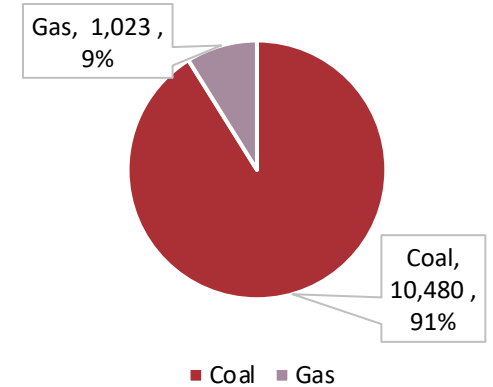
<https://npp.gov.in/public-reports/cea/monthly/installcap/2022/JUL/capacity2-Northern-2022-07.xls>

Thermal Generation Landscape in Rajasthan

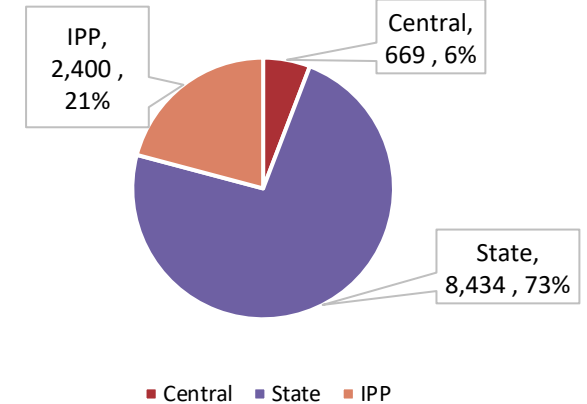
Thermal power continues to play a significant role in Rajasthan’s electricity generation portfolio. Herein, Rajasthan Vidyut Utpadan Nigam Ltd (RVUNL) is the major player holding 73% of the assets. 91% of thermal electricity generation comes from coal, whereas gas contributes only 9% in overall electricity generation. This limits ramp up and ramp down capabilities, limiting grid balancing capabilities in high renewable energy scenarios.

Further, Rajasthan is dependent on Coal India and other states for procurement of coal, inducing risk of externalities for Rajasthan’s energy security.

Fuel-wise thermal capacity installed in Rajasthan as of July 2022 (MW, %)



Sector wise Thermal Capacity installed in Rajasthan as of Jul 2022 (MW, %)



Market Players

Plant Load Factors of Rajasthan Thermal Power Plants in FY20

Sector	Plant Load Factor (%)
Central	70%
State	53%
IPP	66%

Source: CEA All India Electricity Statistics, General Review 2021

Source

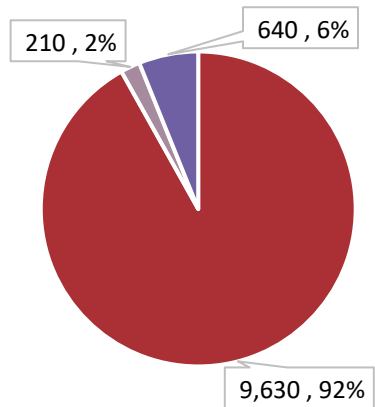
National Power Portal data

<https://npp.gov.in/public-reports/cea/monthly/installcap/2022/JUL/capacity2-Northern-2022-07.xls>

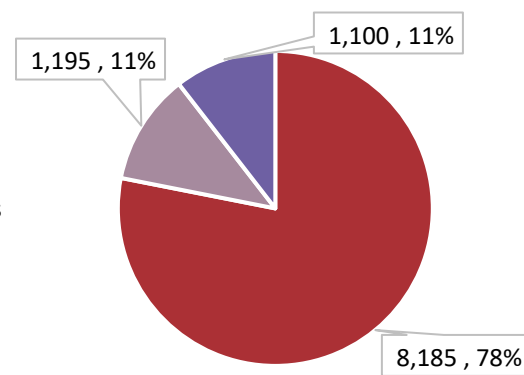
Thermal Generation Landscape in Rajasthan

About 59% of Rajasthan's thermal capacity is concentrated in the southeastern region, particularly in the districts of Kota, Baran, and Jhalawar. The clean energy transition is shaping a significant shift in the state's electricity generation loci. Majority of the current renewable energy capacity is spread across the western districts of Barmer, Jaisalmer, and Jodhpur. Bulk of the future capacity is also being planned in the same regions.

Age-wise coal power capacity installed in Rajasthan as of April 2022 (MW, %)

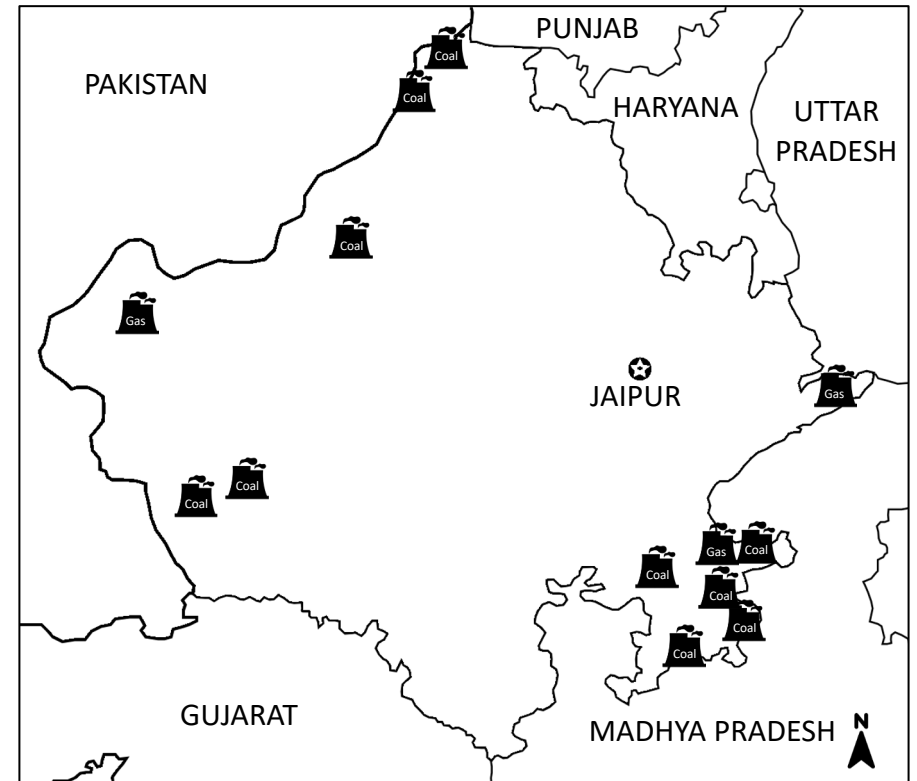


Age-wise coal power capacity installed in Rajasthan by April 2030 (MW, %)



- <25 years
- 25-30 years
- >30 years

Spatial Distribution of Thermal Assets in Rajasthan



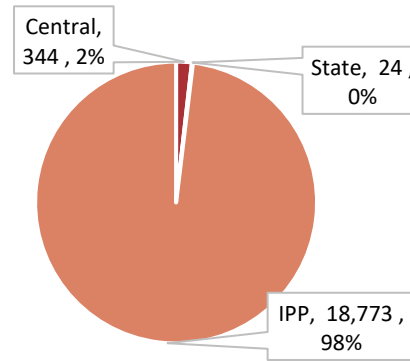
Source

Author's analysis of the power plant data aggregated from multiple sources.

Renewable Energy Landscape

Recently, India updated its NDC to a target for achieving 50 per cent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030. IEEFA report (IEEFA, 2020) suggests that Rajasthan will play a crucial role in achieving India's clean energy transition. Rajasthan is India's leading renewable energy state and has set an ambitious target of 30,000 MW of solar energy and 7,500 MW of wind and hybrid power generation.

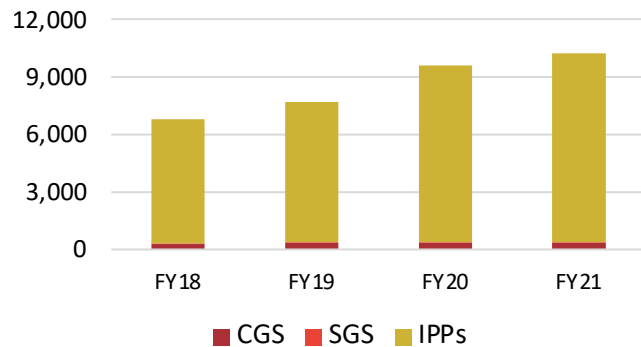
Sector wise RES Capacity installed in Rajasthan as of Jul 2022 (MW, %)



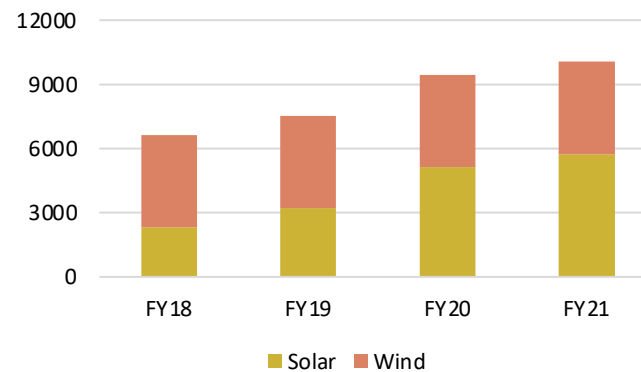
Market Players

Solar Energy

Year-wise RES capacity addition in Rajasthan



Year-wise cumulative solar and wind capacity addition in Rajasthan (MW)




Wind Energy


Source


- CEA Annual Reports FY18, FY19, FY20 & FY21
- RRECL Pragati Pratedan 2021-22


Key Developments


Rajasthan leads the country with total renewable energy deployment of 13 GW at the end of the 2022 financial year. Various developments indicate accelerated renewable energy deployment. At the same time, incidences of conflict with local communities and threats to biodiversity are being reported, raising the demand for a Just Transition.


-  Rajasthan leads in installed capacity of solar energy with installed capacity as on Jun 2022¹ **13 GW**


-  THDCIL, NTPC and two others have signed MOU with RRECL for RE capacity of ² **40 GW**

-  State government has allotted land bank for setting up solar and wind energy plants ³ **16,000 Hectares**

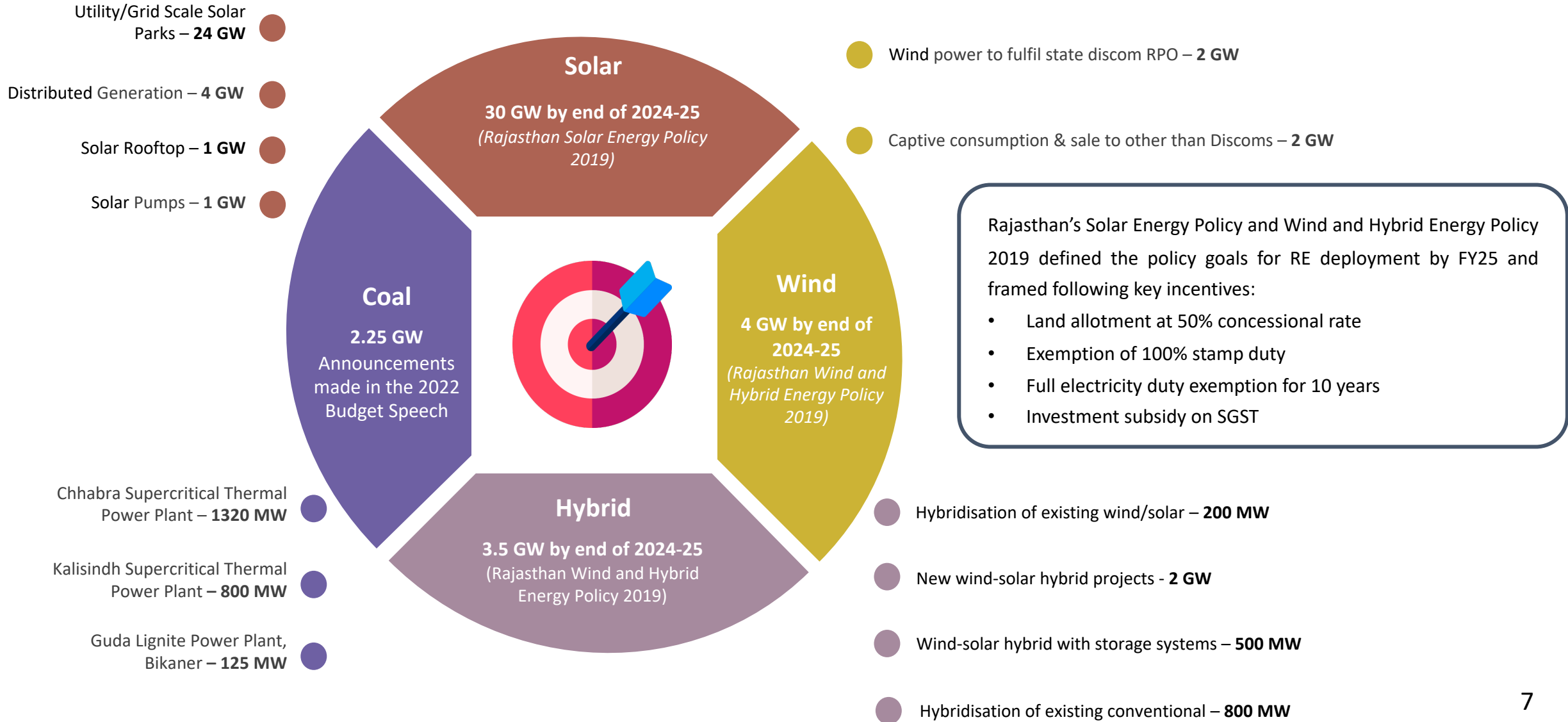
-  SC ruled that all O/H power lines in the priority GIB areas must be moved U/G ⁴ **SC Ruling**

-  NTPC to set-up battery storage capacity near Fatehgarh-III Transmission Substation ⁵ **250 MW, 500 MWh**

-  RUVN to procure wind power, through competitive bidding executed by SECI ⁶ **1200 MW**

-  Rajasthan exited NTPC PPAs from primarily gas-based generation capacity ⁷ **252 MW**

Generation Related Policy Developments



Transmission Landscape

Rajasthan is estimated to add more than 50 GW of renewable energy capacity by 2030. Majority of this capacity is expected to serve neighbouring states, creating demand for significant intra-state and inter-state transmission capacity expansion, especially in western Rajasthan.

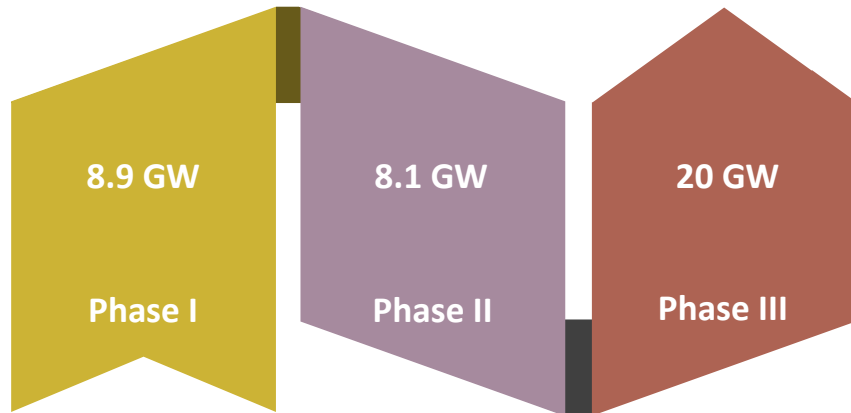
Market Players






RRVPN

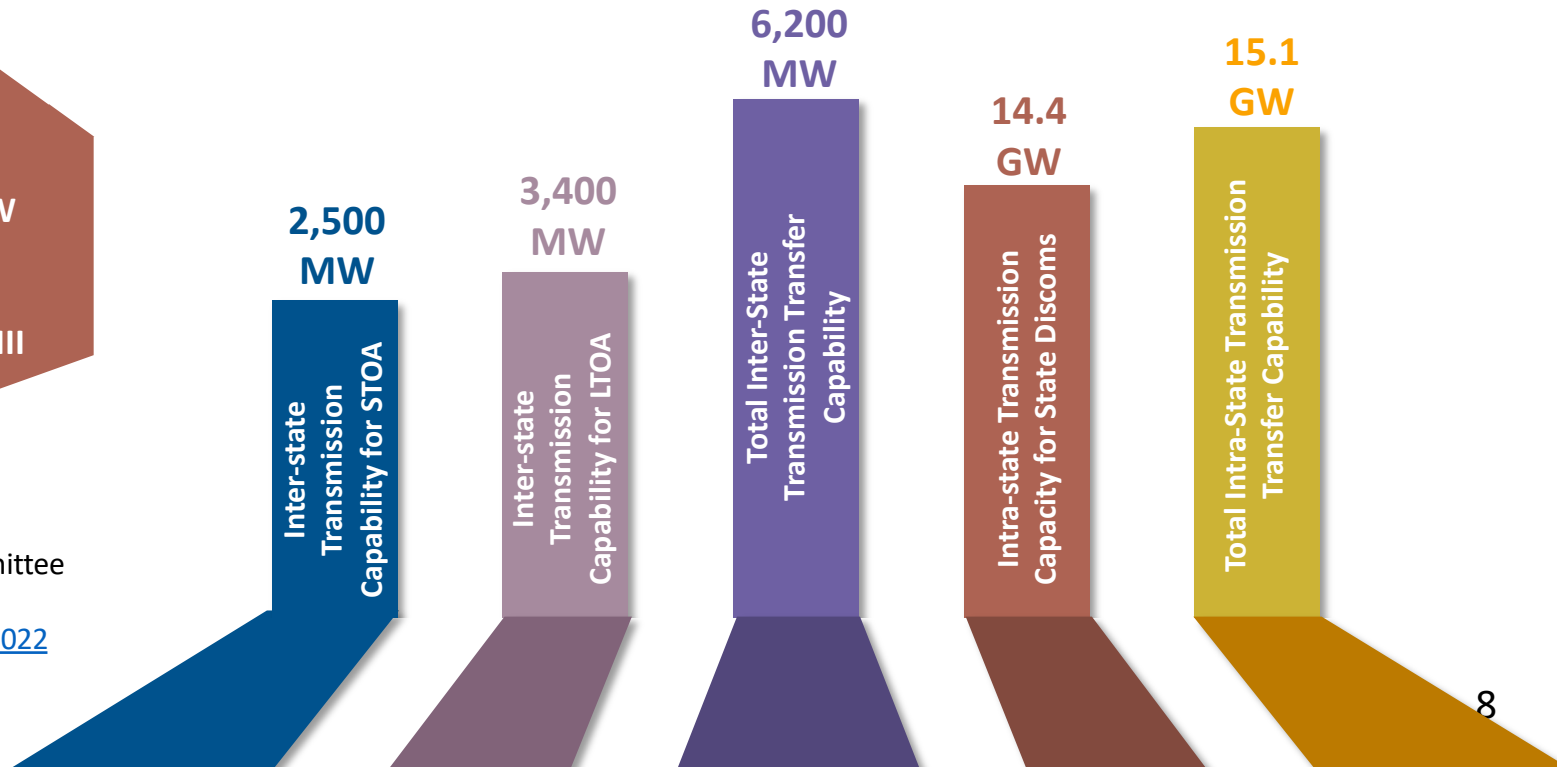
Transmission System Expansion Plans
for evacuation of power from Renewable Energy Zone (REZ)



Source

- Minutes of 4th meeting of Northern Regional Power Committee (Transmission Planning) [NRPC(TP)]
- POSOCO Data - [Import Capability of Rajasthan for March, 2022](#) & RERC Petition No: /1875/21

Inter-state and Intra-state Transmission Capacity in Rajasthan as of March 2022



Transmission Landscape

Green Energy Corridor

For evacuation of large-scale renewable energy, Intra State Transmission System (InSTS) project was sanctioned by the Ministry in 2015-16. It is being implemented by eight renewable-rich states, Rajasthan being one of them.

Phase I

9,700 ckm of transmission lines and 22,600 MVA substation capacity, with an estimated cost of transmission projects of Rs. 10,141.68 crore, for grid integration and power evacuation of approximately 24 GW of RE power is expected to be completed by 2022.

Phase II

The new intra-state transmission infrastructure, comprising a network of grid substations, is expected to generate 6,311 MW of green energy in the districts of Jodhpur, Barmer, and Jaisalmer in Rajasthan. Transmission lines of 1,170 ckm and 1,580 MVA capacity to evacuate 4,023 MW of renewable energy at a cost of Rs. 880.92 crore, with Central Financial Assistance of Rs. 290.70 crore.

Source

- https://mnre.gov.in/img/documents/uploads/file_f-1647243859886.pdf
- <https://pib.gov.in/PressReleaseDetail.aspx?PRID=1788010>

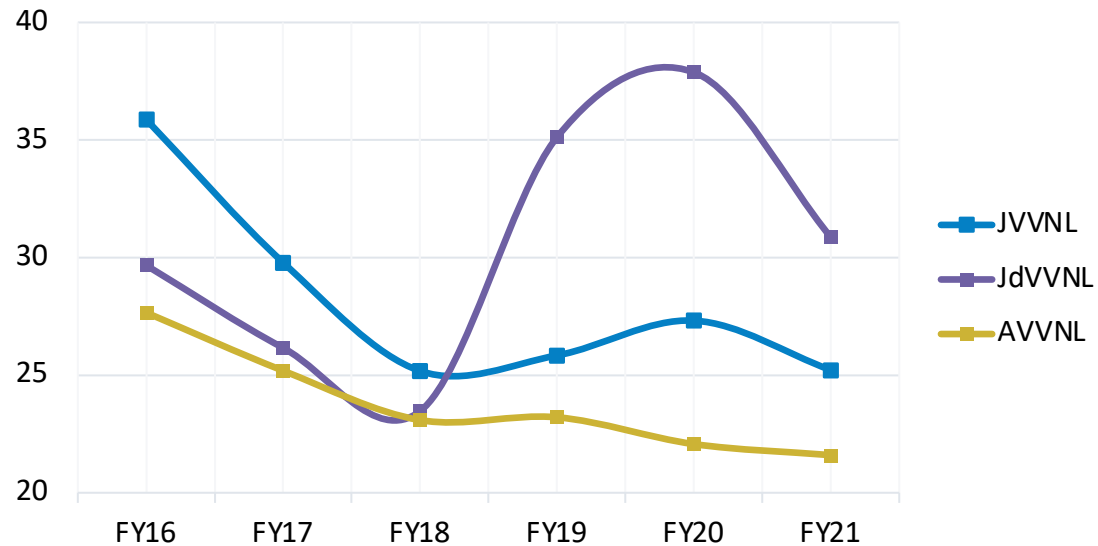
Electricity Distribution Landscape

Rajasthan is largely served by three public distribution companies, with Tata Power and CESC serving four districts amongst them as distribution franchisees. Secure Meter serves as metering, billing and collection franchisee in Bhilwara city.

AT&C for FY 2020-21



AT&C loss of Rajasthan Discom (%)

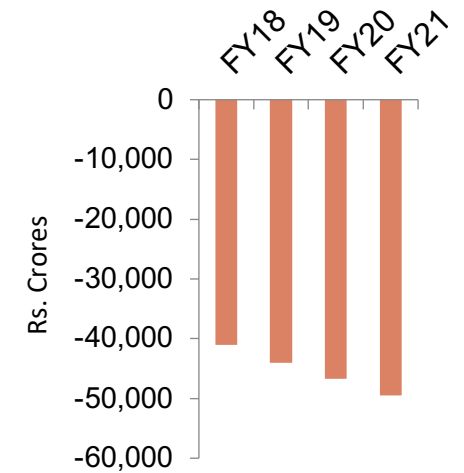
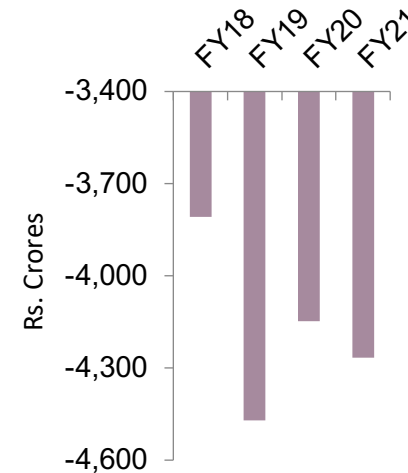
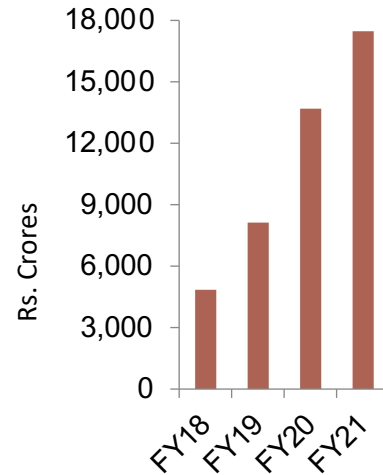
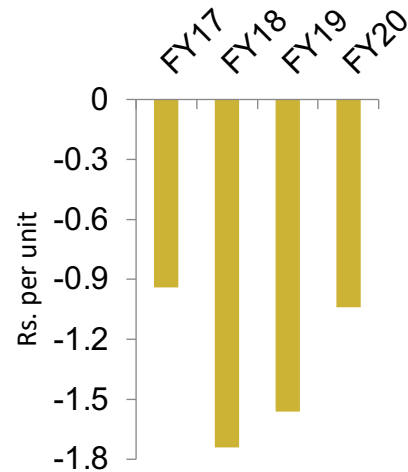


Market Players



Electricity Distribution Landscape

Electricity distribution in Rajasthan continues to suffer from fiscal distress because of high operational and technical losses, the burden of legacy PPAs, and severe liquidity issues. Absence of investments to augment grid integration capabilities may prove detrimental to Rajasthan's energy transition goals.



ACoS – ARR Gap

Gap on energy sold basis (excluding regulatory income and UDAY Grant) for FY20: Rs. 1.04/unit

Tariff Subsidy Due

Total outstanding tariff subsidy (including the DBT scheme) receivable from the state government: Rs. 17,458 crore

Revenue Deficit

Total revenue deficit of three Discoms (excluding revenue subsidy from the state government) at the end of FY21: Rs. 4,266 crore

Regulatory Assets

Total regulatory assets of Discoms at the end of FY21: Rs. 49,493 crore

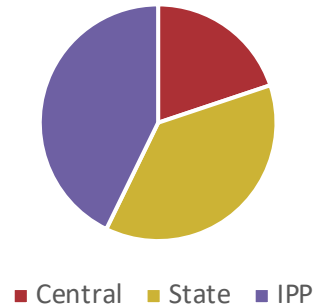
Source

Author's analysis based on data compiled from tariff orders, true-up orders, and annual reports of Rajasthan Discom from FY17 to FY20.

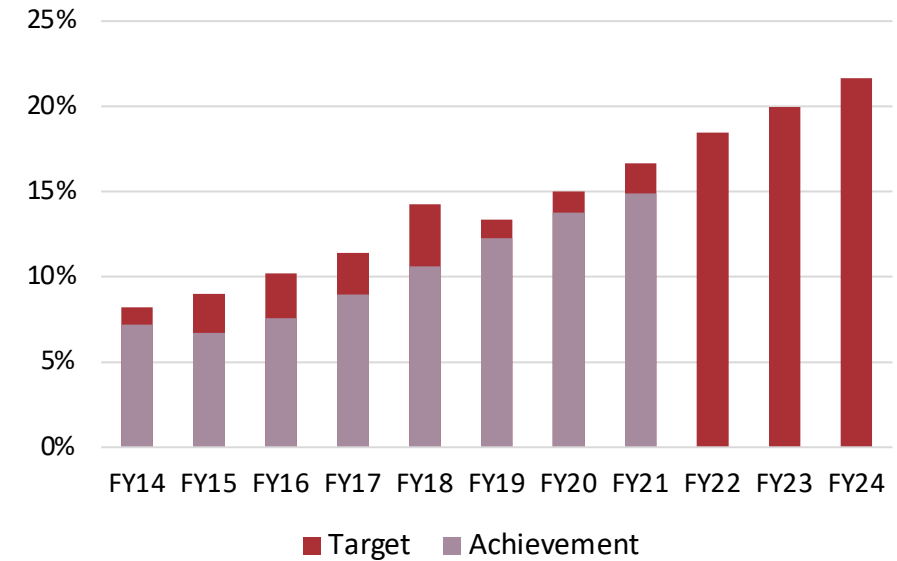
Electricity Distribution Landscape

IPPs constitute 43% of the total contracted capacity by Discoms, presenting a significant shift over the last decade. Despite renewable purchase agreements reaching record lows, average power purchase costs have continued to escalate because of rising fuel costs and low utilisation of contracted thermal capacity. However, the Discoms have done reasonably well in meeting their RPO mandates.

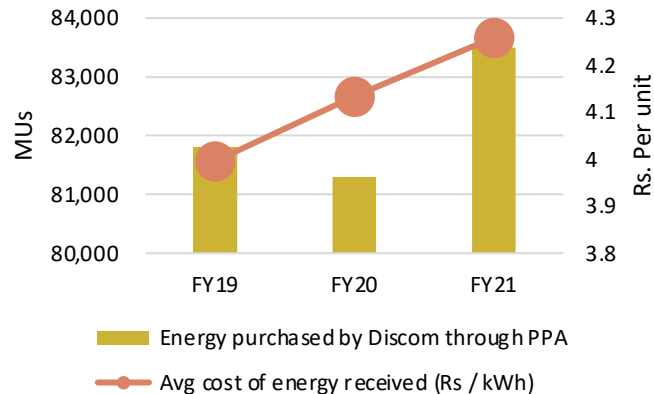
Sector-wise contracted capacity of Rajasthan Discoms in FY20



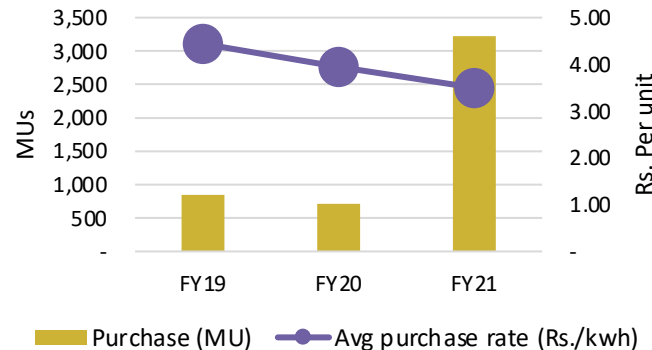
Rajasthan Discoms RPO Compliance



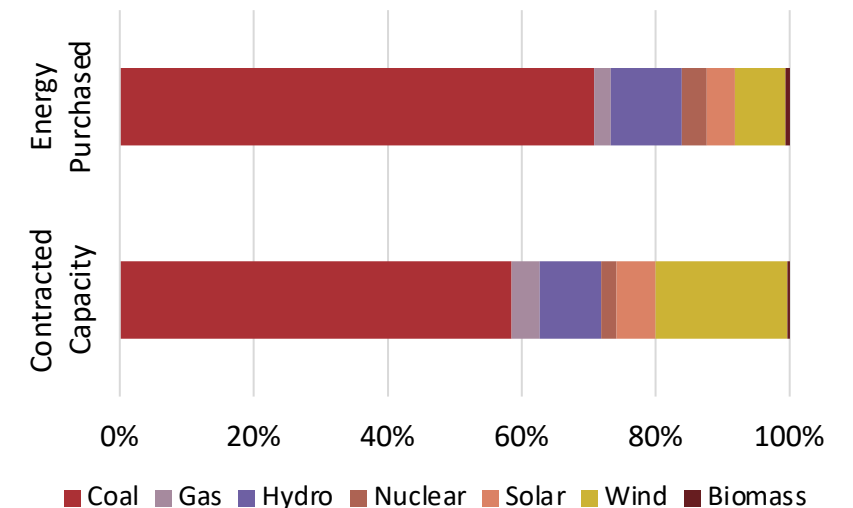
Power purchased by Discom through PPA



Short term procurement by Rajasthan Discoms



Fuel mix of Rajasthan Discoms' contracted capacity and energy purchased



Source

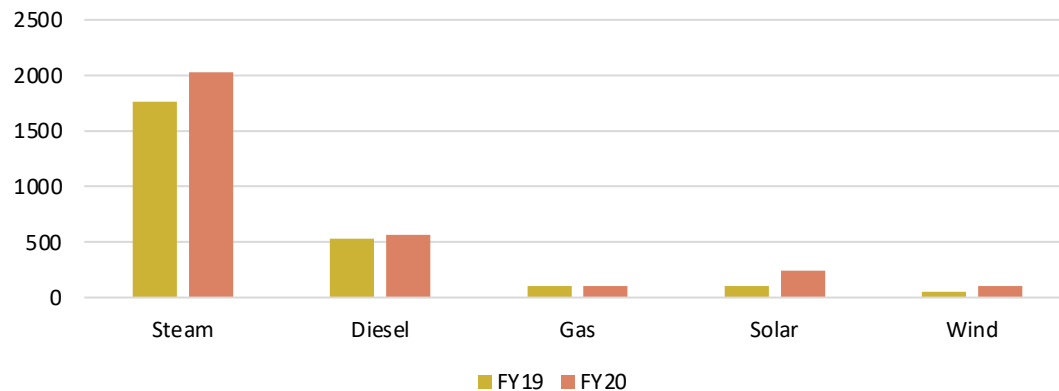
- Data compiled from the true up documents of RJ Discoms for FY19, FY20 & FY21
- RERC orders dt. 11.01.2019 & 25.03.2021 & RERC (Power Purchase & Procurement Process of Discoms) (5th Amendment) Regulations, 2018

Open Access and Captive Power Landscape

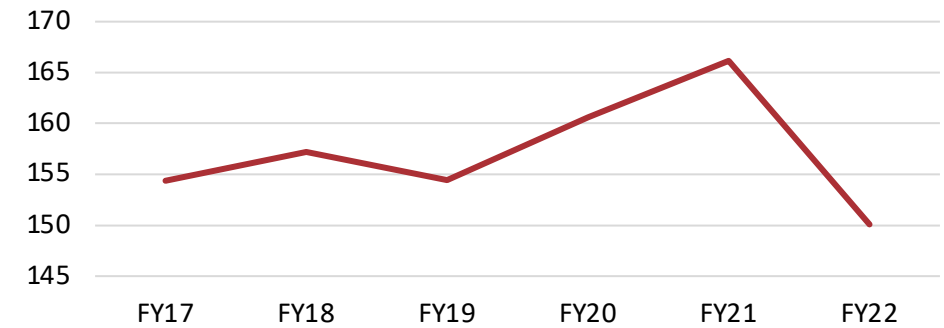
Open access in Rajasthan continues to be throttled by high tariff barriers, despite a growing demand from industry. However, there is pertinent case for rationalisation of fixed charges and banking charges levied on industries so that the burden of infrastructure and grid management costs is not unfairly socialised amongst other consumers, including domestic and agriculture consumers.

Captive power capacity in Rajasthan is also dominated by fossil fuels, even though there is a strong economic case for distributed solar. However, similar concerns about the socialisation of costs exists.

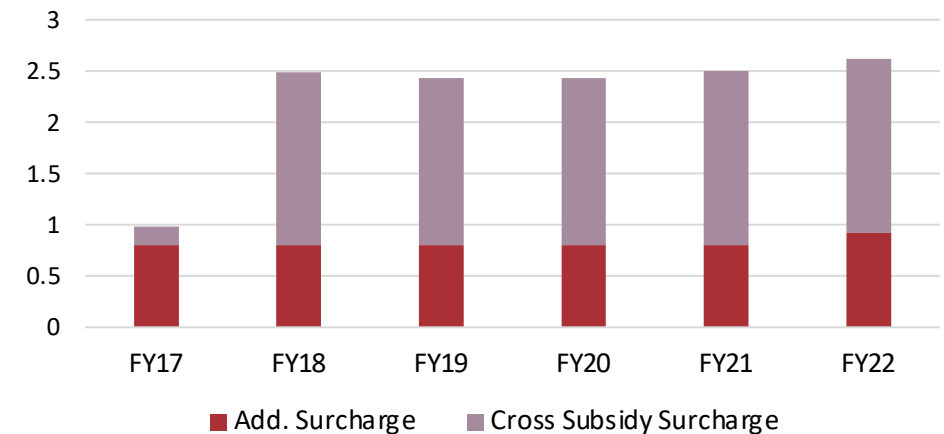
Installed captive power capacity in Rajasthan (MW)



Long Term Open Access (LTOA) transmission tariff (Rs./kW/month)



Cross subsidy and additional surcharge in for Large Industrial Service (Rs./Unit)



Note: Wheeling Charges remained at Rs. 0.01 per unit for EHV supply

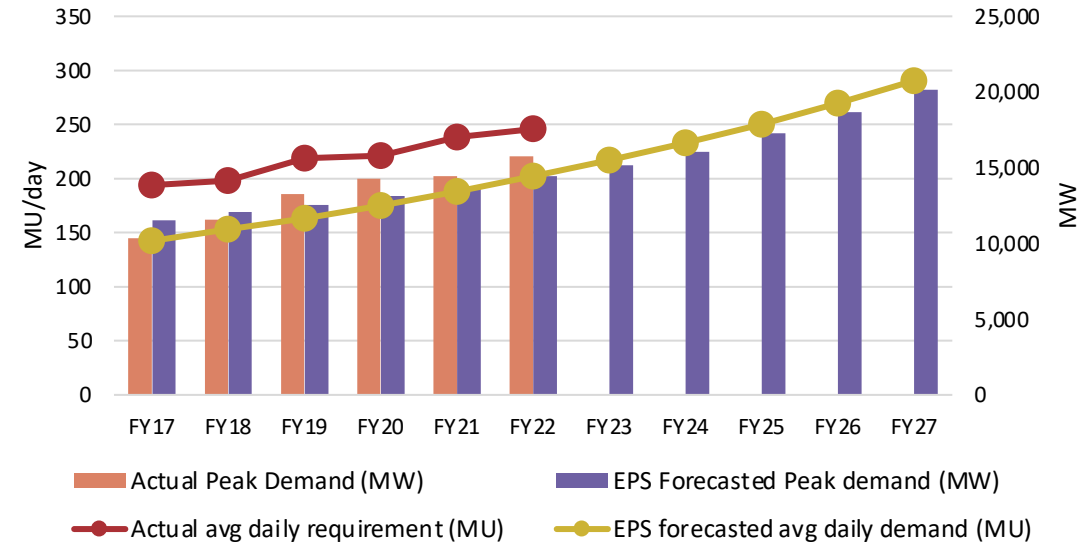
Rajasthan Electricity Demand Landscape

Historically, Rajasthan’s electricity demand growth has been lower than the EPS 18 forecasting estimates, resulting in excess capacity. However, recent years have displayed opposite trends with peak demand and overall electricity requirements surpassing the EPS 19 estimates.

Rajasthan’s demand mix is dominated by agriculture and domestic consumption, presenting a challenging landscape for tariff rationalisation and distribution of cross-subsidy benefits. Agricultural demand continues to display strong growth, likely because of large pendency of new connections, agricultural modernisation, falling ground water level, and a shift towards water-intensive cash crops.

Moving forward, electricity demand is likely to display high uncertainty and increasing complexity because of shift towards electric mobility, rooftop solar, key infrastructure projects and increase climate variability. Hence, planning energy transition shall become increasingly complex, with possibly significant financial implications for deficiencies in planning. The ability to create flexibility across generation, transmission and distribution shall dictate the pace of clean energy transition in Rajasthan.

Comparison of EPS and actual peak demand & average energy requirement of Rajasthan

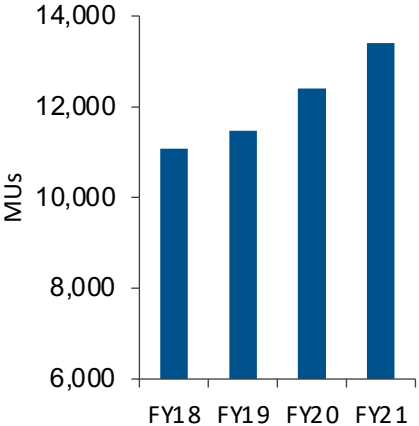
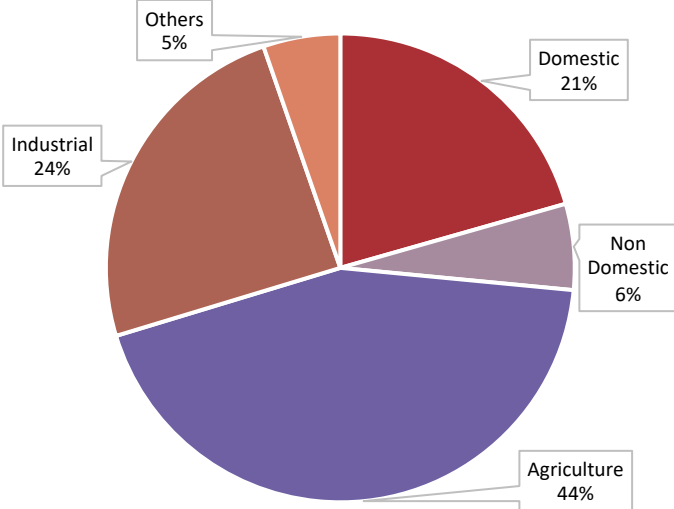


Source

CEA 19th EPS and NRLDC Annual reports for FY17 to FY22

Rajasthan Electricity Demand Landscape

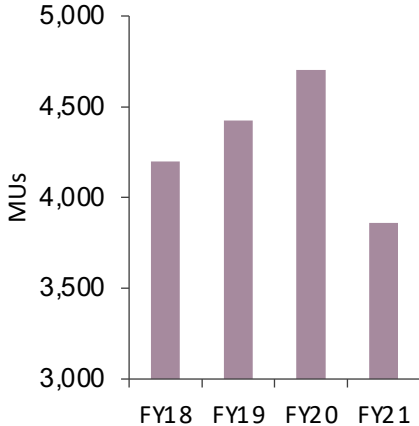
Category-wise consumption mix of Rajasthan Discoms for FY21



Domestic

3-year CAGR: 6%

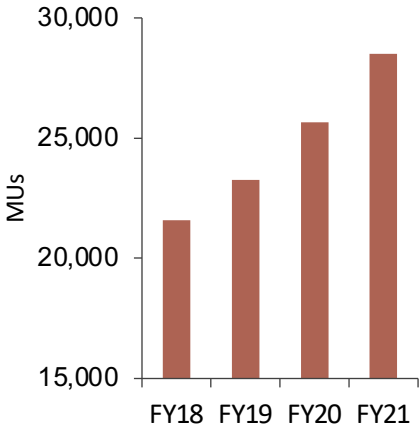
For the same duration, sanctioned connected of domestic consumers grew at 8% CAGR



Non-Domestic

3-year CAGR: -3%

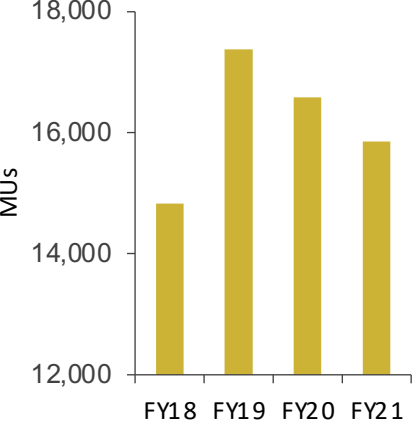
For the same duration, the total sanctioned connected of non-domestic consumers grew at 6% CAGR



Agriculture

3-year CAGR: 12%

The total sanctioned connected of agriculture category increased at 9% CAGR



Industrial

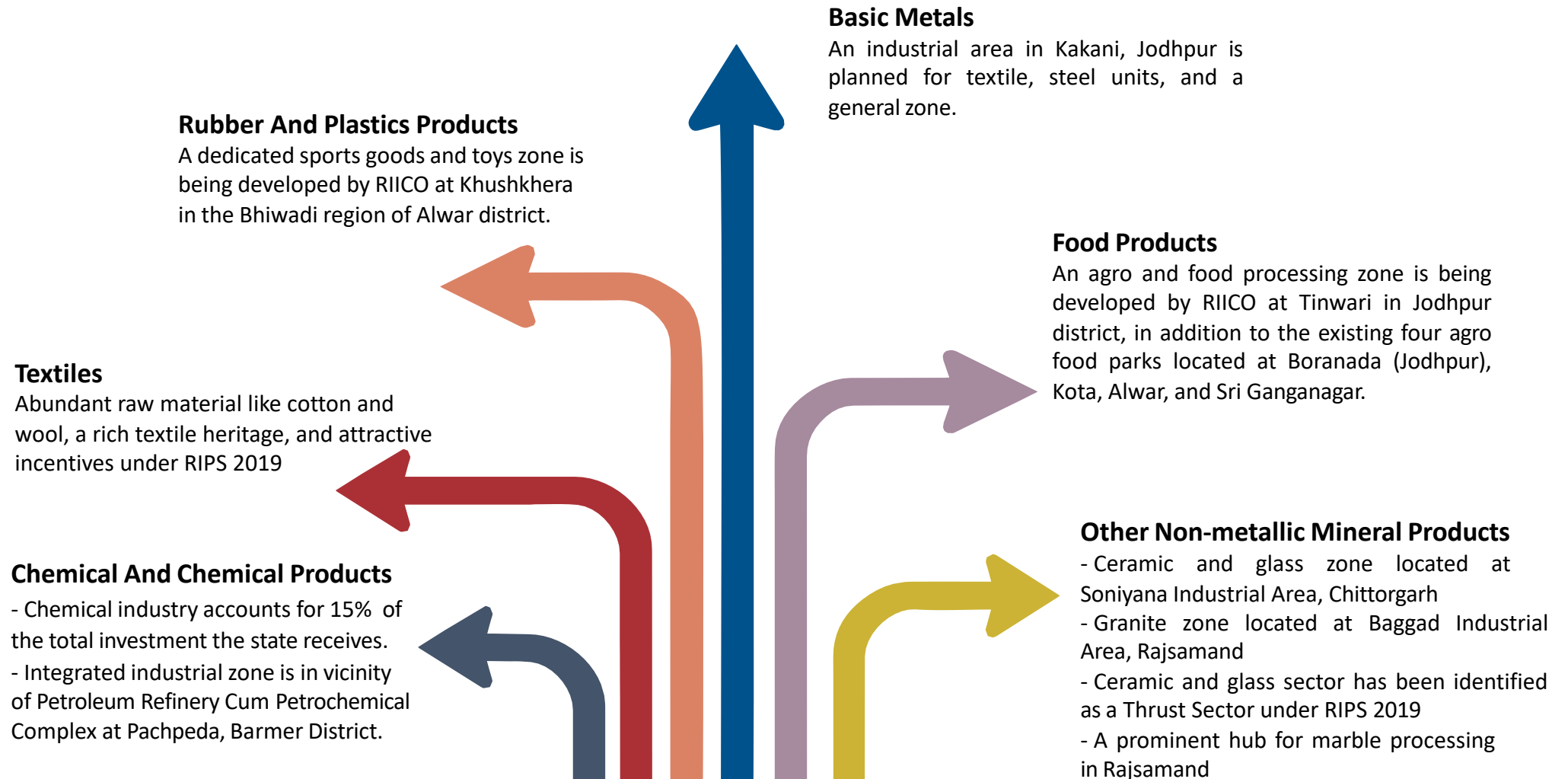
3-year CAGR: 9%

The total sanctioned connected of industrial category grew at 6% CAGR

Source

Author's analysis of data compiled from the true-up petitions of Rajasthan discoms for FY19, FY20 & FY21.

Potential Drivers of Electricity Demand - Industry



Potential Drivers of Electricity Demand - Others

Electric Vehicles

Under the Rajasthan Electric Vehicle Policy 2022, EVs are expected to significantly increase their share in new vehicle registrations by 2027.

- For 2 wheelers - 15%
- For 3 wheelers - 30%
- For 4 wheelers - 5%

Agriculture

- New connections
- Day time supply for farming
- Decreasing groundwater levels
- Adoption of farm technologies

Residential Consumption

- Increase in per capita consumption
- Increase in space cooling requirements

Development Corridors

- Bharatmala Corridor
- Delhi-Mumbai Industrial Corridor (DMIC)
- Petroleum, Chemicals & Petrochemicals Investment Region

Source

- Rajasthan Electricity Consumer Landscape, Centre for Energy, Environment & People (CEEP), 2022

Summary

The accelerated energy transition is a key driver for various stakeholders, including market players, regulators, discoms, and end consumers. The transition offers a multitude of pathways which shall have their unique opportunities, challenges and costs. For instance, there is a place for both large-scale as well as distributed renewable energy, including microgrids and rooftop solar. Further, a wide array of technologies and solutions such as energy storage, improved short-term forecasting, smart transformers, and energy-efficient appliances, are available. Rajasthan's clean energy transition roadmap shall be required to be cognizant of its challenges, strengths and opportunities. Key points for deliberation are summarised below:

1. Strengthen short-term and long-term demand forecasting capabilities
2. Strengthening and expanding transmission network while preserving impact on biodiversity and local ecosystems
3. Enabling markets for alternatives such as energy storage, demand response and energy efficiency.
4. Optimising power procurement costs and reducing fixed cost burden
5. Deepening research and experience for low carbon pathways
6. Creation of meaningful jobs
7. Aligning policy and institutions with Climate Goals

Bibliography

1. India adds record 7.2 GW solar capacity in Jan-Jun 2022 https://www.business-standard.com/article/companies/india-adds-record-7-2-gw-solar-capacity-in-jan-jun-2022-mercom-india-122081800815_1.html
2. THDCIL signed MOU with RRECL for establishment of renewable energy parks/projects of 10,000MW in Rajasthan <https://www.thdc.co.in/en/content/thdcil-signed-mou-rrecl-establishment-renewable-energy-parksprojects-10000mwin-rajasthan>
NTPC Renewable Energy Limited signs MOU with Rajasthan <https://pib.gov.in/PressReleasePage.aspx?PRID=1838841>
3. Rajasthan allots land to Adani firm to set up 1,000 MW solar power project https://www.business-standard.com/article/current-affairs/rajasthan-allots-land-to-adani-firm-to-set-up-1-000-mw-solar-power-project-122061101050_1.html
4. Supreme Court orders the laying of high-voltage power lines underground in great Indian bustard habitats in Gujarat and Rajasthan <https://frontline.thehindu.com/dispatches/supreme-court-orders-the-laying-of-high-voltage-power-lines-underground-in-great-indian-bustard-habitats-in-gujarat-and-rajasthan/article34402014.ece>
5. NTPC Issues Tender for 250 MW/500 MWh Battery Energy Storage System in Rajasthan <https://mercomindia.com/ntpc-tender-250-mw-500-mwh-battery-storage-rajasthan/>
6. SECI invites bids for 1,200 MW wind power projects <https://www.thehindubusinessline.com/markets/commodities/seci-invites-bids-for-1200-mw-wind-power-project/article64927237.ece>
7. Rajasthan to exit from five high-cost power contracts with NTPC <https://timesofindia.indiatimes.com/city/jaipur/rajasthan-to-exit-from-5-high-cost-power-contracts-with-ntpc/articleshow/83913398.cms>