

Renewable Energy Growth in Eastern Region States

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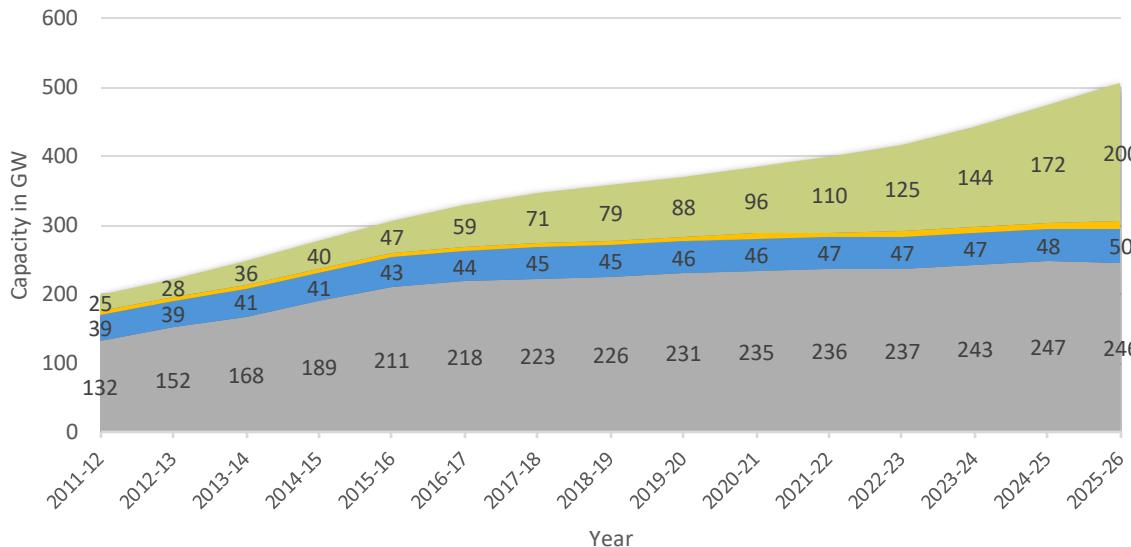


India's Clean Energy Transition

Where We Stand Today?

India's RE Sector

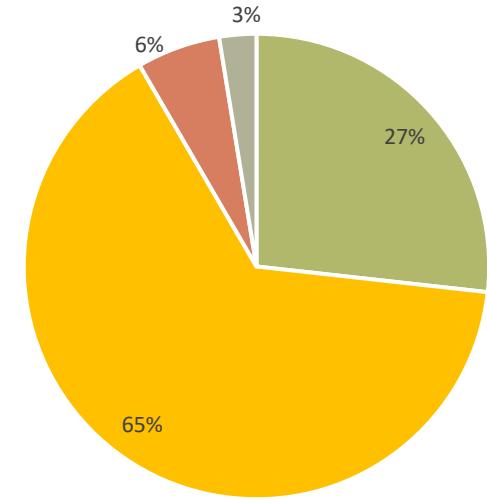
India's installed capacity growth (GW)



Source: MNRE

■ Thermal ■ Hydro ■ Nuclear ■ Renewable

Source-wise installed RE capacity

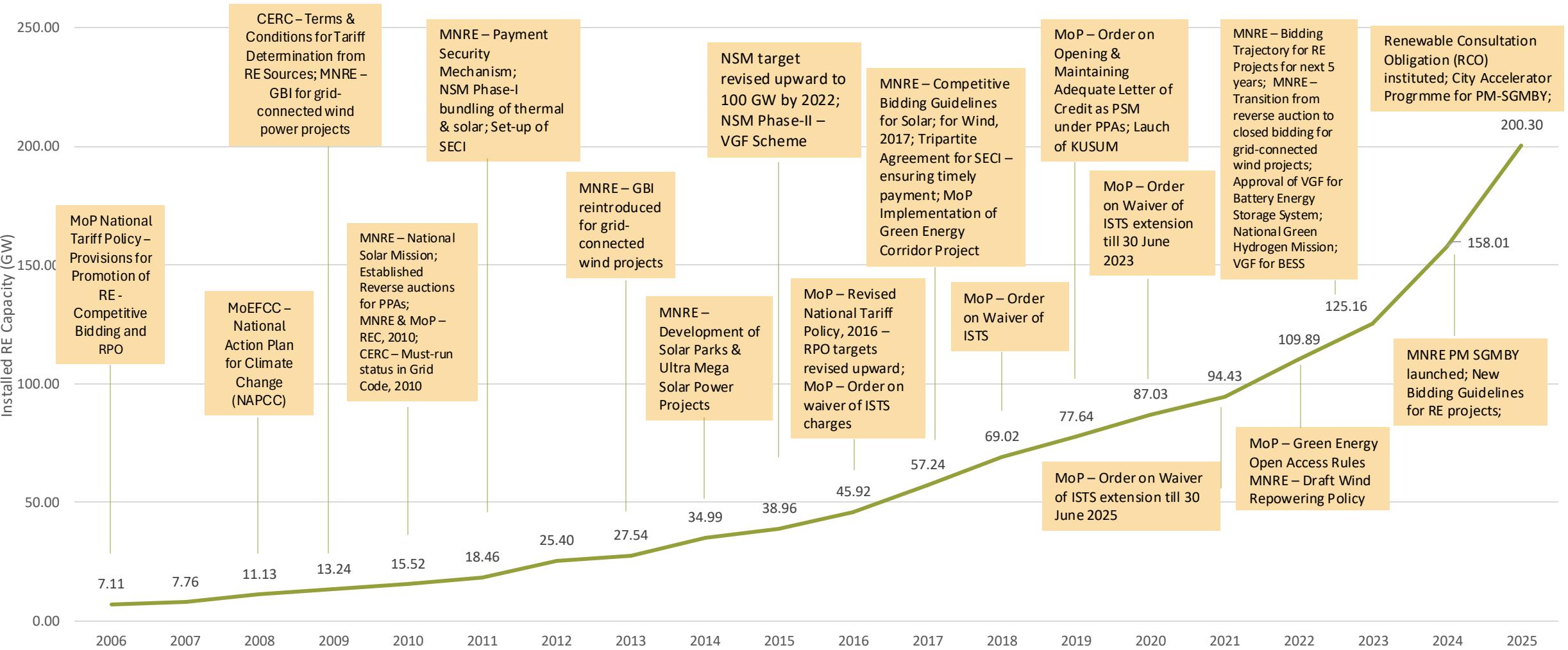


■ Wind ■ Solar ■ Bio Power ■ Small-Hydro

- With 200 GW of installed RE capacity, India has emerged as the fourth-largest RE market in the world.
- RE have become the primary driver of national capacity addition over the past several years.
- Growth has been overwhelmingly solar-led, with solar now accounting for 65% of India's total RE capacity.

Growth Drivers

Structured and comprehensive policy/strategic action to build the demand and supply side market for RE



Growth Outlook

Present Status to Long-Term Vision



Immediate Barriers to Growth





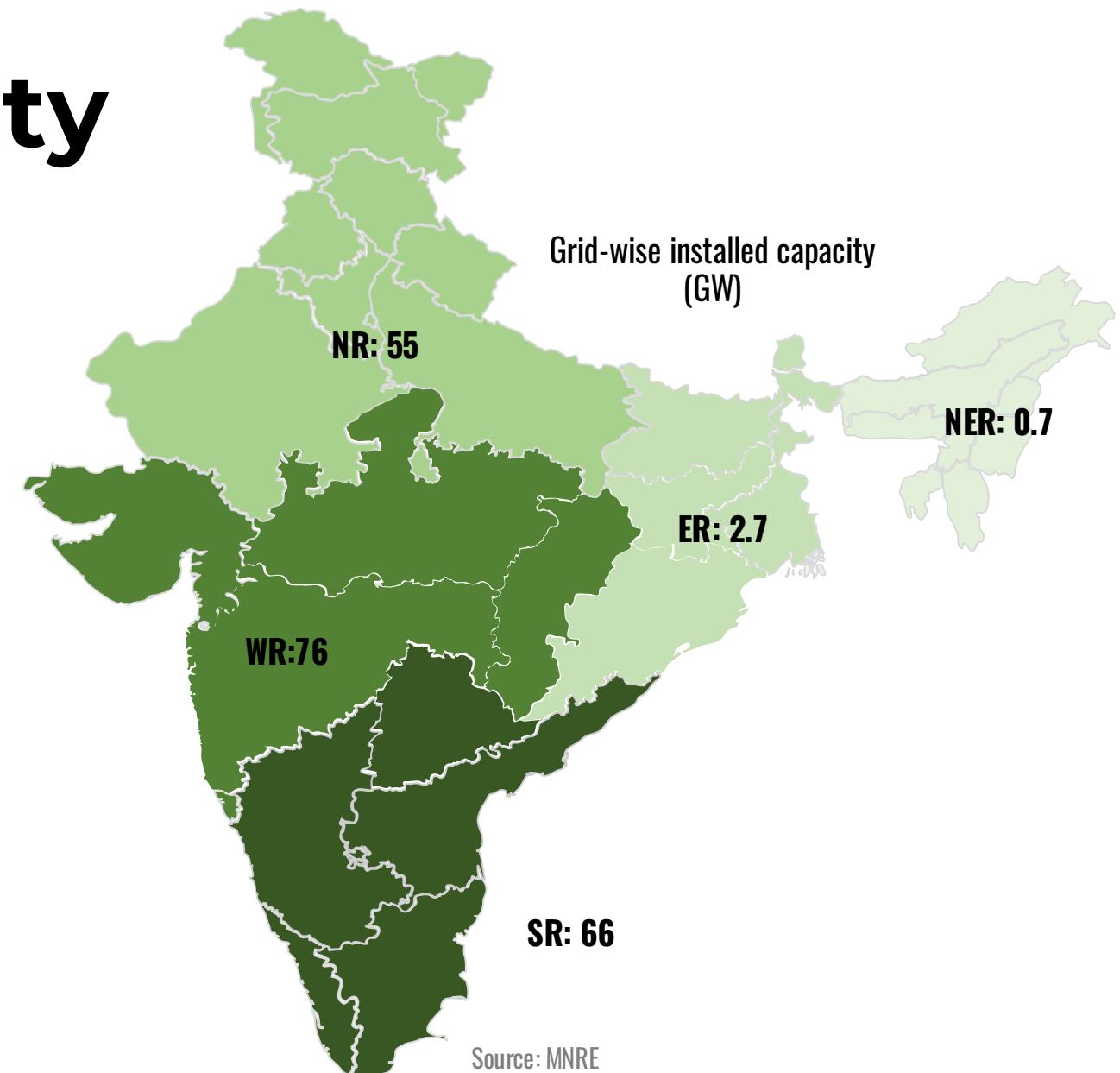
The Regional Imbalance

Why does this matter?

Regional Inequality in RE Growth

Seven states account for 86% of India's RE capacity.

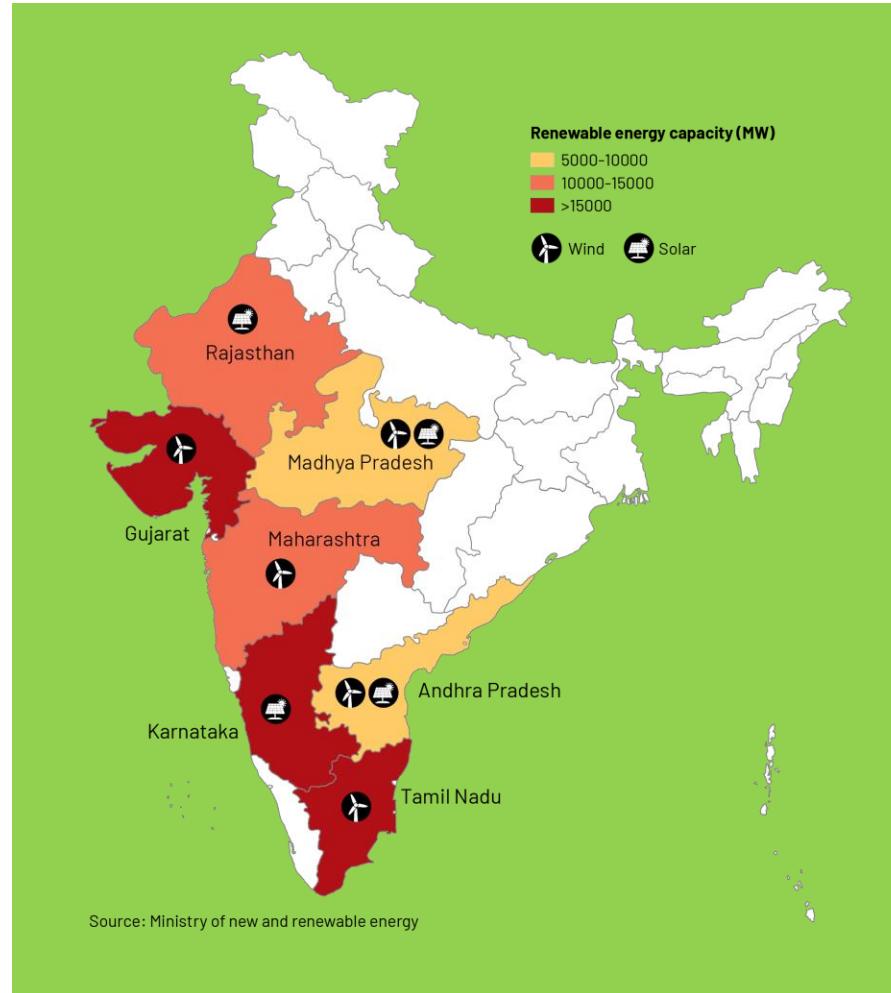
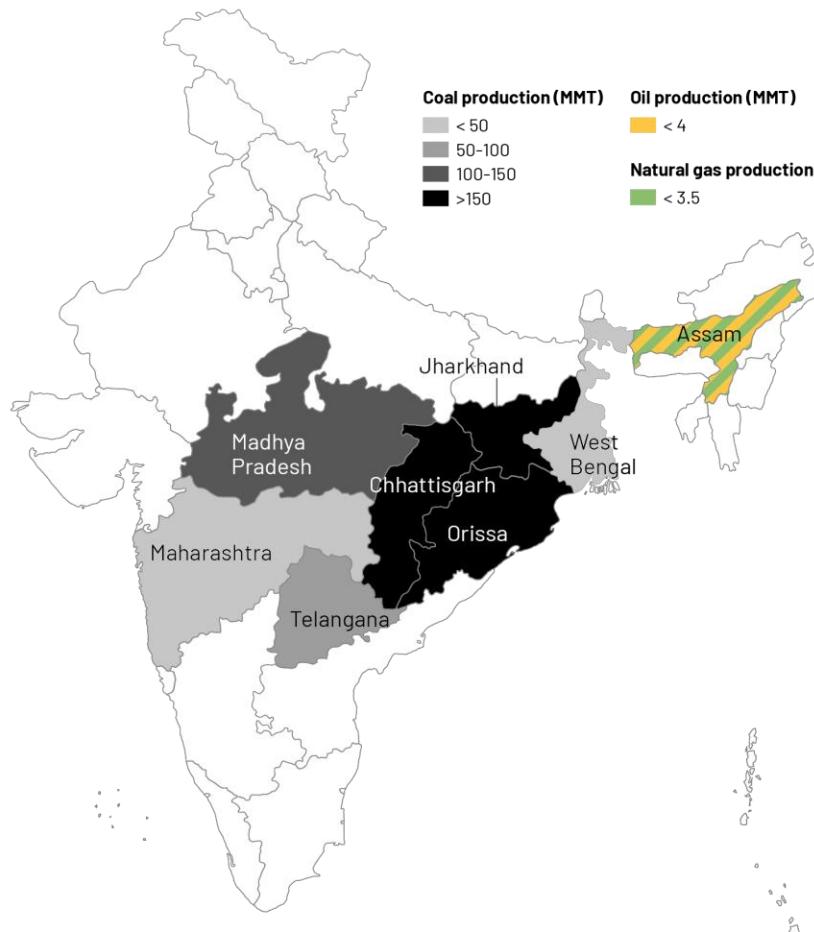
- Rajasthan (20%), Gujarat (19%), Maharashtra (13%), Tamil Nadu (12%), Karnataka (11%), Andhra Pradesh (6%) and Madhya Pradesh (5%).



Case for Balanced RE Growth

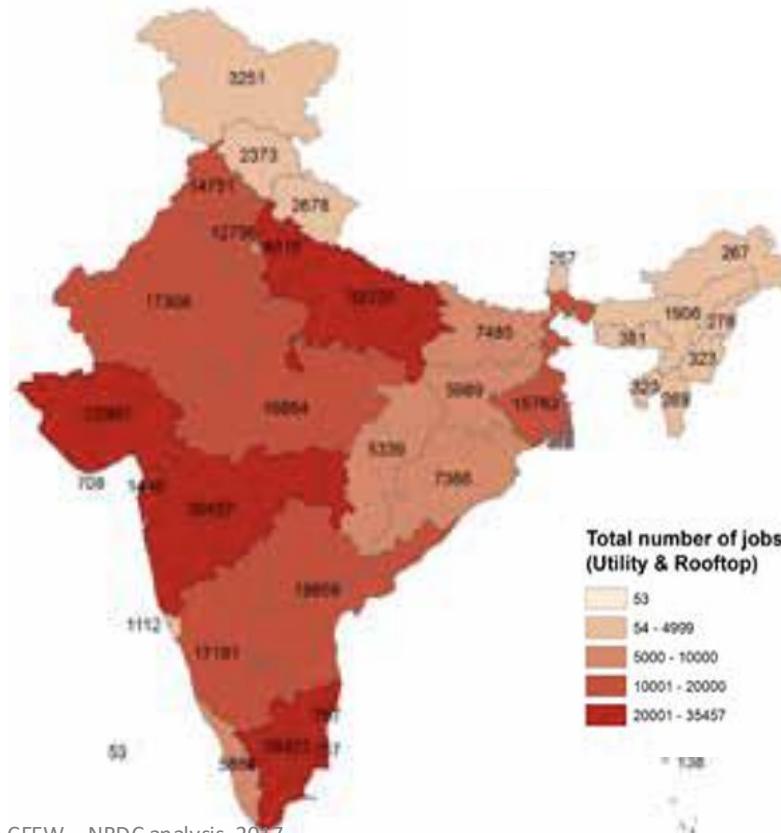


Transition Vulnerability of ER States



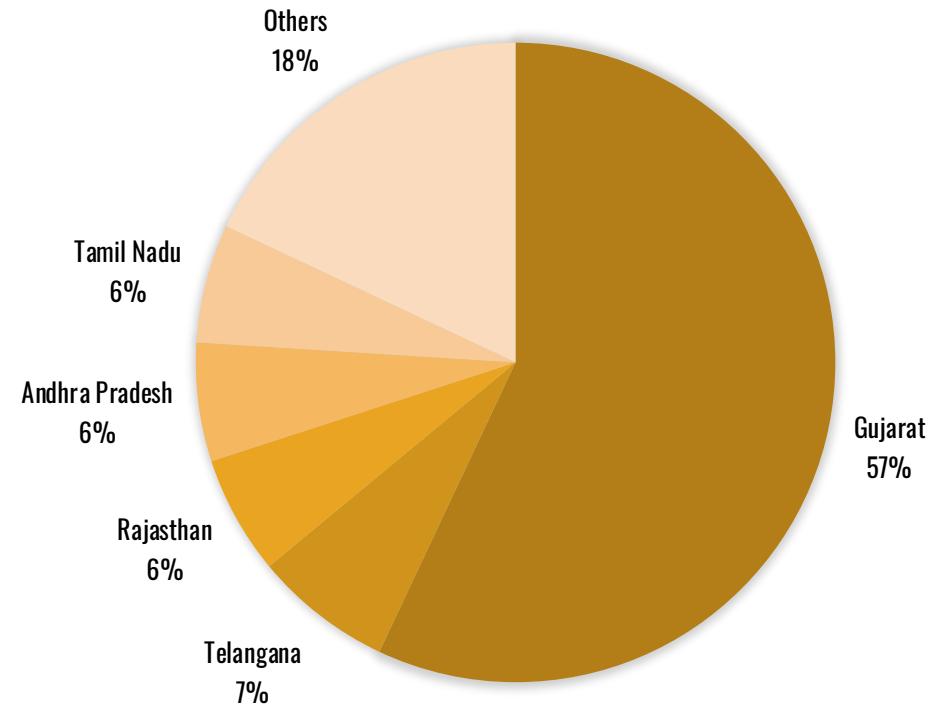
Need for Green Economy & Green Job Creation

State-wise employment potential for solar



Source: CEEW – NRDC analysis, 2017

State-wise upcoming PV manufacturing capacity



New capacity addition during 2023-26: 72.6 GW
Source: JMK research & IEEFA

Ensuring Energy Security

Renewable Consumption Obligation (RCO): A New Driver for RE Demand in India

- RCO, introduced under the Electricity (Amendment) Rules, 2022, mandates all obligated entities—DISCOMs, open-access consumers, and captive users—to meet a minimum share of renewable electricity each year.
- Consolidates earlier RPO categories (solar, non-solar, HPO) into a single consumption-based framework for clearer, more transparent compliance.
- National trajectory (2024–2030) prescribes steeply increasing annual RE consumption targets aligned with India's 500 GW non-fossil goal.
- Non-compliance attracts penalties under the Electricity Act, strengthening enforceability and driving long-term RE procurement planning.

For low-RE states, RCO creates an urgent need to ramp up in-state capacity, diversify technologies, and reduce dependence on interstate procurement.

RCO Obligation						
Sl. No.	Year	Wind Energy	Hydro Energy	Distributed Renewable Energy*	Other RE	Total Renewable Energy
1	2024–25	0.67%	0.38%	1.50%	27.36%	29.91%
2	2025–26	1.45%	1.22%	2.10%	28.24%	33.01%
3	2026–27	1.97%	1.34%	2.70%	29.94%	35.95%
4	2027–28	2.45%	1.42%	3.30%	31.64%	38.81%
5	2028–29	2.95%	1.42%	3.90%	33.09%	41.36%
6	2029–30	3.48%	1.33%	4.50%	34.02%	43.33%

3. Enhanced Role of Eastern India

Trends and Enablers

Installed Capacity, as of Oct

State	Thermal [MW]	Hydro [MW]	Nuclear [MW]	Renewable [MW]	Total (MW)
Odisha	5,972	2,179	-	953	9,105
ASSAM	1,144	522	-	356	2,022
CHATTISGARH	12,627	274	136	2,008	15,044
WEST BENGAL	8,476	1,483	-	771	10,731
JHARKHAND	3,522	177	-	255	3,954

Significant Unexplored RE Potential

Technology-wise RE potential across key states

Technology	Source	Assam	West Bengal	Jharkhand	Chhattisgarh	Odisha	India
Ground mounted solar	MNRE	19.1	22.74	51.8	126.5	139.4	3,343
Floating solar*	CSTEP	0.4	1.1	4.5	6.5	21.2	207
	iFOREST	0.4	31.8	22.5	39.5	120.2	-
Rooftop solar (under high scenario)	iFOREST	13.4	45.6	22.4	20.9	-	-
AgriPV	CSTEP	0.9	264.7	128.4	484.4	49.7	13,803
PSP	CEA	0.3	5.5	1.5	8.9	4.7	176
Wind (at 150 agl)	NIWE	0.4	1.3	-	2.7	12.1	1,163

*CSTEP analysis is based on GIS based water bodies, of greater than 1.5 ha for assessment with 12 months water availability

Focus on ‘Land Neural’ Technologies

- Eastern states face significant land constraints – dense settlements, forest cover and competing land demands.
- RE expansion must thus be anchored in technologies that minimise land-use conflicts, leverage existing natural and built assets, and align with the region’s ecological and socio-economic conditions.

High availability of **water bodies** enables large-scale **Floating Solar PV** across Odisha, West Bengal, Assam, and Jharkhand— supports utility-scale deployment without land acquisition.

Extensive **agricultural activity** creates opportunities for **Agri-PV**, balancing farm productivity with decentralised power generation.

Urban and peri-urban density across major cities strengthens the case for **Rooftop Solar**, especially under PM-SGMBY, where uptake is already rising in several ER states.

Hydro-rich geographies in Odisha, West Bengal, and Jharkhand position the region well for **Pumped Storage Projects (PSP)**, essential for balancing high solar penetration.

Closed/abandoned mines across the coal belts of Odisha, Jharkhand, & Chhattisgarh offer opportunities for repurposing degraded land and water assets for RE generation.

High RE Procurement Potential

State-wise Projected Contracted Capacity Mix by 2029-30 for Utility Demand (MW)

	Coal	Hydro	Solar	Wind	DRE	PSP	Battery	SToA/ MToA	Other (Gas, Nuclear)	Total
Assam	1,908	1,399	2,354	500	385	-	695	837	606	8,684
Chhattisgarh	9,435	772	5,559	2,370	2,128	-	2,553	-	2,814	25,634
Jharkhand	5,798	372	2,226	1,700	801	-	149	-	-	11,046
Odisha	7,397	2,891	2,565	2,245	1,693	500	125	-	-	17,416
West Bengal	12,446	1,634	10,741	5,140	3,541	1,400	1,590	236	-	36,737

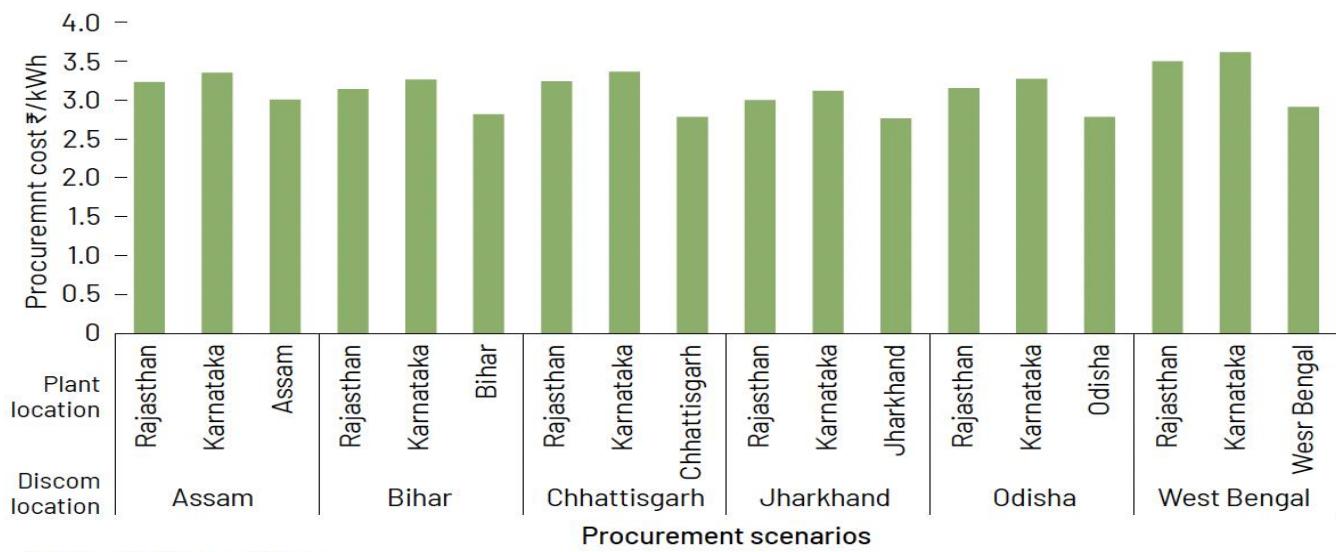
Source: CEA Resource Adequacy Studies

- Additional RE demand will be created by open access and captive power consumers due to RCO implementation.
- In case of states like Odisha, with high captive installed capacity, this could be as high as 24 GW by 2030 of captive/OA consumers.

Improving economics - Discontinuation of ISTS Charges Waiver

- Introduced in 2016 to support states with 'low RE' potential in meeting their RPO.
- Initial impact - opened up RE markets by enhancing the competitiveness of solar & wind projects, contributed to exponential growth.
- Contributed to regional imbalance due to the effective impact of waiver on procurement cost of discoms - 14% to 25%.
 - Assessed generation LCOE differential - Rs 0.02 to Rs 0.40 per kWh;
 - Estimated ISTS charges - Rs 0.40 to Rs 0.90 per kWh.
- **Set to be phased out in 2028 (for solar & wind), creating a balanced playing field for all states.**

Procurement cost comparison for state discoms considering a non-ISTS waiver scenario



Source: iFOREST estimates

4. Land-Neutral RE Technologies

Progress & Enablers

Floating Solar PV

Technology: Solar module deployment on water bodies—using underutilised surfaces without competing for land—while offering higher efficiency through natural cooling, reducing evaporation, integrating seamlessly with existing water infrastructure, and enabling scalable deployments, provided sites meet hydrological, stability, anchoring, grid, and environmental requirements.

Outlook for India

- Floating solar deployments expanding rapidly, driven by growing recognition of technical and spatial advantages.
- India has over 24.24 lakh water bodies, with nearly two-thirds in five states, including West Bengal, Odisha and Assam. Eastern states collectively hold more than half of India's water bodies.
- Emerging guidelines in states such as Odisha, Kerala and Uttar Pradesh indicate a clear policy shift toward structured FSPV development, with commercial scale-up expected over the next 3–5 years.



Implementation status

- India has ~700 MW operational FSPV, with 1,600 MW under development and 5,000+ MW in exploration, reflecting rapid scale-up.
- No standalone national FSPV policy, but the technology is integrated into major programmes (National Solar Mission, Solar Parks/UMSP schemes) and recent CEA/CERC directives; most current projects stem from the Solar Parks scheme.
- States are beginning to formalise FSPV, though few (e.g., Jharkhand, Karnataka) specify water-surface allocation mechanisms; new Guidelines/SoPs issued by Kerala, Uttar Pradesh, and Odisha in 2024–25 now define site allocation, technical norms, environmental safeguards, and livelihood protections to enable scalable deployment.

Key FSPV Projects in India

Project	State	Capacity (MW)	Developer	Status
Omkareshwar Floating Solar Park	Madhya Pradesh	600	RUMSL	278 MW; commissioned in 2024
Tata Power Kayamkulam Floating Solar Project	Kerala	101.6	Tata Power Solar	101.6 MW; commissioned in 2022
NTPC Ramagundam Floating Solar Project	Telangana	100	NTPC Limited	100 MW; commissioned in 2022
NTPC Kayamkulam Floating Solar Project	Kerala	92	NTPC Limited	92 MW; commissioned in 2022
NTPC Simhadri Floating Solar Project	Andhra Pradesh	25	NTPC Limited	25 MW commissioned in 2021
Sagardighi Floating Solar Project	West Bengal	5	WBPDCL	5 MW commissioned; in 2021
GVREL Floating Solar Park Phase-I	Jharkhand	755	GVREL - NGEL & DVC JV	Under Development
DVC Floating Solar Park Phase-II	Jharkhand	234	DVC	Under Development
Erai Floating Solar Park	Maharashtra	105	MAHAGENCO	Under Development
Getalsud Floating Solar park	Jharkhand	100	SECI	Under Development

Enablers for scaling FSPV in Eastern States

- **Clear institutional mechanisms:** Create a single-window/nodal system and transparent processes for water-body allocation, approvals, and project development.
- **Guidelines & SoPs:** Issue comprehensive procedures for site identification, hydrology checks, technical due diligence, environmental safeguards, and fisheries/livelihood protection.
- **Technical & environmental safeguards:** Standardise reservoir safety norms, compatibility assessments, bathymetry, water-level studies, and anchoring–mooring requirements.
- **GIS-based site prioritisation:** Use spatial mapping to identify technically suitable, grid-accessible, low-conflict water bodies and minimise evacuation costs.
- **Stakeholder & livelihood integration:** Engage fisheries groups and local communities early, ensure continuity of traditional uses, and adopt benefit-sharing mechanisms.
- **Demonstration / Lighthouse Projects:** Support state-backed 10–50 MW flagship FSPV projects to showcase technical viability, standardise processes, and build investor confidence.
- **Distributed FSPV on Small Water Bodies:** Promote 10 kW–1 MW systems on ponds and minor irrigation tanks through simplified permissions, model DPRs, and streamlined contracting to enable scalable rural deployment.

Agri-PV

Technology: Dual-use system enabling simultaneous agriculture and solar generation on the same land parcel—using crop-sensitive designs (elevated structures, wide inter-row spacing, vertical bifacial panels) that maintain sunlight, crop cycles, and farm-machinery access.

Outlook for India

- Land-efficient solution for a country with high land pressure and 146+ million small/marginal farms, supporting solar expansion without displacing agriculture.
- Aligns with India's 500 GW non-fossil target by 2030, enhancing farmer incomes while avoiding diversion of productive farmland.
- National assessments show multi-GW potential; Odisha alone has a minimum technical potential of ~1.6 GW.



Implementation status

- Early pilots underway in Maharashtra, Madhya Pradesh, Telangana, and Uttar Pradesh across multiple models—elevated structures, developer-owned/land-lease, farmer-owned CAPEX, and FPO/collective models.
- PM-KUSUM Component A beneficiaries show very high awareness and willingness for Agri-PV, but scaling is limited by financing and tariff barriers.
- Strong demand for both financial and technical support, especially for design optimisation, credit access, and project viability.

Installed Agri-PV Projects in India till March 2024

State	No of project	Capacity (kW)	Capacity (MW)
Gujrat	5	6115.2	6.11
Kerala	1	4000	4
Maharashtra	8	3656.9	3.65
Delhi	2	2110	2.11
Madhya Pradesh	1	2000	2
Telangana	1	400	0.4
Himachal Pradesh	1	250	0.25
Rajasthan	2	135	0.13
Haryana	2	105	0.10
Uttar Pradesh	2	210	0.21
Karnataka	1	3	0.003
Total	26	18985.1	18.98

Enablers for Scaling Agri-PV in Eastern States

1

Promote pilots in suitable agro-climatic zones and develop crop-specific technical standards (spacing, shading tolerances, irrigation design).

2

Integrate Agri-PV into rural development & crop diversification plans, linking with PM-KUSUM 2.0, horticulture missions, and income-enhancement programmes.

3

Issue clear dual-use land guidelines to provide regulatory certainty (height norms, cropping requirements, land conversion rules).

4

Provide financial de-risking—interest subvention, credit guarantees, VGF support (Odisha's analysis shows VGF of ~₹1.1 crore/MW is needed to bring LCOE below ₹4/unit).

5

Create Agri-PV facilitation cells within SIAs/RE nodal agencies for faster approvals, crop-panel optimisation support, and farmer handholding.

6

Enable farmer collectives, FPOs, and cooperatives to participate through land aggregation, shared ownership, or RESCO models.

Rooftop

Technology: Solar PV mounted on residential, commercial, industrial, and institutional rooftops, generating electricity for on-site consumption and reducing grid dependence. It can be deployed under many models, including CAPEX, RESCO / OPEX Model, Group/Community Solar, Virtual Net Metering, Peer-to-Peer etc.

Outlook for India

- RTS outlook remains strong, with 25–30 GW expected by 2026–27.
- Residential uptake accelerating under PM-SGMBY (10 million households), boosted by subsidy rationalisation and digital processes.
- C&I segment growing, with 7–7.5 GW/year expected by 2025, driven by savings and ESG commitments.
- Key hurdles: financing gaps, DISCOM alignment, and regulatory uncertainty on grid-integration caps and net-metering.



Implementation status

- Nationally, RTS penetration remains modest (~22 GW) but is accelerating due to central schemes, regulatory reforms, and stronger supply chains. Uptake is led by urban centres, industrial clusters, and institutional campuses (PSUs, railways, coal companies).
- State disparities persist:
 - Assam continues to lead residential uptake in the ER, supported by early incentives, strong utility facilitation, and active participation under PM-SGMBY.
 - Odisha is showing rapid C&I growth, driven by industrial belts, behind-the-meter systems, and institutional demand.
 - West Bengal, Jharkhand, Chhattisgarh show moderate progress, hampered by slow approvals, weaker vendor ecosystems, and limited consumer financing.
 - Business-model diversification is underway—RESCO models expanding (e.g., CREDA's 20 MW RESCO tender for housing societies).

Installed rooftop capacity in India

State	Rooftop Capacity (MW)	PM-SGMBY 2024-25 (MW)
Assam	243	202
West Bengal	67	3.4
Jharkhand	42	5.1
Chhattisgarh	167	59.4
Odisha	122	74
India total	22,420	7,075

Enablers for Scaling rooftop solar in Eastern States

- **Strengthen Policy & Regulatory Frameworks:** Harmonise net-metering rules, set predictable technical/connection standards, and issue clear district-level PM-Surya Ghar implementation guidelines for DISCOMs, vendors, and consumers.
- **Improve Financing Access & Consumer Affordability:** Expand access to low-cost capital through interest subvention, on-bill financing, credit guarantees, and standardised small-ticket loan products for households and MSMEs.
- **Strengthen DISCOM Readiness & Digital Systems:** Deploy single-window digital portals and build DISCOM capacity on technical standards, grid integration, metering, and efficient consumer service.
- **Build a Reliable Vendor & Installer Ecosystem:** Enforce strict vendor empanelment and quality norms while strengthening local installer and O&M workforce capabilities across cities and industrial clusters.
- **Promote Cluster-Based & Aggregated Deployment Models:** Drive RTS scale through demand aggregation for industrial estates and housing societies, and expand community/virtual solar options for consumers without suitable roofs.
- **Strengthen Consumer Awareness & Trust:** Run sustained outreach on PM-Surya Ghar benefits, payback expectations, system quality, and safety, supported by clear consumer toolkits and grievance channels.

Pump Storage

Pumped-Storage Projects store excess electricity by pumping water to an upper reservoir during low-demand periods, and release it through turbines during peak demand — providing grid-scale storage, peak-load balancing, and long-duration storage for renewables.

Outlook for India

- Given the intermittency of large-scale RE, PSP/PSH remains an important cost-effective, mature, and large-scale storage solution.
- For ER states, especially those with hydro potential or reservoirs — PSPs offers strong development potential.
- Proactive SNA/developer action needed for navigating environmental clearance processes, multi-agency coordination, land/water rights issues, and upfront infrastructure investments.



Implementation status

- MoP guidelines issued 2023, identified 56 PSP sites (total ~73.2 GW) across 15 states + 1 UT, and allocated to central PSUs.
- As of May 2025, there are 8 commissioned PSPs (~4.8 GW), and an additional 125 projects in the environmental-clearance / ToR pipeline (~151.7 GW potential).
- Recent policy push (MoP TBCB guidelines for PSPs in Febr 2025; as well as state notification in Odisha, Assam etc.) aims to accelerate PSP development, with faster clearances, and support for enabling infrastructure.

PSPs at various stages of the EC pipeline in India

Particular	No. of PSPs	Capacity (GW)
Applied for Terms of Reference	13	14.8
Received Terms of Reference	96	115.1
Applied for Environmental Clearance	1	1.5
Received Environmental Clearance	7	10.3
Under Construction	8	9.9
Total	125	151.7

Source: Prayas Energy, June 2025

PSPs under development in 6 key states

State	No. of PSPs	Capacity (GW)
Maharashtra	18	29.55
Andhra Pradesh	23	26.73
Uttar Pradesh	12	18.22
Rajasthan	10	14.20
Chhattisgarh	12	13.68
Tamil Nadu	9	10.30

Enablers for Scaling PSP in Eastern States

- **Clear policy & institutional framework:** Implementation of the 2023 MoP PSP guidelines, including streamlined EC/ToR processes, well-defined site allocation to PSUs or JVs.
- **State-level prioritisation:** States like Odisha or others in ER need to map hydro/water resources, identify viable PSP sites, and integrate PSP targets in state RE/hydro policies.
- **Infrastructure & financing support:** Budgetary incentives (as suggested: e.g. ~₹1–1.5 Cr per MW in enabling infrastructure), favourable loan/tenor norms via institutions like PFC/IREDA/REC, and incentives to encourage private participation.
- **Environmental & social safeguards:** Comprehensive EIA, clear water-use and reservoir-safety norms, equitable redistribution, and community/fisheries engagement — especially critical for ER's ecological and social landscape.
- **Integration with RE and storage strategy:** PSPs must be actively planned as part of the overall RE roadmap (solar, wind, floating solar, rooftop) to balance intermittent generation, enable storage, and support grid stability.

5. The Way Forward

Critical lessons for growth

Crucial to strengthen policies & institutions

State	Policy	Target	Institutional
Odisha	Odisha Renewable Energy Policy, 2022	10.96 GW of RE by 2030	RENA set up within GRIDCO
	Odisha Pumped Storage Policy, 2025		
	Guidelines for Establishing Floating Solar PV Power Projects on Water Bodies in Odisha, 2025		
Assam	Assam Solar Power Generation Promotion Policy, 2025	3,500 MW solar by 2027, 5,000 MW of PSP by 2035	RE division set up within APDCL
	Assam Pumped Storage Power Generation Promotion Policy, 2025		
Jharkhand	Jharkhand State Solar Policy, 2022	4 GW Solar by 2027	JAREDA PMU set up
Chhattisgarh	Chhattisgarh Solar Energy Policy, 2017-27	4.5 GW solar by 2030	-
West Bengal	Policy on Co-generation and Generation of Electricity from Renewable Sources of Energy, 2012	-	-

Odisha's early leadership demonstrates what Eastern states can achieve through strengthen policies & institutions

Key priorities

- 1. Build a Coherent State-Level RE Governance Architecture:** Establish strong policies, empowered RE agencies/cells, single-window systems, cross-departmental coordination frameworks, and updated policies with clear implementation mechanisms.
- 2. Create a Multi-Technology Project:** State-led bankable project pipelines are crucial in early stage of sector development. This requires structured identification, DPRs, model bidding docs, and investor engagement.
- 3. Strengthen RE Procurement Capacity for DISCOMs & C&I Sector:** Build multi-year RE procurement strategies, aggregated demand platforms, green open access facilitation, and cost-modelling tools for DISCOMs/C&I.
- 4. Invest in Digitisation & Data Systems for Faster RE Adoption** Deploy GIS tools, digital timely approval systems, RE dashboards, and consumer-facing applications (PM-SGMBY, net metering, etc.).
- 5. Enable Financing & Risk Mitigation Mechanisms:** Introduce tech-specific state subventions, credit guarantees, viability-gap support, green finance lines, and improved bankability frameworks.
- 6. Build Skills, Local Supply Chains & an RE Workforce Strategy:** Develop state-level RE skilling, local manufacturing promotion (mounting structures, floaters, inverters), and O&M workforce planning.
- 7. Integrate Climate & Transition Priorities into RE Planning:** Align RE planning with the state's development agenda, just transition strategies, mine repurposing, green industrialisation, and district-level climate/energy planning.

Thank you.
