India’s Power Sector: a Primer

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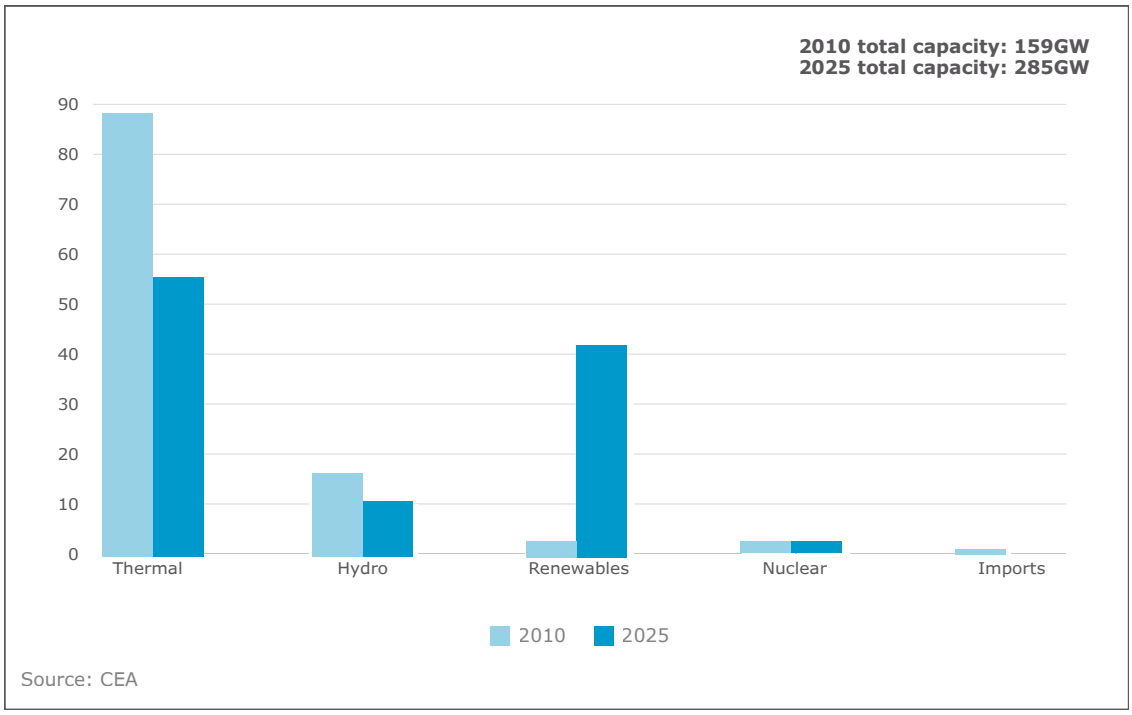
Figure 1: India's Power Generation Mix, by percentage.



Source: CEA

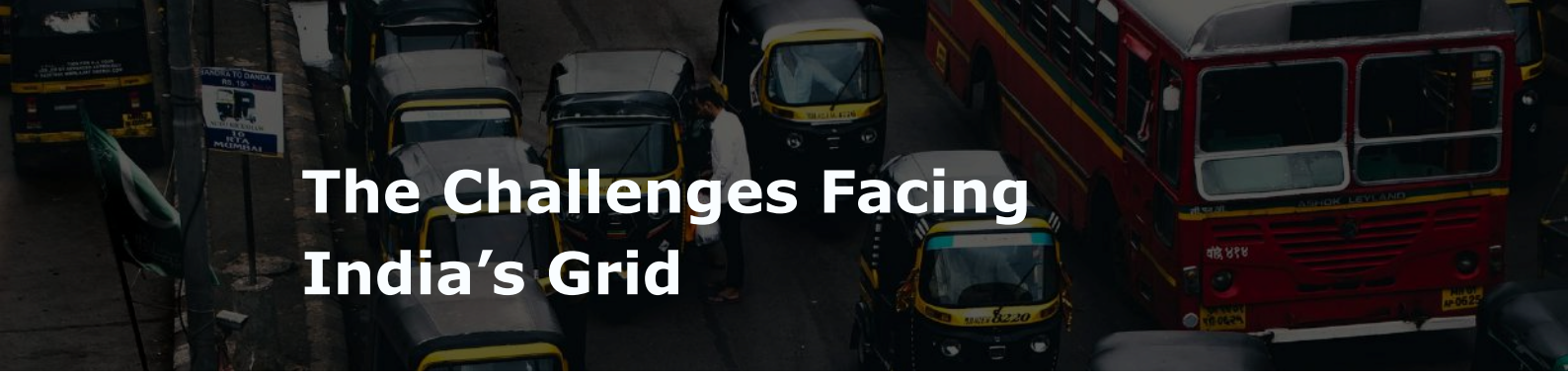
India has the world's biggest unified grid. With 485 gigawatts (GW) as of June 2025, it has the third-largest power generation capacity, after China and the United States.

Capacity has grown more than threefold since 2003, when the Electricity Act deregulated and restructured the power sector. Since then, India's grid has seen two distinct stages of growth. Between 2009-2015, large-capacity grid additions were dominated by coal-based power stations. Since 2015, growth in renewable sources has also surged, mostly driven by solar and wind, and the power mix has gradually diversified.

Thermal power, predominantly coal-based, remains the backbone of India's energy infrastructure, accounting for about 46% (219GW) of total capacity and 76% of actual generation.

Solar, virtually non-existent in 2010, grew to 110.8GW by 2024, supported by ambitious national targets, fiscal incentives, and falling technology costs. Wind power has also advanced steadily to 51GW, bolstered by strong resource availability and state-level procurement schemes. Hydropower has grown slowly to 48GW, while nuclear power is at 8.78GW, contributing to base-load stability.

India's renewables portfolio is also bolstered by contributions from biomass (10.9GW) and small hydro (5GW).



The Challenges Facing India's Grid

Under India's 2030 target, renewable capacity must reach 500GW and account for more than 50% of installed capacity. The country has achieved the latter target, thanks in part to the Central Electricity Authority (CEA) tweaking the definition of "renewable" to cover all non-fossil generation (except nuclear). With the inclusion of hydropower, renewable capacity reached 242.8GW in July 2025, reaching the 50% goal five years ahead of schedule.

However, reaching the 500GW target will be a more difficult challenge, for several reasons:

1. Bidding and Contracting

a. The Ministry of Power has issued standard bidding guidelines for the procurement of renewable power. This process is coordinated by four Renewable Energy Implementing Agencies (REIAs), which act as market makers and intermediaries. However, the current rate of bidding by the REIAs is well short of the 50GW+ per year required to reach the 500GW target.
b. Even after the auctions, REIAs need to get a state or other off-taker to sign a Power Purchase Agreement and arrange long-term contracts (also called Power Sale Agreements, or PSAs). The gap between bids and confirmed PSAs is widening as the number of auctioned projects increases.
c. Banks are unwilling to finance projects without long-term PPAs. While they accept private buyers' PPAs, they insist on a contract duration of at least 10 years at a firm price.

2. Construction Challenges

a. **Transmission** – This is the biggest challenge in many key renewable-generating states. With projects concentrated in a few states, sub-station capacity and connecting transmission lines are often delayed, creating a major bottleneck. A government initiative offering transmission cost-waiver incentives for projects commissioned early has triggered a rush that has left transmission line construction behind schedule.
b. **Land Acquisition** – While there are solar parks where land has been mostly acquired by either central or state governments, in some cases residual land possession is often a challenge. For projects on private land, cost escalation can be an issue.
c. **Equipment Supply Delays** – Many generators have reported delays in solar panel and wind turbine supplies.

3. Operational Challenges

a. **Short-term Market Sales –** Most renewable generators aim for 25-30% merchant capacity (the portion of capacity to be sold on the open market rather than through long-term contracts) in order to take advantage of better pricing. However, current short-term market prices during solar hours have been highly unfavourable, with zero prices seen in many blocks.
b. **Financing Gaps –** Financing for assets covered by long-term PPAs is relatively easy to secure, but significantly more difficult for innovative solutions like forecasting, digitisation and hybridisation of supply. Given the scale of new renewables coming onto the grid, high-efficiency digital real-time forecasting solutions are necessary for the commercial survival of these projects.
c. **Distributors' Financial Health –** Distribution companies (DISCOMs), especially those owned by state governments, face significant financial challenges. Most struggle with a fiscal mismatch due to a gap between their average cost of supply (ACS) and average revenue realised (ARR). One of the key factors is that many states still have high distribution losses (also known as Aggregate Transmission & Commercial losses). These are mainly a result of high power-line losses, as well as poor metering and collection. Losses at most state-owned DISCOMS exceed 15%, while those at private operators average in the lower teens

1 India's Power Grid: An Overview

Until the passing of the 2003 Electricity Act, power generation in India was a licenced business. Tariffs were determined through a cost-plus system, based on a 70:30 Debt:Equity model in which the generator is allowed a certain return on equity (currently 15%) by regulations issued in five-year cycles. Every five years, while the broad tariff parameters do not change, the regulator can modify the return on equity and normative debt cost to be recovered.

The Electricity Act defined two methods of tariff determination: Section 62 and Section 63. Section 62 is the existing cost-plus model, which remains in place. However, the majority of new projects since the Act use Section 63, under which tariffs are determined through competitive bidding. This is now the dominant method of finalising PPAs for new projects and has contributed to a massive capacity increase and continuously dropping PPA tariffs.

Figure 2: India's major public- and private-sector power generators.

Sr. No.	Category	Generators	Capacity (MW)	Generation (BU)	Renewable (MW)	Thermal (MW)	Hydro (MW)	Nuclear (MW)
1	Central Govt-Owned	NTPC	73,874	380.49	~3,300	~70,000	~574	—
2		NPCIL	8,180	~48	—	—	—	8,180
3		NHPC	~7,000	~29	—	—	~7,000	—
4		NEEPCO	~2,057	~8	~900	~1,100	~57	—
5		SJVN	~2,091	~7	—	—	~2,091	—
6		THDC India Ltd	~1,587	~5	—	—	~1,587	—
7	State Govt- Owned	MSPGCL	~13,500	~50	~500	~13,000	—	—
8		TANGEDCO	~10,200	~46	~1,000	~9,200	—	—
9		UPRVUNL	~6,600	~32	—	~6,600	—	—
10	Private Sector-Owned	Adani Power	~15,210	~57	~1,000	~14,200	~10	—
11		Tata Power	~13,600	~42	~3,000	~10,600	—	—
12		JSW Energy	~6,700	~22	~1,600	~5,100	—	—
13		Re-New Power	~13,000	~19	~13,000	—	—	—
14		Reliance Power Ltd	~5,945	~40	~185	~5,760	—	—
15		Greenko	~6,900	~5	~6,900	—	—	—
16		Suzlon Energy	~3,900	~4	~3,900	—	—	—
17		Azure Power	~2,900	~3	~2,900	—	—	—

Source: Collated from publicly available information on the official websites of the respective generators.

Generation

By FY2023–24, renewable generation had reached 225.83 Billion Units (BU), accelerated by falling technology costs and policy initiatives, for example:

- Streamlining of competitive bidding guidelines.
- Appointment of dedicated agencies to coordinate the bidding process (REIAs).
- Creation of a dedicated transmission network in the form of green energy corridors (see box).
- Promoting round-the-clock renewables.
- Incentivising renewable open access and market-based instruments for renewable power sales.

Thermal power continued its upward trajectory, while there were modest increases in hydro and nuclear capacity. India also imports small amounts of electricity (4-5 BU) from Bhutan and potentially from Nepal, mostly hydropower-generated.

Green Energy Corridors

India's Green Energy Corridors (GEC) are projects aimed at facilitating renewable integration into the grid by installing transmission lines, substations, and other necessary infrastructure between generation sites and load centres. The primary aims of the GEC are to:

- Facilitate renewable integration by creating dedicated high-capacity transmission networks to evacuate power from renewable-rich regions.
- Promote renewable development and reduce curtailment.
- Enhance grid capacity by upgrading and expand existing transmission infrastructure.
- Enable seamless inter-state and intra-state renewable power transfer by developing transmission corridors.

Transmission

In July 2012, India experienced the world's largest blackout, which left 620 million people without power for more than 13 hours. Since then, reliability and stability have improved significantly. The addition of generation capacity has been backed by a massive expansion of the transmission network linking generation sources to distribution companies across states and regions.

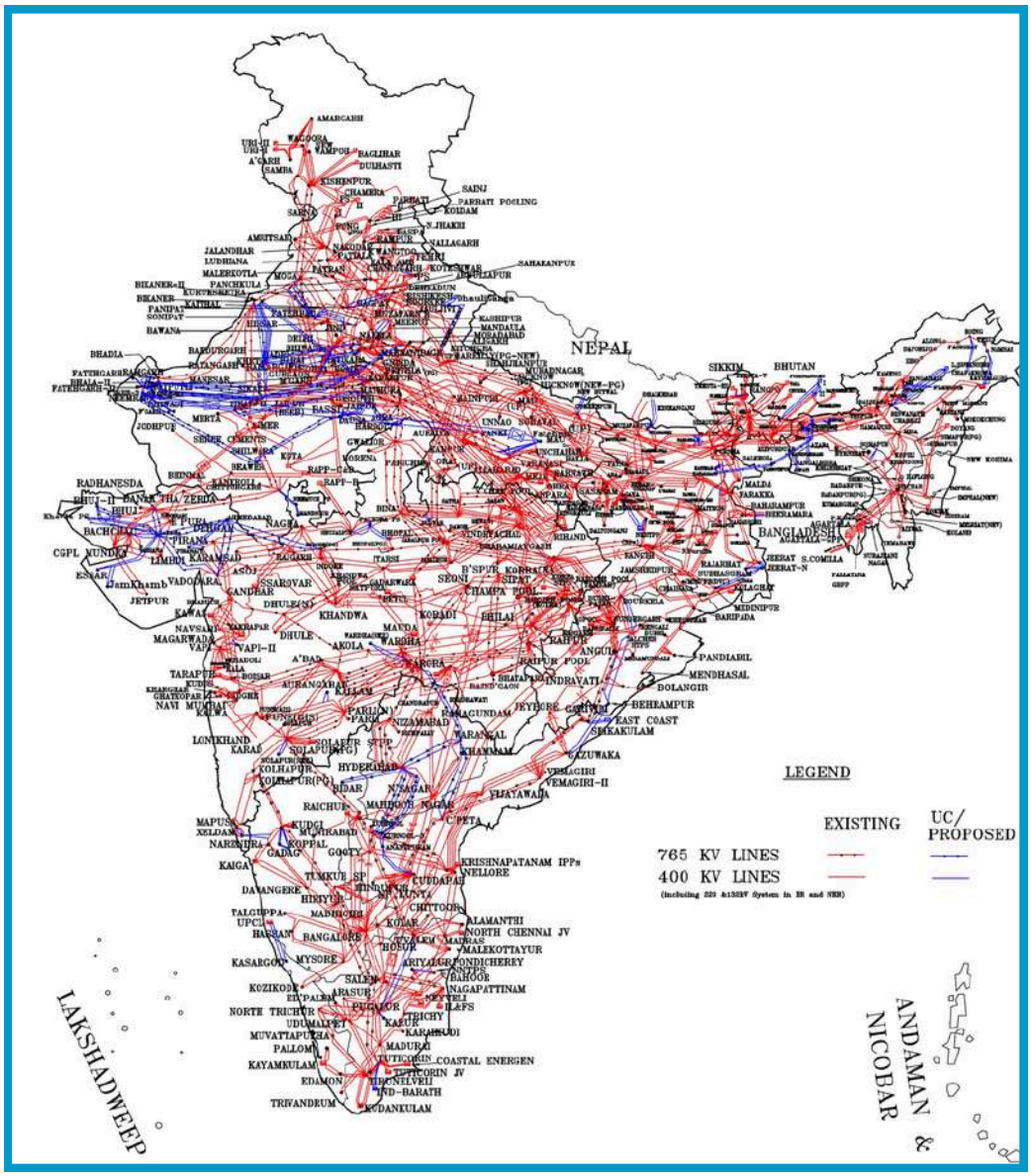
By March 2024, inter-regional transmission capacity reached 118,740MW, enabling seamless power flow and facilitating market integration.

The Power Grid Corporation of India (POWERGRID) dominates transmission, handling about 50% of the country's generated power through its network, while state utilities manage intra-state transfers. Private-sector participation through tariff-based competitive bidding has further contributed to infrastructure growth, especially for renewable energy evacuation via green corridors (see box, p5).

Power Grid Regions of India

Source: PIB, Ministry of Power

Power Map of India



Source: PIB, Ministry of Power

Distribution

Distribution companies (DISCOMs), the critical last mile of the power value chain, are primarily state-owned entities operated by state governments. Indian law does not allow the federal government to control distribution.

There are 58 separate state-owned DISCOMs. The industry has also seen growing private participation, with eight private utilities now operating in urban areas.

DISCOMs are responsible for purchasing power, managing distribution infrastructure, and ensuring efficient billing and metering. However, the sector is plagued by high Aggregate Technical & Commercial (AT&C) losses, financial inefficiencies, and inadequate infrastructure. To address these, the government has introduced various support programmes focusing on smart metering, loss reduction, and operational efficiency improvements.

'Firm and Dispatchable' Power in the Renewables Context

The concept of "firm and dispatchable" power is central to the successful integration of renewables into the grid.

Firm Power – Refers to a power source that can be counted on to deliver a specific amount of electricity at any given time, regardless of weather conditions or time of day. For renewables, this means making energy available when the sun isn't shining or the wind isn't blowing.

Dispatchable Power – Refers to power that the system operator can "dispatch" or control in real time, increasing or decreasing output to meet changes in demand or maintain grid stability. This is essential for balancing the supply and demand on the grid.

Generators need various tools to make renewable power firm and dispatchable:

Storage – Pairing renewable generation with storage solutions like batteries or pumped hydro enables energy to be captured when it's produced and released when it's needed.

Hybrid System – Combining multiple renewable energy sources (such as solar and wind) can help to smooth out variations in generation since different sources may complement each other.

Forecasting and Scheduling – Utilising advanced weather and demand forecasting to better predict when renewable energy will be available and needed, and scheduling accordingly.

Market Structure

India's power buyers are primarily state DISCOMs (purchasing under long-term PPAs) and open-access industrial consumers. Sellers are public or private generators, including Independent Power Producers (IPPs) and renewable energy firms.

The landscape of power trading is more complex. Companies such as **Power Trading Corporation (PTC) India, NTPC Vidyut Vitran Nigam Ltd (NVVN),** and **Tata Power Trading (TPT)** facilitate deals of various durations, which are transacted on transparent, real-time trading platforms. These include the federal government's DEEP (Discovery of Efficient Electricity Price) portal; the three power bourses (Indian Energy Exchange, Power Exchange India Ltd, and Hindustan Power Exchange); and Over-the-Counter platforms offering trade-related information.

The DEEP portal handles bilateral contracts for short-term (up to 12 months) and medium-term (12 months to seven years) DISCOM power purchases. The exchanges offer diverse products including Day-Ahead Market, Real-Time Market, and Green Day-Ahead Market (outlined in Section D) and Term-Ahead Market, through which power can be purchased for up to three months.

Key Players

Each segment of the industry has some dominant players:

- **Generation (see Figure 3):** NTPC (central govt-owned), MSPGCL (state-owned), Adani Power and Tata Power (private), Re-New Power (renewables).
- **Transmission:** POWERGRID dominates, with more than 85% of the inter-state network.
- **Distribution:** While some major cities including Delhi, Mumbai, Kolkata, and Ahmedabad are served by private distribution companies, most of the country is still serviced by state-owned DISCOMs. One exception is the state of Orissa, which has privatised distribution under Tata Power. The main private DISCOMs are Tata Power, Adani, Torrent, CESC, and Reliance Infra. Balance distribution is operated by companies owned by their respective state governments.

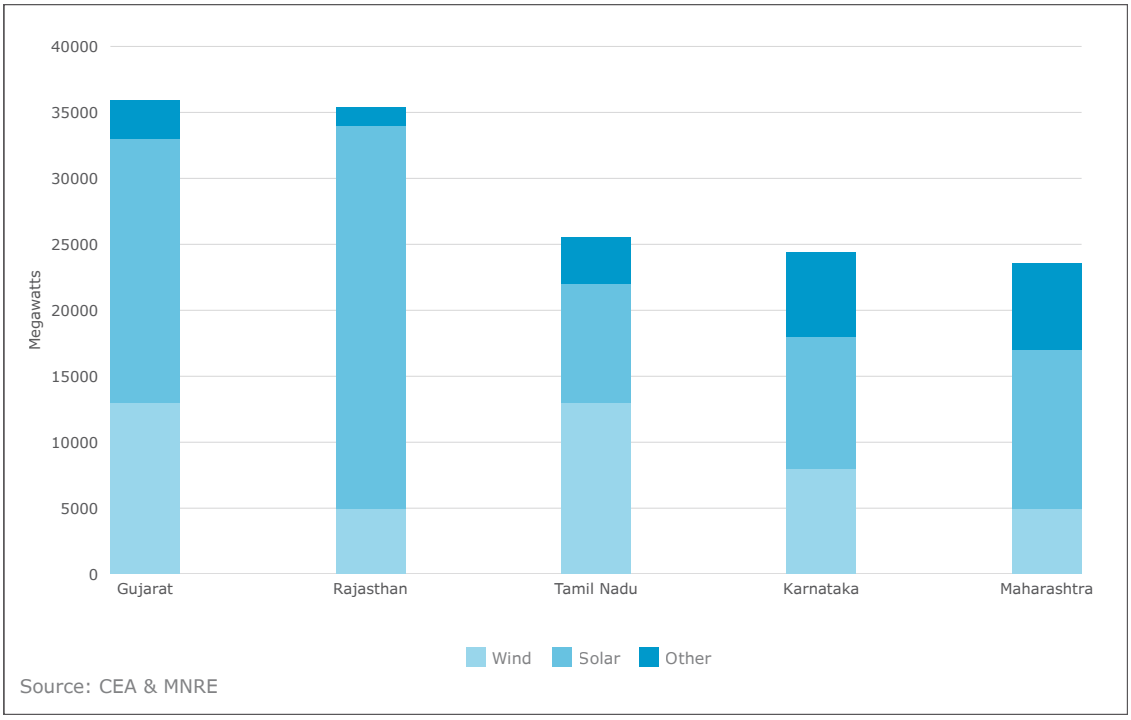
Figure 3: Main players in India's power market.

Source: ARE

Renewables by State

Gujarat is the leading renewables state with 35.95GW, representing a 16% share of national renewables, followed closely by Rajasthan. The top five states contribute about 63% (227GW) of India's renewable capacity.

Figure 4: Top renewable generators by state.



Source: CEA & MNRE

The top-five renewables generating states are:

- **Gujarat:** 35,945MW of renewable capacity (17% of the national total). Gujarat mandates high Renewable Purchase Obligation (RPO) targets, integrated with solar parks and hybrid tenders. Distribution companies achieved more than 95% RPO compliance in FY2023–24.
- **Rajasthan:** 35,397MW, including the country's largest solar park in Bhadla. Solar accounts for more than 80% Rajasthan's renewables portfolio. RPO fulfilment was 98% in FY2023–24.
- **Tamil Nadu:** 25,546MW. Tamil Nadu leads in wind energy. Thanks to institutionalised long-term PPAs and banking mechanisms, the state achieved 94% RPO fulfilment in FY2023–24.
- **Karnataka:** 24,372MW of capacity, with a high share of wind and hydro. The state achieved 97% RPO compliance, aided by policy support for rooftop and floating solar.
- **Maharashtra:** 23,548MW installed. The state has a diversified renewables mix (wind + bagasse + bioenergy). RPO compliance stood at 92% in 2023–24, supported by REC trading.

India's Renewables Policy Landscape

In September 2023, the Ministry of Power issued guidelines for renewable power projects, titled "Tariff-Based Competitive Bidding Process for Procurement of Firm and Dispatchable Power from Grid-Connected Renewable Energy Power Projects with Energy Storage Systems".
The stated aim of the policy is to:

- To provide firm and dispatchable renewable power to distribution companies.
- To boost renewable capacity additions and meet Renewable Purchase Obligation requirements.
- Outline a transparent procurement framework that shares risk appropriately and is fair for all stakeholders.
- To promote inter-state/intra-state, long-term power purchases.

Bidding Process

- Electronic bidding is a single-stage, two-part process (technical and financial bids).
- Technical bids are evaluated first, followed by financial bids of qualified participants.

Financial Criteria

- Applicants must meet financial criteria, such as net worth and liquidity parameters.
- Earnest Money Deposit to be submitted.

Project Timeline

- Sets an indicative timetable for the bid process, generally expected to be completed within 110 days.

Power Purchase Agreements and Regulatory Considerations

- The document requires adherence to the 2003 Electricity Act and follows related regulatory and market principles.

Power Curtailment

- Provision for generation compensation if curtailment (controlled shutdown/limitation of generation to maintain grid stability) is a result of grid unavailability or must-run status; the producer will sell their energy on an exchange.

Defaults

- In case of DISCOM defaults, the generator can terminate the PPA.

Renewable Energy Integrating Agencies

- The Ministry of Power has appointed four agencies to run the mandatory competitive bidding process for all PPAs between regulated entities and renewable energy generators.

The Market

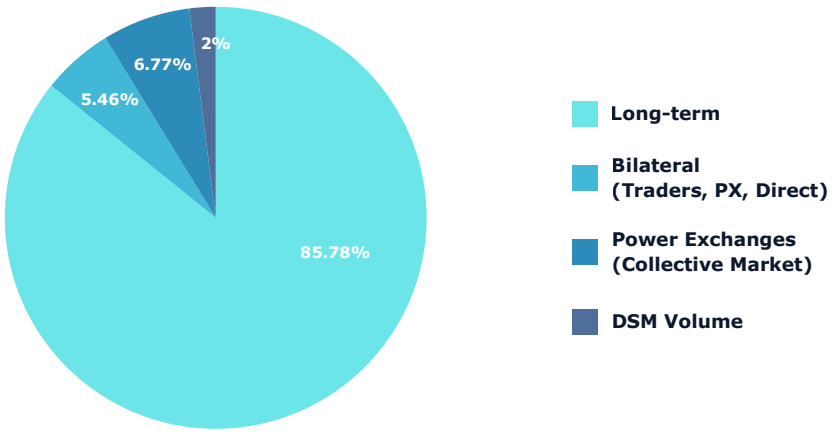
The 2003 Electricity Act established a structured framework for transparent, competitive, and diverse forms of electricity trading. It encompasses both the long-term market and the evolving short-term market, which now represents about 15% of the total power trade.

Figure 5: Power trading volume in India's short-term market.

Table-1: VOLUME OF SHORT-TERM TRANSACTIONS OF ELECTRICITY AND DSM (ALL INDIA), APRIL, 2025				
Sr. No.	**Transaction**	**Volume (MU)**	**% to short-term transactions and DSM Volume**	**% to Total Generation**
A	**Short-term transactions**			
1	Bilateral[5] (Traders, PX, Direct)	**7298.47**	**38.40**	**5.46**
2	Power Exchanges (Collective Market)	**9040.84**	**47.57**	**6.77**
	(i) IEX			
	(a) DAM	4351.71	22.90	3.26
	(b) RTM	3892.89	20.48	2.91
	(c) GDAM	683.73	3.60	0.51
	(d) HP-DAM	23.09	0.12	0.02
	(ii) PXIL			
	(a) DAM	32.78	0.17	0.02
	(b) RTM	31.89	0.17	0.024
	(c) GDAM	0.00	0.00	0.00
	(d) HP-DAM	17.34	0.09	0.01
	(ii) HPX			
	(a) DAM	3.90	0.021	0.0029
	(b) RTM	3.51	0.02	0.003
	(c) GDAM	0.00	0.00	0.00
	(d) HP-DAM	0.00	0.00	0.00
B	**Through DSM**	**2666.51**	**14.03**	**2.00**
Total Short-term transactions and DSM[6]		**19005.83**	**-**	**14.22**
Total Generation		**133623.18**	**-**	**-**

Source: NDLC

Figure 6: Share of various kinds of Electricity Transactions in Total Electricity Generation, April 2025



Source: CERC

There are multiple contract types in the market:

- **Power Purchase Agreements (PPAs):** Long-term bilateral contracts between electricity generators and buyers (typically DISCOMs or large industrial consumers). PPAs, ranging from 10 to 25 years, are vital for project bankability. Types include:
  - Regulated PPAs (through bidding or government allocations)
  - Open Access PPAs (for captive or third-party use)
  - Merchant PPAs (shorter duration, market-based pricing)
- **Day-Ahead Market (DAM):** Facilitates power procurement one day in advance through market bidding on exchanges. The DAM will be coupled by January 2026 to create a unified price across the three power exchanges.
- **Real-Time Market (RTM):** Allows for intra-hour procurement and balancing of supply-demand gaps.
- **Term-Ahead Market (TAM):** Includes intra-day, day-ahead contingency, daily, weekly, and monthly contracts. Offers mid-term flexibility.
- **Green Markets (G-DAM & GTAM):** Enable trading of renewable energy for Renewable Purchase Obligation compliance and facilitate integration of green power into the grid.
- **High-Price DAM/TAM (HP-DAM & HP-TAM):** These contracts allow high-cost imported fuel-based generators to bid at price caps up to INR20/kWh (USD0.23). They were introduced after the government imposed a price cap (INR10/kWh) on the main market but realised that more expensive power sources such as imported LNG or gas or Battery Storage power may be needed for grid-balancing purposes. Only these sources are allowed to bid on this market.

Contract Durations

- **Short-term:** Defined as any contract not exceeding one year; mostly facilitated by either exchanges or licenced traders.
  - DEEP portal: bilateral contracts range from a few weeks to 12 months
  - Single block contracts: 15 minutes to 12 months.
  - RTM: 15-minute blocks.
  - DAM, Intra-day TAM, GTAM: weekly to three-month contracts.
- **Medium-term:** 12-month to seven-year contracts, can also be facilitated by traders.
- **Long-term:** PPAs ranging from seven to 25 years, typically involving regulatory approvals for tariff discovery.
- **Energy Derivatives:** launched in July 2025 on the Multi-Commodity Exchange of India (the commodity bourse run by the National Stock Exchange), to be overseen by the Securities and Exchange Board of India.

Many short-term physical delivery contracts are now classified as Non-Transferable Specific Delivery forward contracts, allowing forward hedging while ensuring delivery integrity.

New Market Mechanisms

India’s power industry is in a transformative phase. Several new frameworks and financial mechanisms are being developed or piloted to support the clean-energy transition, deepen market integration, and enhance operational and pricing efficiency. These initiatives reflect India's efforts to align with global best practices and its commitment to a net-zero future.

Virtual Power Purchase Agreement (VPPA)

A VPPA is a financial contract that allows commercial and industrial consumers to virtually procure renewable energy without taking physical delivery. Using VPPAs, corporate buyers can sign long-term agreements with renewable developers and settle the difference between the market price and the strike price through a Contract for Difference (CfD) mechanism.

This model is gaining traction with multinational corporations operating in India and seeking carbon neutrality. Discussions are underway to enable policy clarity and define financial settlement mechanisms with the support of CERC and MoP.

Contracts for Difference (CfD)

The CfD mechanism is being evaluated as a future procurement model to stabilise revenue for renewable energy generators and reduce cost volatility for distribution companies or bulk procurers. CfDs are globally recognised as an effective tool for market-based renewables deployment, especially in the UK and EU.

Under the CfD system, a strike price is agreed upon. If the market price falls below this, the offtaker pays the difference; if it rises above, the generator pays back the surplus.

India is considering CfD pilots to hedge price risks in Green Day-Ahead and future Green Market expansions.

Green Day Ahead Market (G-DAM) Expansion

India launched G-DAM in 2021, enabling trade of renewable energy on a day-ahead basis through exchanges. Expansion plans include:

- Introduction of Green Term-Ahead Market contracts with longer durations (weekly/monthly).
- Coupling Renewables Banking and Green Open Access Rules to ease procurement.
- Enabling HYRE (Hybrid Renewables + Storage) products to ensure round-the-clock clean energy.

Green Energy Open Access

India introduced Green Energy Open Access rules in 2022, allowing consumers to purchase electricity directly from renewable energy sources using existing transmission and distribution infrastructure.

As well as enabling consumers to source green energy, even if it's generated in a different location, the mechanism helps distribution companies meet their Renewable Purchase Obligations. The rules involve a suite of charges.

- **Transmission Charges –** Costs associated with transmitting electricity over long distances. Methodologies vary across states (INR/MW/month or INR/kWh), often linked to peak demand.

- **Wheeling Charges –** Fees for using the distribution network. States determine these charges, sometimes considering voltage levels. Key issues include cost allocation between wire and supply businesses.

- **Cross Subsidy Surcharge –** This is to address the impact on existing customers who subsidise certain consumer categories. The formula is often linked to tariff policy, though some waivers exist for renewables.

- **Additional Surcharge –** May apply if the utility has stranded costs due to customers opting for open access. Application can vary by state.

- **Standby Charges –** Applies when open access consumers need backup power from the distribution utility. It's often calculated as a percentage of the normal tariff.

- **Banking Charges –** Relates to “banking” excess renewable energy for later use. Can be "in-kind" (a percentage of energy banked) or in INR/kWh.

Ancillary Services Market Reforms

Following the introduction of CERC Ancillary Services Regulations in 2022, India is building a structured ancillary market.

- Includes Fast Frequency Response, ramping services, and reserve capacity.
- Battery Energy Storage Systems are expected to become eligible as grid participants.
- Supports Renewables variability management and frequency control in a high-VRE grid scenario.

Electricity Derivatives Market

In June 2025, the Securities & Exchange Board of India (SEBI) approved the launch of electricity derivatives trading on the National Stock Exchange (NSE) and Multi Commodity Exchange of India. These products aim to provide market participants with effective hedging tools against price volatility, enable more accurate price signals, and encourage capital investment across the electricity value chain.

The contracts are based on the volume-weighted average price (VWAP) of the Day-Ahead Price across all power exchanges and cash settled. Trading units are set at 50 MWh with a tick size of INR1/MWh. A total of 12 monthly contracts will be available, in cycle.

Open interest is capped at 3 lakh (300,000) MWh, or 5% of market-wide open interest, whichever is higher. Members can hold up to 30 lakh (3 million) MWh or 20% of market-wide open interest.

Through long-term price visibility, this will provide support to both generators and buyers who might want to hedge their positions.

Market Coupling

In July 2025, the CERC announced that India's Day-Ahead Markets would be coupled by January 2026. This will create a centralised and unified price mechanism across the country's three exchanges, which have been running their own independent auctions. Similar to the market coupling structure rolled out in the European Union in recent years, the move is designed to produce more uniform electricity prices (including a single reference price for the emerging derivatives market), improve resource efficiency, boost renewables integration, and enhance security of supply.

2 India's Power Policy and Regulatory Landscape

Overview

India has two primary legal instruments for managing its power sector: one to regulate electricity demand and supply, and the other to improve efficiency.

1. The 2003 Electricity Act

This was a comprehensive piece of legislation that amalgamated, repealed, and replaced many previous archaic laws. The Act:

- Aimed to create a unified legal framework to foster competition, regulate tariffs, and promote renewable energy.
- Delicensed generation, including captive generation (on-site power production by consumers), thereby encouraging private sector entry and investment in energy technologies.
- Separated generation, transmission, and distribution into separate business activities as body corporates, compared with the previous integrated Electricity Board model, under which single entities controlled all functions.
- Mandated the promotion of competition, particularly through open access in transmission and distribution, enabling consumers with a load of 1 MW or more – industry, commercial, domestic or any other- to procure power directly from generators. It is further reduced to 100KW for renewable supply.
- Demarcated roles and responsibilities of institutions, and between federal and state governments.

The Act catalysed sectoral liberalisation by delicencing generation, creating and empowering regulatory commissions at state and national levels, and introducing Open Access (allowing multiple suppliers and consumers to use the same transmission and distribution infrastructure, including allowing corporates to buy directly from generators).

Open access rules allow consumers with a load of 1MW or more to procure power directly from generators. That figure drops to 100kW for renewable power.

The Act also created the Central Electricity Regulatory Commission (CERC), which has taken a proactive stance in reforming market design through instruments like the 2021 Power Market Regulations, General Network Access Regulations, and Ancillary Services Framework, laying the foundation for greater grid reliability and real-time balancing.

These regulations have enabled the growth of renewable energy and created a robust short-term market that is critical to balancing the system. As of 2025, India's short-term power market accounted for about 15% of total traded electricity generation, reflecting increasing reliance on market-based procurement.

In July 2025, the CERC announced that India's Day-Ahead power markets (DAM) would be coupled, creating a centralised pricing mechanism for DAM electricity contracts, and potentially other contracts in future. It laid the groundwork for a European Union-style system that promotes price convergence, renewables integration, resource efficiency, and security of supply.

2. The 2022 Energy Conservation (Amendment) Act

This legislation is a cornerstone of India's energy transition strategy. It was enacted to align India's energy sector with global sustainability goals and decarbonisation mandates.

The Act significantly strengthens the legal and institutional framework for energy efficiency, carbon market development, and the enforcement of non-fossil energy use with mandatory minimums for designated consumers and financial penalties for non-compliance.

By expanding the scope of non-fossil obligations, enabling carbon credit trading, and bringing new sectors such as buildings, transport, and heavy industry under compliance norms, the legislation promotes a holistic shift toward low-carbon development. It also empowers the Bureau of Energy Efficiency (BEE) with broader functions, including regulation of carbon markets, sustainable building codes, and sectoral energy benchmarks.

Energy efficiency measures have delivered significant results. The Perform, Achieve and Trade scheme, launched in 2012, has set energy conservation targets for 1,333 industrial consumers across 13 sectors. According to the Indian government, the scheme had saved 25.8 million tonnes of oil equivalent as of 2024.

Key Regulations and Directives

India's regulatory environment continues to evolve. Reforms on general network access, ancillary services, green energy access, and efficient grid dispatch have been designed to improve grid stability and efficiency, and support the country's clean-energy and emissions targets. Recent policy moves have further enhanced regulatory clarity and operational efficiency, prompting a significant increase in short-term market transactions and boosting renewables installed capacity.

- **IGEC Regulations 2023:** Introduced critical features like resource adequacy planning, economic dispatch, and real-time unit commitment, facilitating better grid integration of variable renewable energy.
- **GNA Regulations:** Enabled non-discriminatory access to the transmission system by replacing long/medium-term open access with a unified General Network Access mechanism.
- **HP-DAM Introduction:** Allowed platform access to costlier peaking resources like gas-based and battery storage plants to sell at a market-derived price, with a ceiling of INR20/kWh, supporting peak demand of more than 243GW in 2024.
- **Uniform Renewable Tariff Framework:** Brought consistency in tariffs, which is helpful in competitive procurement through Renewable Energy Integrating Agencies (REIA). Different discovered prices are pooled and a singular price established for sale to different distribution companies, with the REIA acting as moderator.
- **Carbon Credit Trading (under EC Amendment Act 2022):** Introduced trading with both compliance and offset mechanisms, allowing obligated entities to claim emission reduction credits.

India's Carbon Credit Trading Scheme

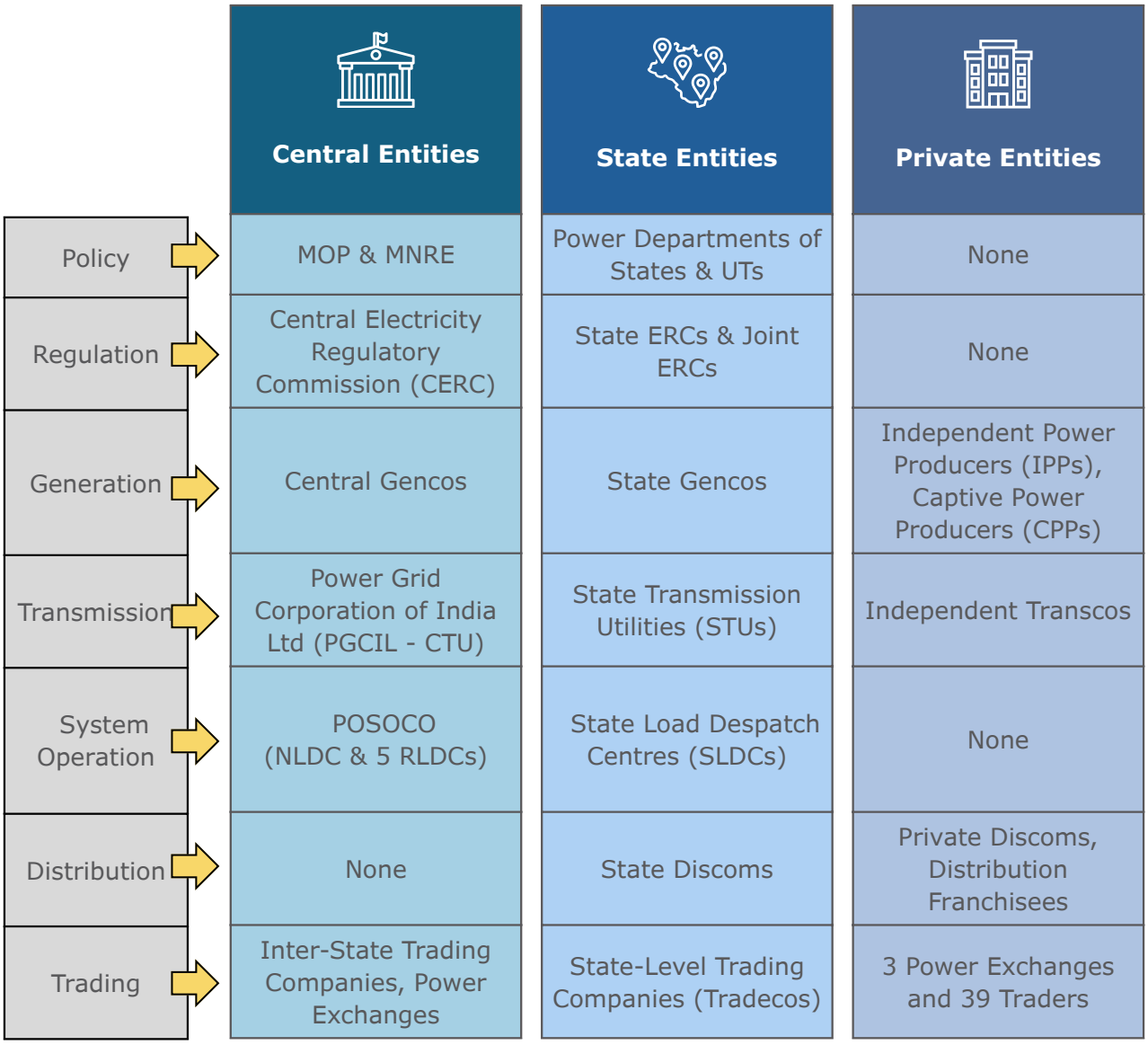
In September 2024, the Ministry of Power and Bureau of Energy Efficiency (BEE) jointly released the operational framework for the Carbon Credit Trading Scheme (CCTS) under Section 14AA of the 2022 Energy Conservation (Amendment) Act. This marked a significant milestone in India's climate policy evolution, transitioning from voluntary carbon markets to a compliance-driven, domestically regulated credit system.

The CCTS provides the mechanism for issuance, trading, and compliance of Carbon Credit Certificates (CCCs) by designated consumers and registered entities. The aim is to create a fungible, tradable asset representing certified emission reductions, thereby providing an economic incentive for decarbonisation across industrial, transport, and energy sectors.

Key Elements of CCTS Notification

- **Nodal Authority:** BEE is the designated central CCTS administrator.
- **Coverage:** Applies to power generators, industrial units, distribution companies, oil & gas, transport, and large commercial establishments.
- **Certificate Validity:** Each CCC remains valid for three years from issuance.
- **Trading Platform:** Trading of CCCs to occur via approved energy exchanges, overseen by the CERC.
- **Compliance & Offsetting:** Obligated entities failing to meet decarbonisation standards can buy CCCs to offset their emissions.
- **Voluntary Participation:** Non-obligated entities can monetise verified emission reductions.
- **Audit & MRV Protocols:** Third-party Measurement, Reporting, and Verification (MRV) guidelines mandatory for certificate issuance.

Figure 7: Power Industry Entities and Functions.



Source: ARE

Grid Controller of India Ltd (Grid-India)

Grid-India is the country's central grid operations agency responsible for real-time balancing, scheduling, as well as national and regional-level market integration. It oversees National, Regional, and State Load Despatch Centres, ensuring secure grid operation and facilitating electricity markets.

Grid-India handles daily transactions of 3,500–5,000 GWh, including real-time adjustments, RE forecasting, and DSM penalties. It ensures integration of more than 125 GW of RE capacity and operationalizes services like Ancillary Markets, SCED, and Automatic Generation Control (AGC).

Grid-India Structure

NLDC (National Load Despatch Centre): National coordination, market integration, scheduling power based on merit order (lowest cost first) and as per the requisition of buyers.

Location: New Delhi
Operator: Grid-India, under the Ministry of Power (MoP)
Mandate: National-level grid coordination and real-time electricity market facilitation

Key Responsibilities:

- Implements daily schedules and optimises cost-effective generation.
- Oversees market integration across the Day-Ahead, Real-Time, Green Day-Ahead, and High Price Day-Ahead markets.
- Coordinates with power exchanges, the Central Transmission Utility, and inter-state generating stations.
- Supervises real-time balancing across all five Regional Load Despatch Centres (RLDCs).
- Manages the National Renewable Energy Forecasting Portal to support renewable integration.

Reporting Mechanism:

- Receives continuous telemetry and data from RLDCs.
- Reports to the CERC and MoP through regular dashboards and operational reports.
- Issues national-level operational directives and alerts in the event of grid stress or code violations.

RLDCs: Regional balancing, congestion management, RE forecasting.
Total Number: 5 (Northern, Western, Eastern, Southern, North-Eastern)
Headquarters: Delhi (NRLDC), Mumbai (WRLDC), Kolkata (ERLDC), Bengaluru (SRLDC), Shillong (NERLDC)
Mandate: Ensure regional grid balance and congestion-free operation

Key Responsibilities:

- Schedule and monitor inter-state power flows and curtail schedules during transmission congestion.
- Perform regional forecasting for renewables and plan balancing reserves.
- Apply mechanisms like Deviation Settlement Mechanism and transmission congestion charges.
- Coordinate with State Load Despatch Centres (SLDCs) for system stability, outages, and reserve margins.

Reporting Mechanism:

- Report upward to NLDC with detailed operational, event, and compliance reports.
- Issue real-time instructions to SLDCs and generators for load ramping, frequency regulation, and emergency response.
- Submit periodic reports to CERC and MoP on regional performance and deviations.

SLDCs: State-level grid management; scheduling, dispatch, and real-time load control.
Total Number: 33 (covering all states and Union Territories).
Mandate: Real-time load management, intra-state scheduling, and operational control.

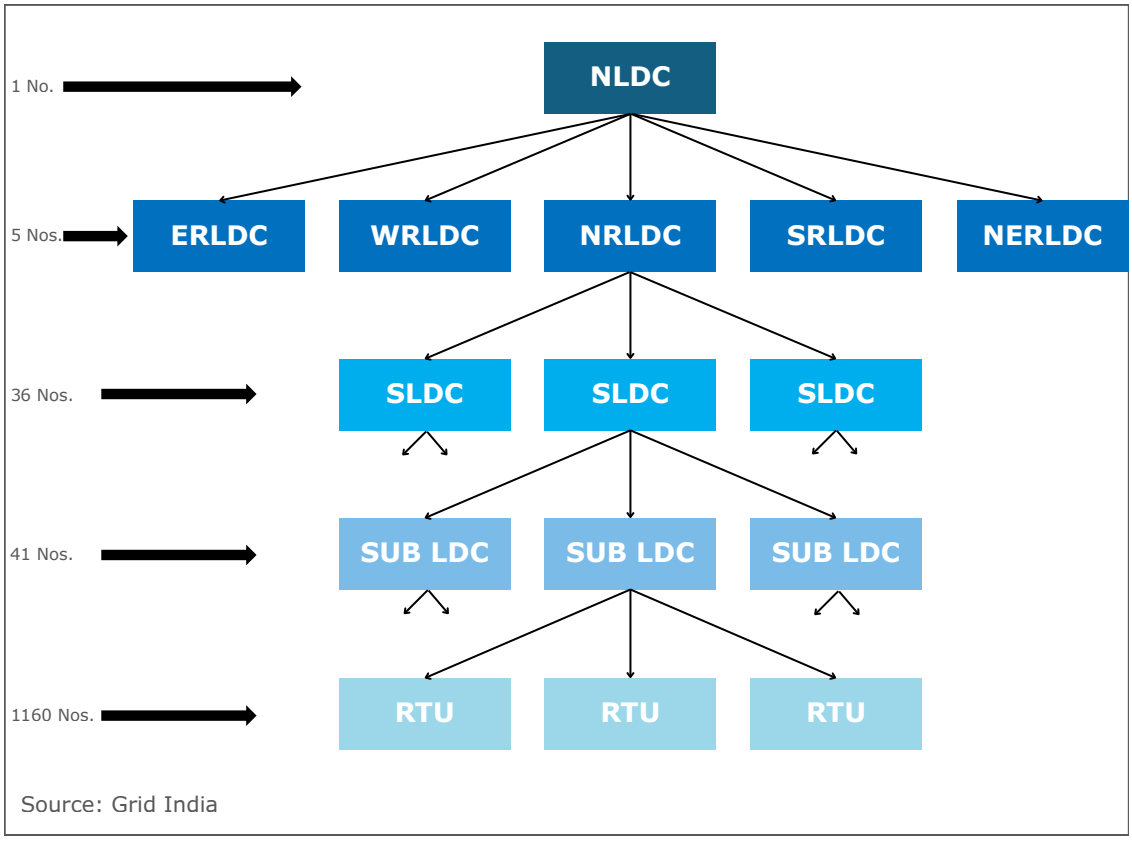
Key Responsibilities:

- Forecast intra-state electricity demand and schedule power procurement from generators and open access sources.
- Coordinate with state DISCOMs, generators, and State Transmission Utilities for outage planning, load shedding, and contingency operations.
- Operate real-time control rooms for frequency and voltage control and execute emergency grid-recovery measures.
- Monitor renewable energy injection and implement state-level compliance with Renewable Purchase Obligations (RPOs).

Reporting Mechanism:

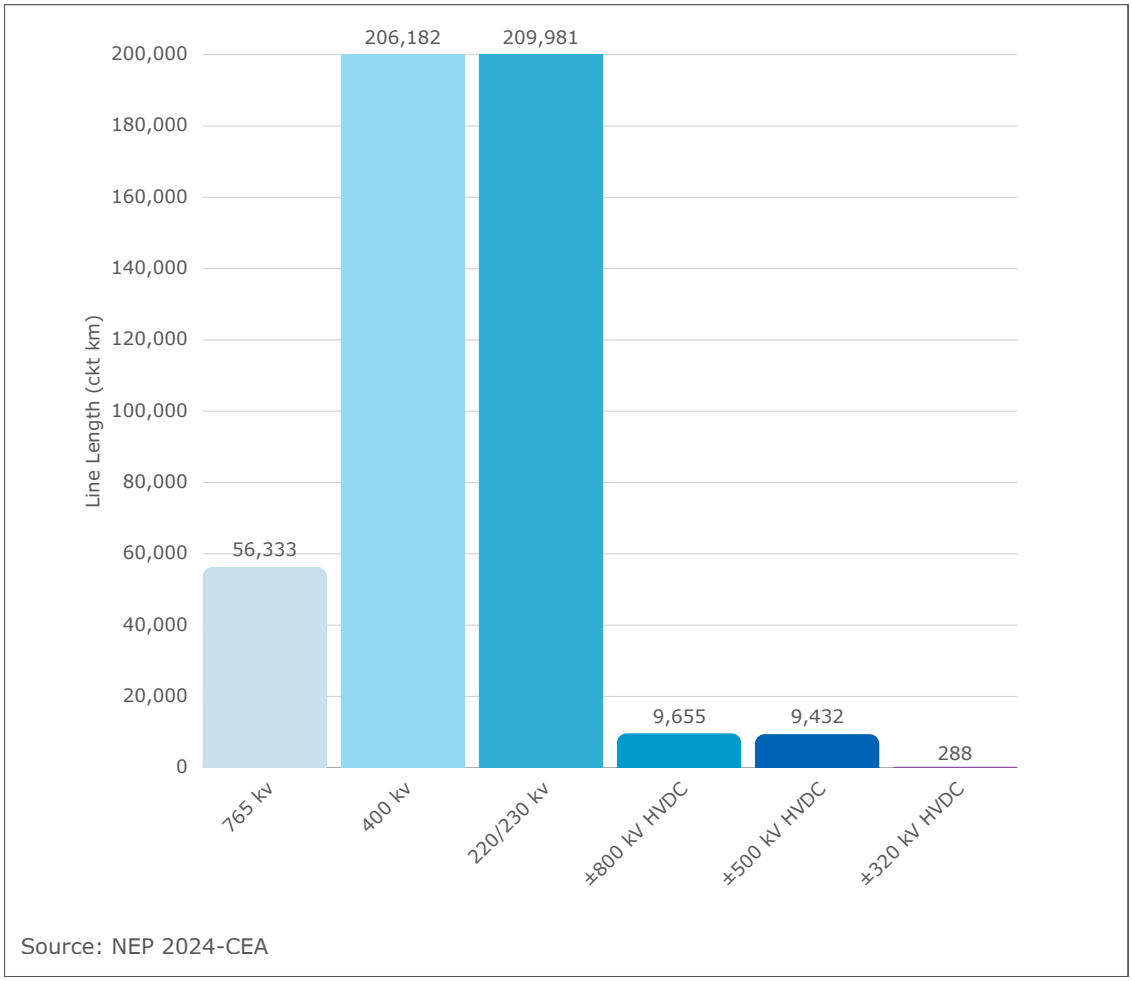
- Report to the relevant RLDC with real-time Supervisory Control and Data Acquisition, scheduling reports, and incident logs.
- Maintain telemetry and control linkages with field substations and generating units.
- Escalate disturbances such as blackouts, transformer failures, or overloads to RLDC for coordinated action.

Figure 8: Hierarchy of Grid-India.



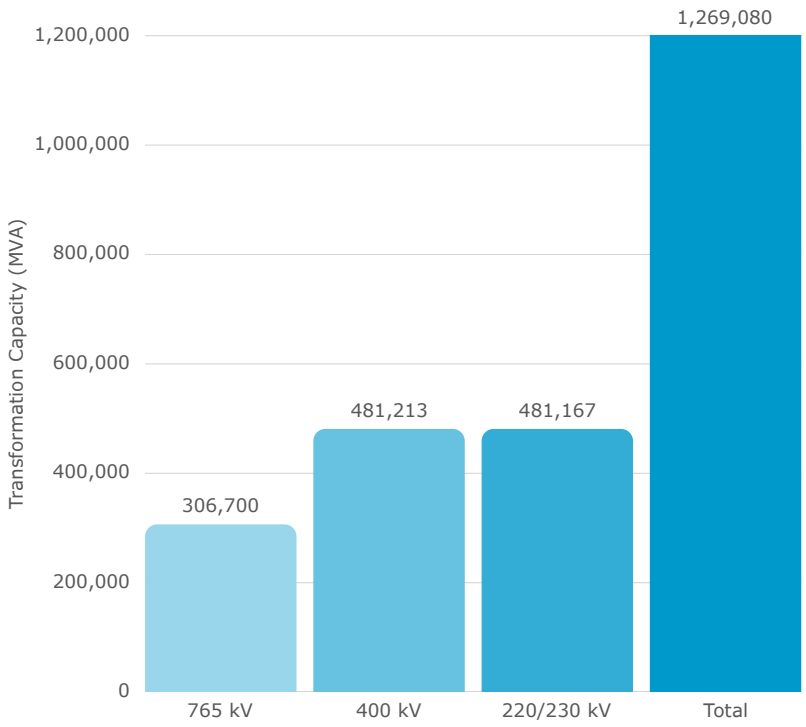
Source: Grid India

Figure 9: Transmission Line Length by Voltage Level (as of January 2025).



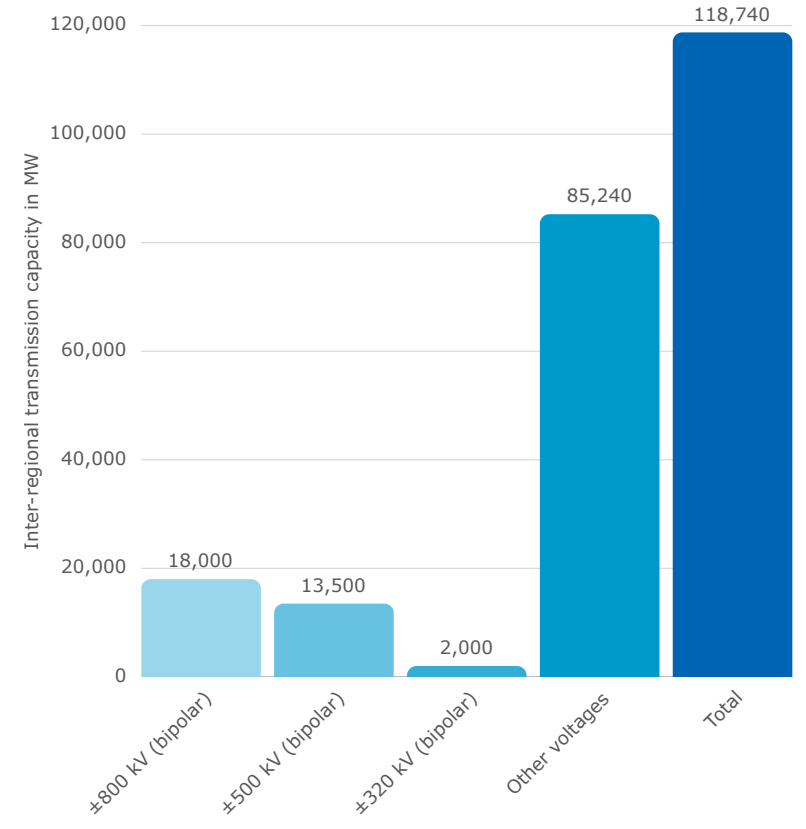
Source: NEP 2024-CEA

Figure 10: Inter-regional Transmission Capacity by Voltage Level.



Source: NEP 2024-CEA

Figure 11: Inter-regional Transmission Capacity by Voltage Level.



Source: NEP 2024-CEA

Role of Government Bodies

Ministry of Power (MoP)

The apex policymaking body overseeing India's electricity sector. The MoP formulates key schemes, implements national-level missions, and supervises key institutions. The ministry plays a pivotal role in driving the energy transition.

Key Functions:

- Policy formation, legislative amendments (e.g., Electricity Act 2003, Energy Conservation Act 2022).
- Notification of schemes for improving sector performance.
- Overseeing other industry institutions.
- Issuing renewable and non-fossil obligations, such as minimum share mandates.
- Supervising implementation of Carbon Credit Trading Scheme (CCTS) and market instruments.

Ministry of New and Renewable Energy (MNRE)

MNRE is the federal government's nodal ministry for all matters relating to new and renewable energy. Its broad aim is to develop and deploy new and renewable energy to supplement the energy requirements of the country.

The MNRE's vision is to develop new and renewable energy technologies, processes, materials, components, sub-systems, products & services at par with international specifications.

MNRE supports MoP on all matters related to renewable energy including policy formulation, increasing renewable energy share, and related research such as:

- Technology mapping.
- Identify areas for research, design and manufacturing.
- Resource surveys.
- Strategy development for promoting cost-effective & affordable RE projects.

Bureau of Energy Efficiency (BEE)

The nodal agency under the Ministry of Power for promoting energy efficiency and implementing the Energy Conservation Act. BEE has introduced sectoral benchmarks, energy-saving targets, and mandatory labelling for appliances under the Standards & Labelling Programme.

Key Functions:

- Implements various schemes and market-based efficiency programmes.
- Issues Energy Saving Certificates and Carbon Credit Certificates.
- Regulates measurement, reporting, and verification protocols and develops sector-specific benchmarks.
- Administers State Energy Conservation Funds.
- Capacity building, research and development.
- Coordinates with international agencies (UNIDO, IEA, GEF).

Central Electricity Authority (CEA)

The technical advisory and planning body under the Ministry of Power. It prepares the National Electricity Plan (NEP), Grid Standards, and conducts demand-supply forecasting, resource adequacy assessments, and performance benchmarking.

CEA has released resource adequacy guidelines, techno-economic viability reports, and grid expansion blueprints aligned with India's target of 500GW in non-fossil generation by 2030.

Key Functions:

- Formulates NEP every five years and long-term planning studies.
- Defines technical standards for generation, transmission, and distribution.
- Approves hydro and transmission projects above threshold.
- Coordinates planning with Central and State Transmission Utilities.
- Monitors power plant performance and system availability.

Renewable Energy Integration Agencies (REIA)

There are four specialised Central Public Sector Enterprises and nodal agencies serving as primary facilitators for developing, procuring, and integrating large-scale renewable energy projects across the country. These agencies also run the mandatory competitive bidding processes for all Power Purchase Agreements (PPAs) between regulated entities.

They also play a pivotal role in meeting India's nationally determined contributions, in particular the target of reaching 500GW of non-fossil fuel capacity by 2030 and attaining net-zero emissions by 2070. The agencies act as intermediaries between power producers and DISCOMs, streamline risk-sharing in long-term PPAs, and facilitate efficient grid-level renewable energy integration.

Role of Regulatory Bodies

Central and State Electricity Regulatory Commissions (CERC/SERCs)

The CERC is the apex regulator of the interstate electricity market in India. It was constituted under the 2003 Electricity Act to ensure transparency, competition, and fair pricing. CERC governs key market trading mechanisms like bilateral agreements or multilateral platforms like the Real-Time Market, Green Day-Ahead Market, Renewable Energy Certificates, and the Power Exchange framework.

CERC regulates interstate supply for both long-term and short-term markets. Short-term transactions now account for about 15% of total electricity consumption. It ensures fair access through regulatory mechanisms such as General Network Access and can also mandate price caps.

Key Functions:

- Tariff setting for inter-state generation and transmission for long-term contracts under Section 62.
- Framing Indian Electricity Grid Code, Deviation Settlement Mechanism, Ancillary Services & General Network Access Regulations.
- Licensing of inter-state traders and exchanges.
- Promoting competition and market development.
- Supervising compliance of market rules and grid codes.

At the state level, **SERCs** regulate tariffs, licenses, and the market structure within their jurisdictions. They play a vital role in shaping open access, Renewable Purchase Obligations, and enabling recovery of cost for distribution companies (DISCOMs) through retail tariff determination. Leading SERCs in Maharashtra, Gujarat, Karnataka, Rajasthan, and Tamil Nadu have enforced progressive RPO targets. They also review net metering, power procurement contracts, and intrastate wheeling charges (the fees that third parties pay to use grid transmission and distribution infrastructure).

Key Functions:

- Determining retail tariffs and wheeling charges.
- Enforcing RPOs and monitor RE procurement.
- Regulating DISCOM performance and loss trajectories.
- Approve open access and intrastate trading
- Align state rules with CERC policies.

The Forum of Regulators (FOR)

FOR was constituted in 2005 under provision under section 166(2) of the Electricity Act, 2003. The Forum consists of Chairperson of Central Electricity Regulatory Commission (CERC) and Chairpersons of State Electricity Regulatory Commissions (SERCs). The Chairperson of CERC is the Chairperson of the Forum.

FOR also runs data collection and analysis for all states, monitoring of the renewable purchase compliance by various states, harmonises regulations across states, undertakes in-house research on various regulations, and develops model regulations wherever necessary. It meets at least twice a year to discuss common regulatory issues.

Appellate Tribunal for Electricity (APTEL)

APTEL was Established under Section 110 of the 2003 Electricity Act to serve as a quasi-judicial authority for adjudicating appeals against orders of the **CERC, SERCs,** or the **Adjudicating Officer under the 2001 Energy Conservation Act**. Headquartered in New Delhi, APTEL's role is to ensure regulatory consistency, protect stakeholder interests, and resolve disputes that arise in the highly complex and evolving Indian power sector.

Jurisdiction and Scope

- Hears appeals against orders issued by CERC and SERCs related to tariff determination, licensing, penalties, and open access disputes.
- Adjudicates on matters involving the **Bureau of Energy Efficiency** under the Energy Conservation framework, especially regarding the **Perform, Achieve, and Trade** and **Carbon Credit Trading** schemes.
- Entertains petitions related to the **Electricity Appellate Jurisdiction** under allied laws like the **Petroleum and Natural Gas Regulatory Board Act** and **Telecom Regulatory Authority of India Act**, wherever applicable by central notification.

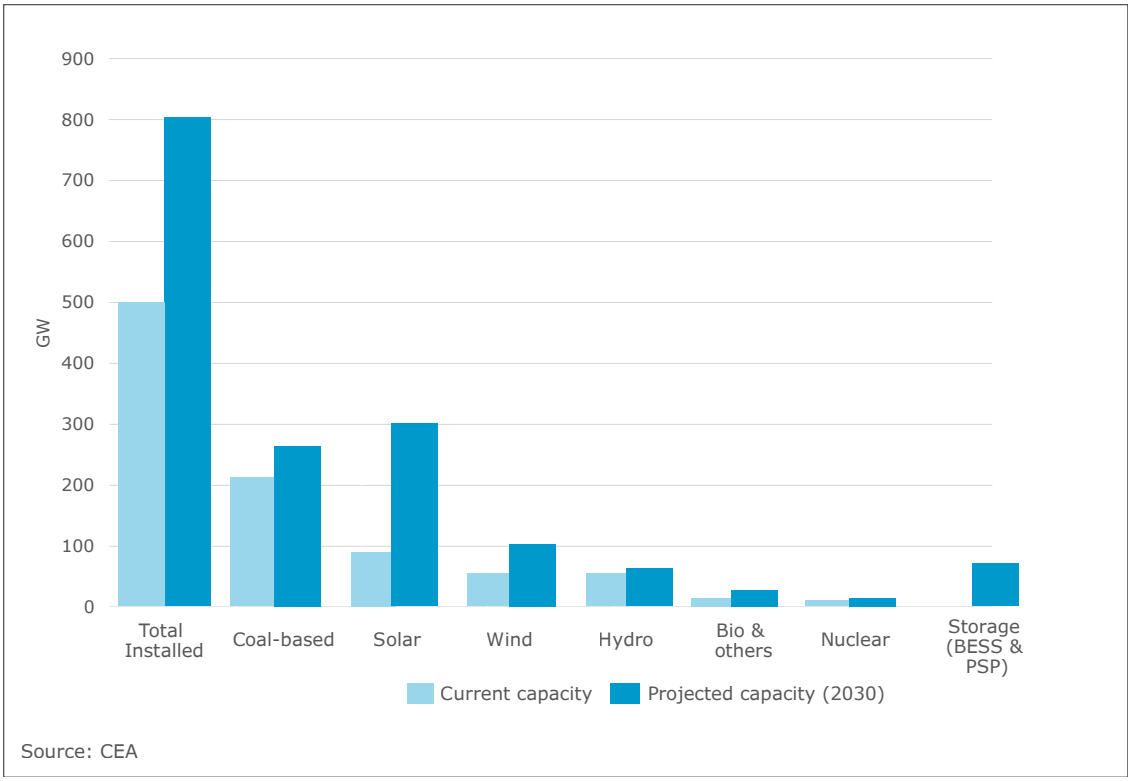
APTEL comprises a chairperson (a former judge of the Supreme Court or Chief Justice of a High Court) and two other Members (Judicial and Technical). Its decisions can only be appealed in the Supreme Court of India, ensuring finality in adjudication.

APTEL also serves as the institutional bridge between regulatory bodies and judicial review, reducing the burden on High Courts. As of 2024, it had disposed of more than 3,500 cases, contributing significantly to legal clarity on regulatory powers, market access, and consumer protection in the electricity sector.

The tribunal's role is crucial in upholding the rule of law in India's power market, where multilateral interests – ranging from DISCOMs and private IPPs to open access consumers – often require expert and speedy resolution of technical and commercial disputes.

3 The Decarbonisation Roadmap for Indian Power

Figure 12: India's current and projected installed capacity



Source: CEA

India's roadmap for significantly decarbonising its power sector by 2030 (and net-zero by 2070) forms the backbone of the country's CO2 reduction commitment.

Though the plan relies mostly on private capital, government bodies coordinate execution, particularly the Ministry of Power (MoP) and the Ministry of New and Renewable Energy (MNRE). India claims to have met one half of its power target already – meeting 50% of total electricity capacity from renewable sources. This has been achieved in part by tweaking the definition of "renewable" to include hydro, so that renewable energy sources (RES) in India now cover the following categories of generation:

- **Solar:** ground-mounted, rooftop, off-grid.
- **Wind**
- **Biomass & Cogeneration**
- **Small hydro:** projects lower than 25MW and mostly Run-of-River
- **Waste-to-energy**

The other pillar of India's renewables target – achieving 500GW of non-fossil fuel capacity by 2030 – will be considerably more difficult (see Key Challenges, P33). It will also mean increasing the actual electricity supply share of non-fossil fuels from the current 25% to around 40% by 2030.

Still, renewables have been India's fastest-growing power source over the past five years, rising from 87GW in April 2020 to 179GW in May 2025. Growth has been particularly rapid in the last two years and is likely to remain the focus of new capacity additions through to 2030 and beyond. Hydro capacity, currently at 49GW, has barely grown over the past five years, with only 2.5GW being added in that time.

However, thermal capacity additions have also been quite slow, expanding from 230GW in April 2020 to 240GW in May 2025. This has led to a significant decline in thermal's share of power mix, from 76% to 50%.

Reaching the target of 500GW from renewable sources remains a key challenge. As of May 2025, total installed capacity of renewable sources was 227GW (including RES and Hydro). It is highly unlikely India can more than double this number in five years, but even getting close will count as a major achievement and deliver a radical change in the country's energy mix.

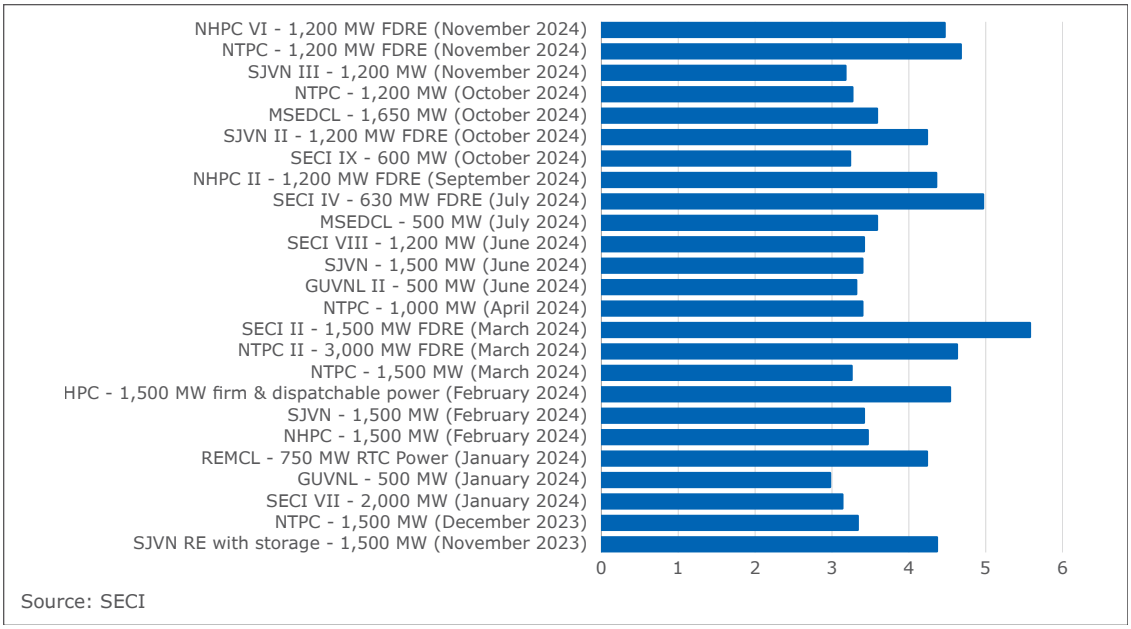
If India were to achieve an additional 200GW of renewables and another 25GW of thermal by 2030, renewables would likely account for close to 40% of the energy mix, from 23-25% currently.

Demand-side factors

We looked at 12 large energy-intensive companies – from the utilities, steel, and cement sectors – and found that capital allocation among the majority of power generators is highly skewed towards new renewable capacity. While few have specific "no-new-coal" investment policies, even companies like NTPC that are building new thermal capacity are allocating two-thirds of capital to renewables. Energy-intensive sectors like steel and cement have clear net-zero targets for 2050 or earlier, while some are stating that their electricity usage will be 100% renewables by 2030.

Cost is an increasingly decisive factor. Results of REIA or state-run auctions show that discovered tariffs for RES hybrid projects with storage are cheaper than new coal-based project tariffs.

Figure 13: Lowest discovered tariffs in recent hybrid, RTC, and FDRE power auctions (INR/kWh)



Source: SECI

Government Plan

Through the MoP and MNRE, the federal government's 500GW-by-2030 plan is supported by policy enablers, fiscal incentives, institutional mandates, and national missions to accelerate the clean energy transition. The government's objectives are comprehensive; to move the country towards net-zero through generation capacity, transforming the energy mix, demand-side management, carbon trading, and encouraging the domestic manufacturing sector to move towards net zero.

Core National Objectives

- Achieve 500GW of non-fossil fuel-based capacity by 2030, including solar, wind, and hydro.
- Achieve 50% of electricity capacity from non-fossil sources by 2030. The government says this target was achieved in July 2025.
- Reduce emissions intensity of GDP by 45% from 2005 levels by 2030.
- Avoid 1 billion tonnes of CO_2 emissions between 2021 and 2030.
- Achieve net-zero emissions by 2070.
- Ensure energy access, affordability, and reliability across rural and urban India.

Key Government Initiatives

Supply Side

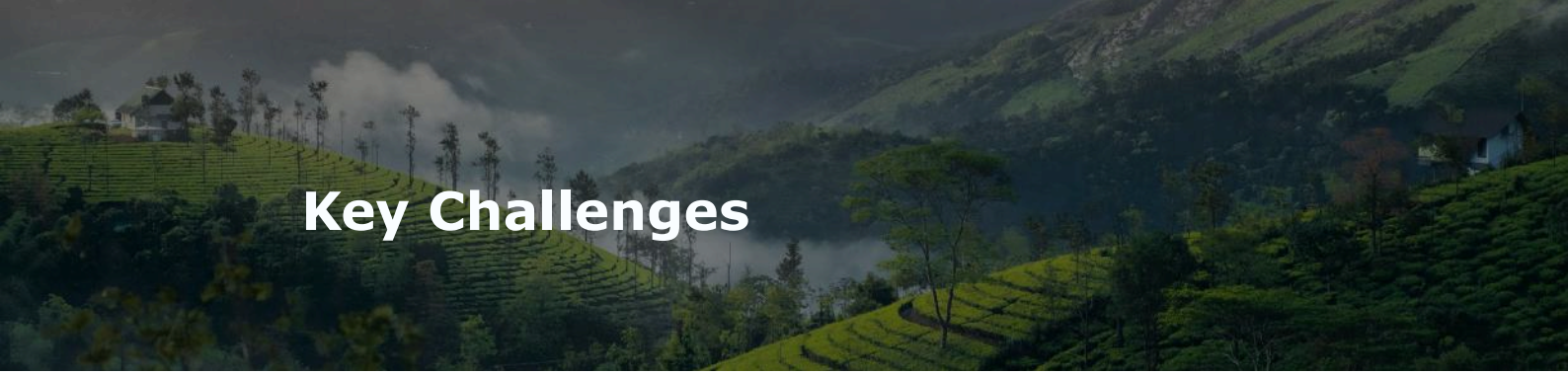
- **National Electricity Plan 2023:** Lays the roadmap for thermal retirement, renewables capacity addition, and grid modernisation.
- **Green Energy Corridor:** Strengthens intra- and inter-state RE transmission networks by building dedicated evacuation infra for green power.
- **Offshore Wind Development Programme:** Targets 30GW by 2030 at identified coastal zones.
- **PM-KUSUM Scheme:** Promotes decentralised solar power for agricultural pumps and rural feeders.
- **Renewable Purchase Obligations:** Sets legally binding targets for distribution companies and industries till 2030.
- **Rooftop Solar Programme Phase-II:** Targets 40GW of rooftop capacity, with subsidies for residential users.
- **Renewable Energy Integration Mechanism:** Operational framework for renewables grid balancing.
- **Flexibility Scheme for Thermal Plants:** Mandates flexible operations to complement renewable fluctuations.
- **National Green Hydrogen Mission:** INR19,744 crore (INR1.98 trillion, or USD2.25 billion) budget to make India a global hub for green hydrogen and electrolysers.
- **Energy Storage Initiatives:** Support for Battery Energy Storage Systems and Pumped Storage Projects.

Market and Demand-Side Measures

- **General Network Access Rules:** Enables transparent and non-discriminatory access to Inter-state transmission systems for renewables developers.
- **National Open Access Registry:** Facilitates seamless renewables procurement and short-term transactions.
- **Time-of-Use Tariff Policy:** Encourages demand flattening through dynamic pricing.
- **Ancillary Services Regulations:** For frequency and voltage support in high-variable scenarios.
- **Carbon Credit Trading Scheme:** Compliance-based mechanism to monetise carbon savings.
- **Demand Side Management programmes:** Targeting peak shaving and efficient appliance penetration.
- **Electricity (Rights of Consumers) Rules, 2020 (Amended):** Includes provisions for net-metering and prosumer rights.
- **Energy Conservation Building Code:** Standards for new commercial and residential construction.
- **Energy Efficiency Obligation Framework:** Expanding obligations to non-industrial sectors.
- **Green Day-Ahead Market:** Renewables trading on power exchanges with 15-minute granularity.
- **National Carbon Market:** Introduced under the Energy Conservation (Amendment) Act, 2022.
- **National Smart Grid Mission:** Digitalisation and automation of transmission and distribution networks.
- **State Energy Efficiency Action Plans:** Under BEE's coordination for implementing demand-side interventions.

Key Players and Roles in Decarbonisation Plan

Institution	Role
Ministry of Power (MoP)	Policy formulation, generation and transmission planning
Ministry of New and Renewable Energy (MNRE)	RE deployment, targets, and financial incentives
Bureau of Energy Efficiency (BEE)	Administers PAT & CCTS, emission monitoring, credit issuance
Central Electricity Authority (CEA)	Demand projections, capacity planning, and integrated resource planning
Central Electricity Regulatory Commission (CERC)	Market regulation, REC trading, DSM pricing
State DISCOMs & Private Developers	Execution of RE capacity addition and demand management
Carbon Market Committees	Oversight on emission trading and compliance monitoring



Key Challenges

Despite a supportive regulatory environment and various direct concessions grated to renewables generators, India's transition to cleaner power still faces multiple challenges.

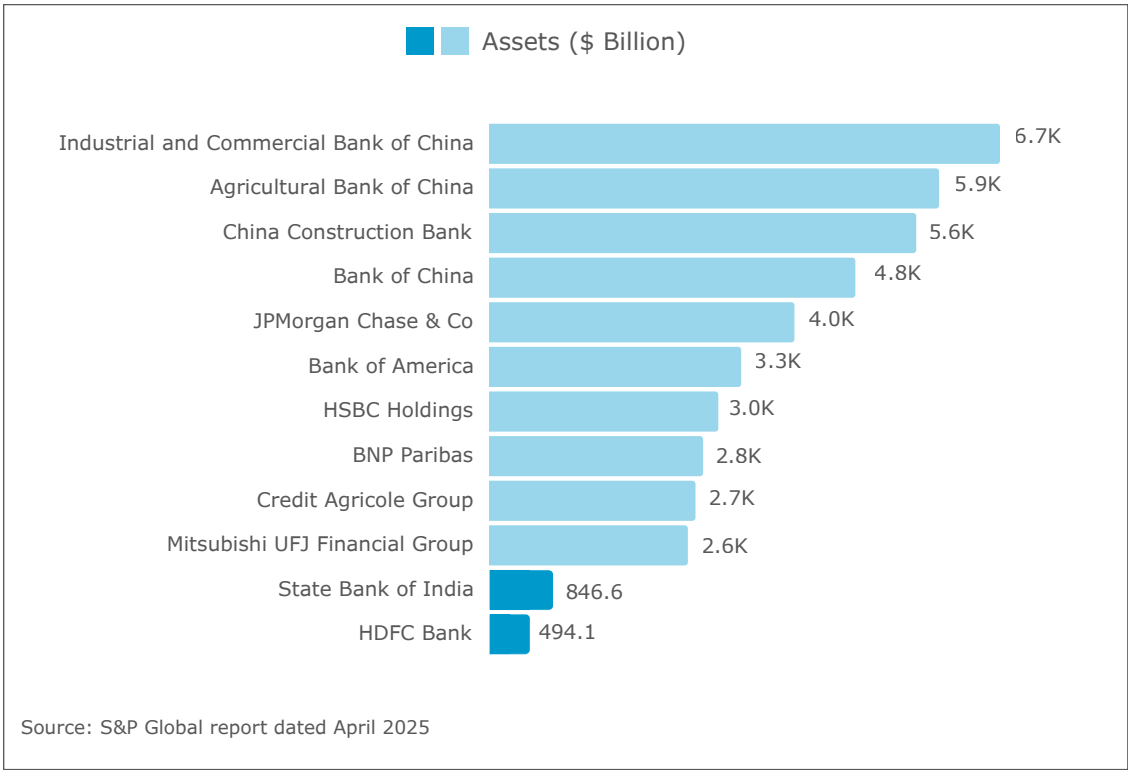
Financing

India's power transition plans are largely dependent on private capital. Assuming a cost of INR5 million/MW (~USD57,000), every 100GW of new renewable capacity will required USD60 billion in new investment, of which USD18 billion (30%) must come as equity and USD42 billion as new debt.

India is currently targeting in excess of 250GW of new capacity, translating to a capital expenditure requirement of about USD150 billion. Upgraded and distribution infrastructure to handle that extra energy will cost an additional estimated USD150 billion. Since typical renewables projects have a gestation period of about two years, this means USD300 billion is required over the next three-to-four years if India is to meet its 2030 targets.

While some larger corporations may be able to raise the required funds, new players who are in the construction phase or yet to get cashflow support for their new project investments are likely to struggle, as most Indian bank balance sheets will not support fresh lending on this scale, leaving international soft funding as the only option.

Figure 14: Clean power funding requirements pose a challenge for domestic banks.



Source: S&P Global report dated April 2025

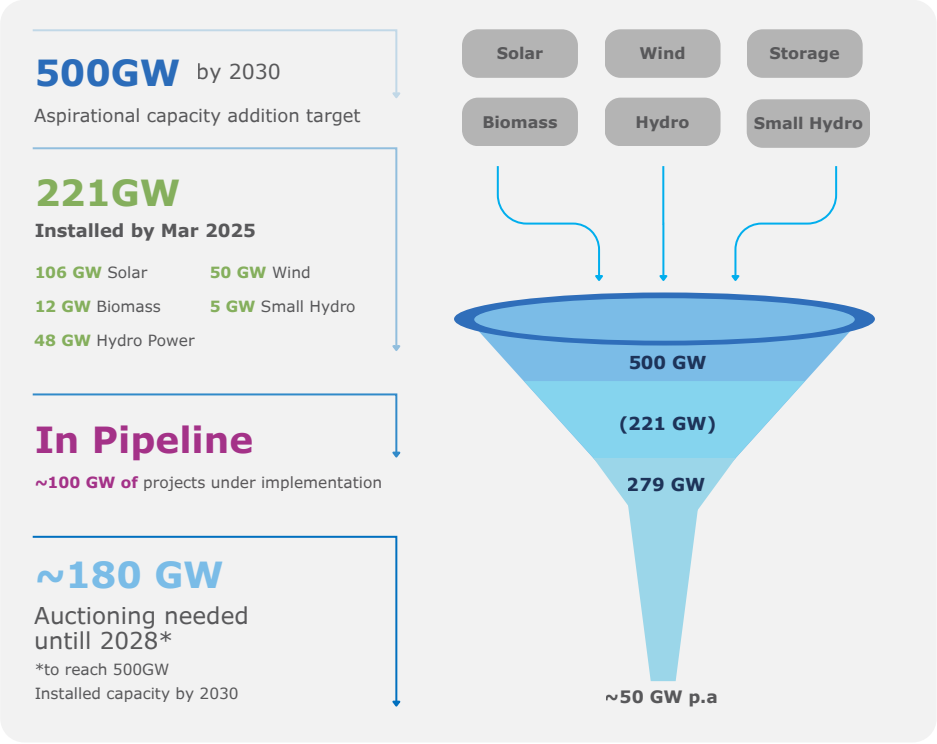
Tendering and Contracting

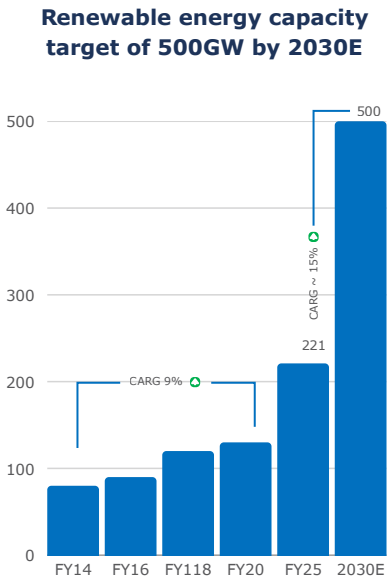
To achieve the 500GW renewables target, India will need to close tenders and finalise contracts of about 50GW per year through to 2030. While tendering did reach 50GW in 2024, pushing those tenders through to the Power Purchase Agreement (PPA) stage has been far from seamless.

Part of the problem is that recent data showed a year-on-year drop in power demand in the second quarter of 2025. In an environment of high tender volume but low demand growth, REIAs will find it difficult to find buyers to sign PPAs. The Solar Energy Corporation of India has a large number of projects where bid prices have been discovered but PPAs with end buyers have yet to be signed.

On the positive side, discovered bid prices for renewables projects have been on a downward trajectory, and generally below the Average Power Purchase cost of most state distribution companies, which means approval from state regulator for new PPA should be easy to secure.

India Targeting 500GW RE Capacity by 2030 Implies ~50GW Additions Annually





Source: CEA, JM Financial Research, Nuvama Research

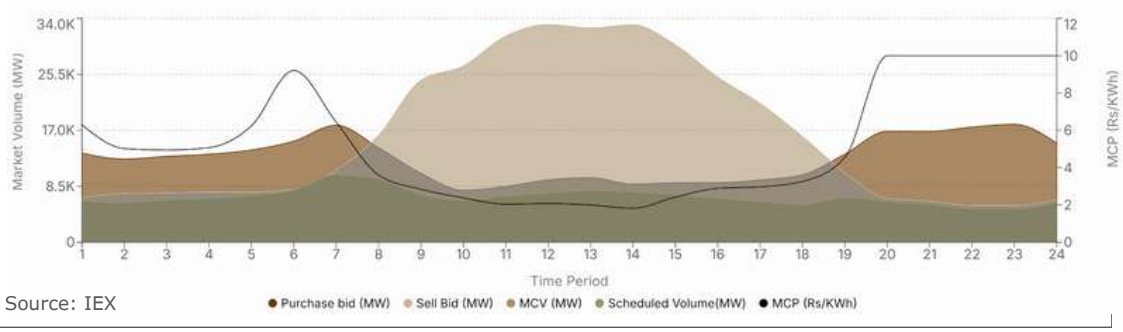
Implementation Challenges

Many generators are struggling with issues ranging from land acquisition, equity financing, and debt funding (primarily affecting smaller companies) to timely evacuation-line completion and equipment supply delays. Given the scale of deployment planned over the next five years – often in a decentralised process involving various players and fragmented schemes – those challenges may escalate.

Sale and Pricing Challenges

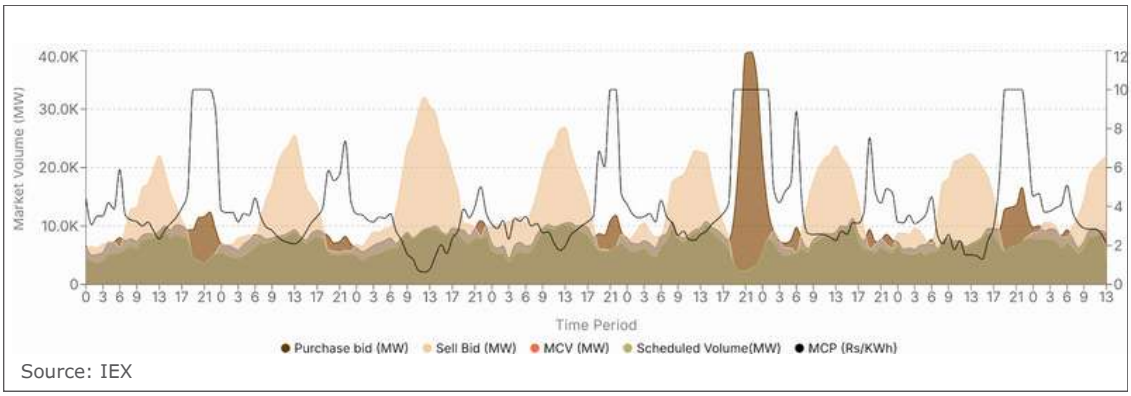
Large solar capacity addition has created a huge supply glut during supply hours (9am-5pm) that has far outstripped demand growth. Day-Ahead Market exchange data show solar-hour sellers far exceed buyers, a problem that will only worsen as new capacity is added.

Figure 15: Day-Ahead Market data for June 2025 from IEX; solar-hour sale-bid volume and non-solar hour higher buy-bid volume for daily market is a challenge.



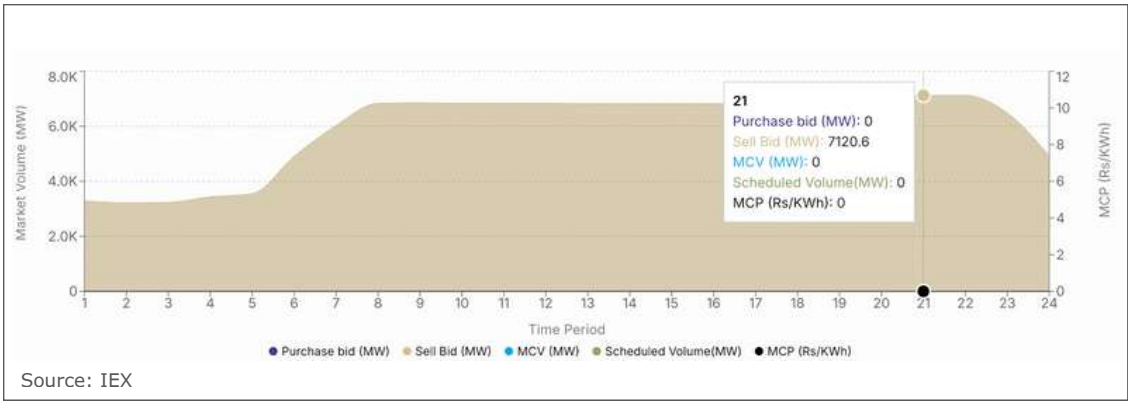
Source: IEX

Figure 16: Market data for a week of June 2025 shows solar hour prices weakening- this is the highest temperature month in India, means high demand.



Source: IEX

The Indian market is highly cost-sensitive. The High-Price Day-Ahead Market received no bids in June 2025 on the IEX's HDAM platform..



Source: IEX

Current market conditions suggest India will struggle to add 250GW of renewable capacity by 2030. However, the country has made significant progress over the last five years. Given that major utility and energy-intensive industrial players have renewable-centric policy and capital allocation plans, we expect the pace of RES capacity addition to continue.

As the world's third-largest emitter of CO2 and third-largest energy consumer, India's clean power programme is of critical importance to the success of the global energy transition. Given the scale of India's renewables integration plans, the process so far has been well managed. The Indian grid, the largest unified grid in the world, has been largely stable and free of major disruptions in recent years, mainly due to a progressively strengthening regulatory, technical, and market framework that has balanced centralised management with decentralised responsibilities.

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