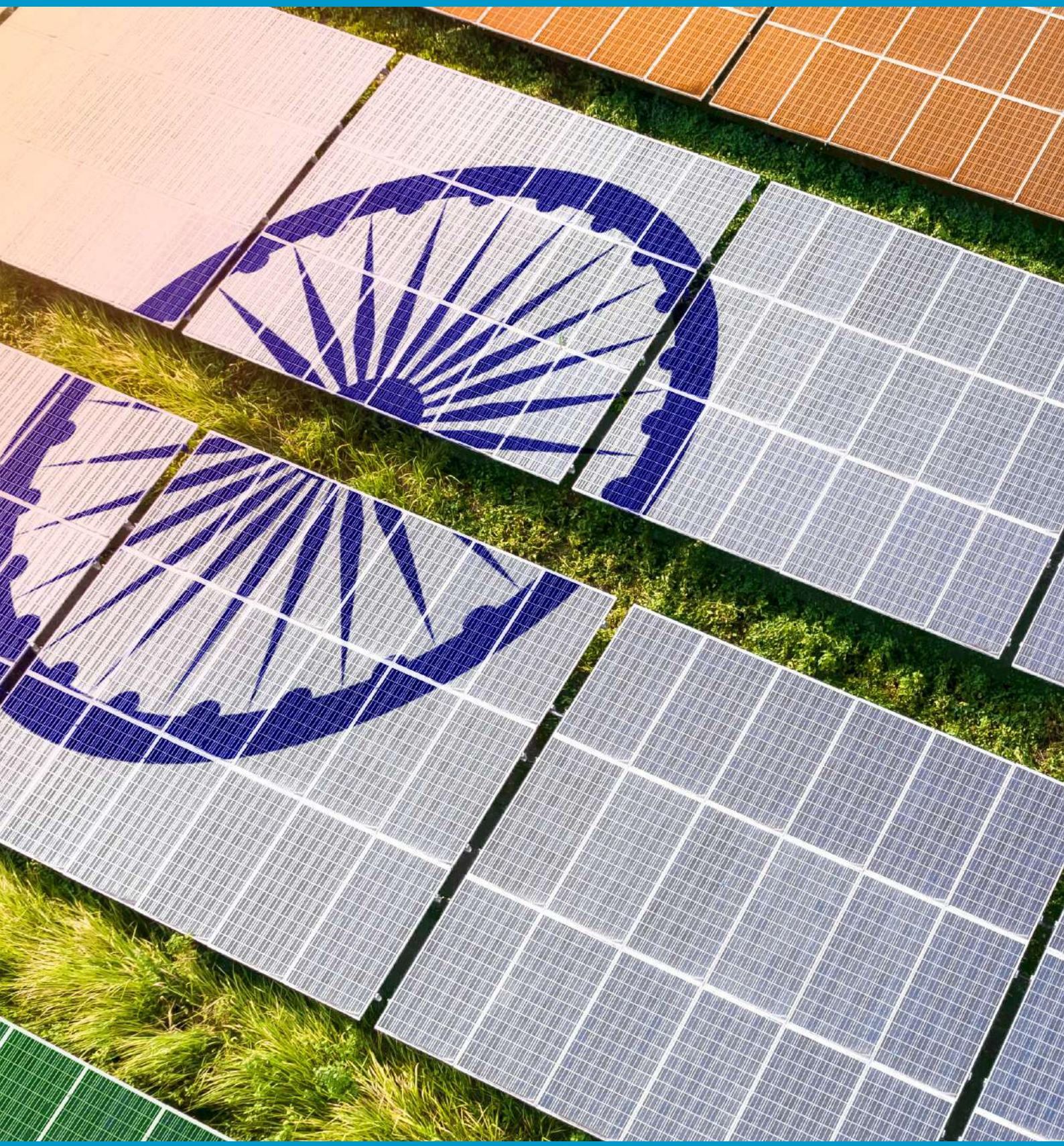
Powering Net Zero

Pathways to Clean Energy for India's Utility Companies



February 2026

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Executive Summary

India's power sector is central to the country's net-zero pathway and, increasingly, to investor opportunities in its accelerating economy.

Power is one of the largest sources of India's energy-related emissions (around half, depending on definitions), making decarbonisation in this sector among the most effective levers for reducing economy-wide carbon intensity. At the same time, electricity demand has risen strongly, to 1.54 million gigawatt hours (GWh) in 2023-24.[1]

Rapid electricity demand growth, rising peak loads, and energy-security considerations are reshaping generation economics. This report assesses how India's leading power companies are positioned to navigate and monetise this transition.

India has moved beyond the first phase of renewable expansion, when value was driven primarily by low solar and wind tariffs. The next phase is defined by firm and dispatchable power, with renewables increasingly paired with storage and hydro to provide grid flexibility. This shift materially alters the investment case. Coal remains necessary for near-term system adequacy but faces rising capital costs, fuel and logistics volatility, and declining utilisation. In contrast, renewables paired with storage are becoming competitive on an all-in delivered-cost basis, while offering greater cost visibility and lower long-term policy risk.

Based on recent project benchmarks, new ultra-supercritical coal plants clear competitive bids around INR5.5 to 6.0 (USD0.06-7) per kilowatt-hour (kWh). However, these tariffs assume high utilisation and stable fuel economics. Once adjusted for lower plant load factors, domestic coal quality issues, and tightening environmental compliance, the effective delivered cost of new coal rises to approximately INR7 to 8 (USD0.08-9) per kWh.

By comparison, recent solar-plus-storage and round-the-clock renewable projects have cleared in the range of INR2.7 to 5.1

(USD0.03-6) per kWh, with availability guarantees embedded in the tariff. For firm renewables, tariff and realised cost largely converge, reducing earnings volatility.

What to track in the transition

The differentiation between India's power companies is less about stated net-zero targets than execution discipline and contract structure. The report uses several pillars to assess transition readiness:

1. **Growth visibility and award-to-Commercial Operation Date (COD) execution timeline**
2. **Cash-flow quality: availability-linked vs energy-only Power Purchase Agreements (PPAs)**
3. **Firming and storage readiness: Battery Energy Storage Systems (BESS) and pumped storage**
4. **Balance-sheet strength and cost of capital**
5. **Return-on-Equity (ROE) trend of leading players**

Companies that score well across these dimensions are better positioned to compound earnings as the grid decarbonises.

We found an emerging divergence between companies.

- **JSW Energy** and **Tata Power** appear best placed to monetise the transition, combining contracted growth with storage depth and improving cashflow quality.
- **Adani Green** remains the fastest scaler of renewable capacity, with strong long-term visibility, though storage integration is still at an early stage.
- **NTPC** offers unmatched scale and sovereign-backed financing, but outcomes hinge on execution speed and managing coal's declining role.
- **Adani Power** remains primarily a thermal story, with limited exposure to the structural upside from renewables and storage.

The story has changed

India's power transition is no longer a binary "coal versus renewables" debate. It is a capital-allocation and execution story, where companies that deliver firm power at predictable prices will attract lower capital costs and more durable valuations. As policy, technology, and market design increasingly reward reliability over raw capacity, the transition creates clear winners (and laggards) within the sector.

In practice, the firm power stack is widening beyond solar and wind. It now spans renewables paired with storage, demand-side flexibility, and a more grid-integrated system that values peak and balancing services alongside energy. This broader view matters because India's decarbonisation pathway is ultimately constrained not by headline renewable capacity, but by the ability to meet round-the-clock demand through seasonal variability, evening peaks, and extreme-weather stress.

Against this backdrop, the conversation is also expanding to include additional non-fossil options for dependable, long-duration supply, notably the re-entry of nuclear into the policy mix.

Ultimately, India's power transition is crystallising into a contest over bankable delivery. It is critical to look past headline net-zero targets and focus on the operational and financial "proof points" that de-risk earnings.

The dispersion across these pillars is key to identifying winners and laggards. With policy and market design increasingly valuing reliability, the premium will accrue to companies that can provide predictable, round-the-clock power at lower cost, aligned to demand patterns.

Note: All currency conversions & market-cap figures in this report are as of 28 January 2026.

1. Decarbonising Indian Power

India's power sector is the largest lever for near-term emissions cuts, a major engine of investable growth, and the cornerstone of India's net-zero commitments. Three facts frame the opportunity:

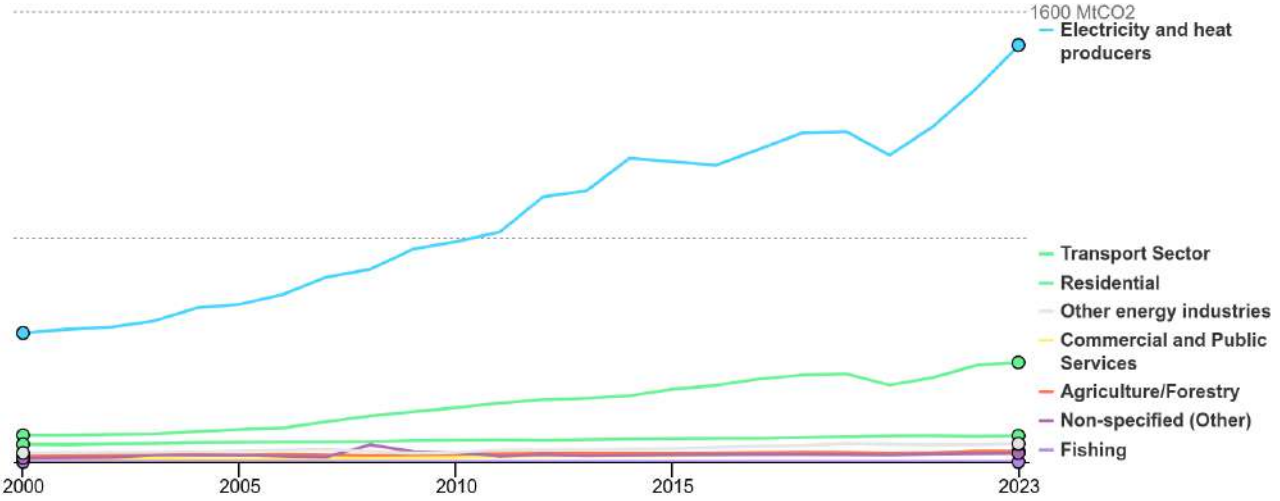
- Electricity and heat account for ~54% of India's energy-related CO_2
- The grid still emits ~0.72 tCO_2/MWh on average; and
- Non-fossil is already at ~50% of installed capacity; 2030 target is 500GW non-fossil (65% of capacity).

Recent utility-scale hybrid projects in India are typically structured with 60–70% solar and 30–40% wind capacity, optimised by location and evacuation constraints. Together, these points translate decarbonisation into quantifiable avoided emissions, lower imported-fuel exposure, and long-duration capex pipelines across generation, storage, and transmission. If the goal is to reduce financed emissions at viable costs, the logic in switching to renewables is irrefutable. A single 1GW solar-wind hybrid delivering 2.5–3TWh/yr abates 1.8–2.1 $MtCO_2$/year at today's grid factor, an auditable emissions outcome for financed portfolios.

Figure 1: India's power emissions landscape

Indicator	Latest Value / Year	Relevance
Total energy-related CO_2 emissions	2.76 Gt (2023)	India accounts for ~8% of global energy-related emissions.
Power sector share of emissions	54% of total[2]	Highlights why decarbonising electricity is the main lever for India's overall net-zero progress.
Grid emission intensity	0.716 tCO_2/MWh (FY2022–23)[3]	Used as the baseline factor for calculating abatement from new renewable projects and green PPAs. Each 1 TWh of clean power displaces ~0.72 $MtCO_2$.
Non-fossil capacity share	>50% (June 2025)[4]	India achieved the 50% non-fossil milestone five years ahead of its 2030 NDC target. Indicates strong policy alignment and build momentum.
2030 non-fossil capacity target	500 GW (≈65% of planned capacity)	Achieving this requires sustained annual additions of 45–50GW renewable capacity and corresponding transmission expansion.
Key policy trajectory	Net-zero by 2070, interim targets 2030 (NDC) and 2032 (sectoral)	Provides long-term visibility for investors; aligns with India's updated Nationally Determined Contribution (NDC) and decarbonisation pathways under Mission 500 GW.

Figure 2: Evolution of CO2 emissions by sector in India since 2000



Source: International Energy Agency. Licence: CC BY 4.0

Cost and competitiveness: why RE wins on current trends

- **Tariffs at scale:** Recent auctions keep utility-scale solar at INR2.7/kWh, with hybrids at INR3.2–3.4/kWh and solar-plus-storage products trending towards INR4–4.3/kWh for flat 24/7 supply constructs, depending on duration and design.[5] Recent tenders for coal capacity by states of Bihar, MP and Assam for new coal capacity have a discovered tariff of more than INR6/KWh (USD0.07), with fixed costs of about INR3/KWh (USD0.03).

- **Compliance backstop:** Under the new Renewable Consumption Obligation (RCO) framework, the Buy-out Price proposed by Central Electricity Regulatory Commission (CERC) is INR245/MWh (USD2.70) for FY2024–25 (around 5% above the FY25 weighted-average Renewable Energy Certificate price).[6]

- **System costs:** Transmission for 500+GW non-fossil by 2030[7] is fully mapped by the Central Electricity Authority (CEA), shifting discussion from "if" to "connectivity and timing". Storage costs are being de-risked via tender design (Round-the-Clock/peak, capacity/energy payments) and Inter-State Transmission System (ISTS) charge waivers for storage.

For corporate and Distribution Company (DISCOM) buyers, RE PPA prices are already below many peak-hour thermal costs once transport, losses, and peak premiums are included, while producing measurable, reportable emissions abatement. Storage adds a premium, but it buys peak reliability and can be structured as capex-light offtake with strong visibility.

Energy security and FX: decarbonisation lowers import risk

- **Import exposure:** Coal imports fell 7.9% in FY2024–25 to 244 million tonnes, saving USD7.9 billion in foreign exchange and reflecting higher domestic output and efficiency.[8] Continued displacement of imported coal in the power mix further reduces tariff volatility and FX leakage.

- **Resilience:** Even though India raised domestic coal stocks to record levels for the purposes of reliability, coal's share in monthly generation dipped at times in 2025, highlighting the greater contribution from clean sources in high-resource months. Despite peak demand

Figure 3: Snapshot of India's renewable hardware ecosystem

Segment	Current snapshot	What still depends on imports	Takeaway
Solar modules	Domestic module capacity at 95–120GW by mid-2025; imports fell >70% QoQ in Q2 2025	Cells and wafers still largely imported; ~68% from China	Module manufacturing is largely local, but upstream dependence persists
Solar imports (2024)	66 GW of cells/modules imported; 4.5GW modules exported	Cells dominate import value (72%)	Self-sufficiency improving, not complete
Battery storage (BESS)	All major utilities assemble BESS domestically	90–95% of lithium-ion cells imported, mainly China and Korea	Storage costs remain linked to global cell supply
Overall implication	Domestic assembly is strong	Upstream inputs remain import-sensitive	FX and supply-chain risks exist, but execution control is improving

continuing to set new records in several months during 2025, coal generation volumes have not collapsed, but coal's percentage share fell because non-fossil generation grew faster.[9]

- **Regulatory scrutiny on new coal:** Recent rejection of a proposed coal project by the Rajasthan regulator highlights rising cost concerns and weakening regulatory support for new thermal capacity.

Renewables combined with storage enables offtakers to hedge fuel and FX risk. For asset owners, it underwrites real returns that are less correlated with international commodity cycles.

India's transition is not just about capacity numbers. It is also about where the hardware comes from.

Solar modules are increasingly domestic, but battery cells for storage are still overwhelmingly imported.

Physical risk, water, and system reliability

- **Water stress:** Around 40% of thermal capacity sits in areas of high water stress; 14 of the 20 largest thermal utilities suffered water-related shutdowns 2013–2016, costing USD1.4 billion.[10] Heatwaves and hydrological volatility elevate this operational risk.
- **System plan:** The 500GW integration roadmap (new 765-kilovolt corridors, High Voltage Direct Current lines, pooling stations) directly addresses curtailment and deliverability, which is key to ensuring that clean energy construction translates into dependable evening supply.[11]

Allocation to hybrids, storage, and transmission are not just transition-aligned; they mitigate material physical risks (water/heat) and stabilise cashflows through improved availability. Decarbonising power tackles around 54% of India's energy CO_2 while delivering sub-

INR3/kWh energy, FX savings, and multi-decade regulated pipelines. Every 1TWh of coal generation displaced avoids 0.72 $MtCO_2$ at today's grid factor – value that is measurable, reportable and financeable.

Zeroing in on costs: Can renewables really compete with coal?

Land, import dependence, and execution gaps
India is no longer debating whether renewable energy can scale; the question is whether utility-scale renewables, backed by storage, can genuinely compete with new supercritical coal on cost and system value. The answer increasingly depends less on pure tariff comparisons and more on three structural bottlenecks: land, supply-chain dependence, and execution speed.

1. Land intensity: how much space does a TWh of energy take up?
Utility-scale solar is materially more land-intensive than coal on a plant-only basis. According to India's Ministry of New & Renewable Energy and Engineering, Procurement & Construction disclosures ground-mounted solar takes up about 4 to 5 acres (1.6 to 2 hectares) – or 3–4 acres/MW for high-efficiency layouts.[12] On a footprint basis, solar therefore uses significantly more land per TWh than a coal plant.

However, this comparison is incomplete. Coal's upstream land footprint (open-cast mines, overburden dumps, and rail infrastructure) is largely off-balance-sheet, while solar's land is co-located with generation. Solar land can also be dual-use (agri-PV, grazing), unlike coal plant sites.

Crucially, both technologies now compete for grid-proximate land, where scarcity is pushing land to nearly 20% of project cost in states such as Rajasthan, with recent stamp-duty changes adding 8–10% to land-related expenses and directly affecting tariffs.[13]

2. Import dependence: solar still leans on China, but the gap is closing
Supply-chain dependence represents another structural vulnerability for solar, compared with domestic coal.

In FY2024, India imported about USD6.2 billion[14] of PV cells and modules, with China accounting for the majority. According to parliamentary data, India imported 35.3 million modules from China in FY2024–25, worth USD1.7 billion.[15]

The trajectory is improving, however. India added approximately 25GW of module and 12GW of cell capacity in 2024, taking domestic module capacity close to 90–100GW,[16] even as imports remained high. Import concentration is easing, with China's share falling from more than 90% to 56–65% by FY2023–24.[17]

Policy is now directly targeting the cell bottleneck. From June 2026, projects will require modules made from domestically produced cells, while players such as Tata Power, Adani and others are expanding cells, ingots, and wafers at scale.

3. Execution bottlenecks: land and social licence are now the key limiters
Both coal and renewables are running into execution bottlenecks, but the nature of the friction differs:

Renewables:
- In Rajasthan and other high-irradiance states, developers face land aggregation risk, legal disputes, and rising stamp duties, which delay projects and lift land-related capex by 8–10%.[18]
- Case studies such as the Tata Power Nandgaon project show how local opposition can suspend 100 MW-scale solar parks, with protests centred around accusation of "corporate land grabs".[19]
- As a result, even "cheap" INR2.3–2.7/kWh solar bids embed delivery risk linked to local politics and land markets.

Coal:

- New supercritical projects such as Buxar and Khurja have experienced multi-year construction delays. The CERC interim tariff order for Khurja STPP notes a 690-day delay in COD for Unit-1 relative to the original investment approval schedule.[20]
- Coal projects also face fuel-linkage uncertainty, rail capacity constraints, and environmental clearances for both the plant and associated mines, which extend execution timelines and increase interest during construction (IDC).

The take-away is that neither coal nor renewables are "frictionless", but the risk profile is different. Renewables concentrate risk in land, grid-connection and policy stability, whereas coal concentrates risk in capex overruns, fuel logistics and carbon policy.

Comparing real costs: Ultra super-critical coal vs RE-RTC

A meaningful comparison between coal and renewables needs to look beyond plain solar or wind tariffs and focus on firm, dispatchable power. On the coal side, that means a new supercritical plant with current capital and fuel costs. For renewables, it means solar and wind combined with storage, delivered as firm and dispatchable renewable energy or round-the-clock products. For a complete picture, stakeholders need to understand what power actually costs per unit delivered, after accounting for utilisation, fuel risk, compliance, and financing.

The case study below compares new coal and firm renewables on both tariff and realised cost per kWh, using actual Indian project examples with published tariffs.

Coal

Torrent Power – 2x800MW Ultra-Supercritical Coal Plant[21]

- **Discovered tariff:** ~INR5.83/kWh (USD0.06) – 25-year PPA
- **Technology:** Ultra-supercritical
- **Capex:** ~INR8–9 crore/MW (USD872,000 to 981,000)

Note: Tariff is representative of market-based coal, unlike regulated cost-plus plants, and reflects today's capital costs, coal linkages, and emissions norms.

Realised Cost Estimate

Component	INR/kWh (indicative)
Headline tariff	5.8
PLF impact (85- 65%)	+1 to +1.3
Fuel & logistics volatility	+0.3 to +0.5
Environmental & OEM creep	+0.2 to +0.4
Real economic cost	~7.3-7.8

Renewables

Morena Solar-plus-Storage project (RUMSL)[22]

- **Configuration:** 600MW solar + 880MWh BESS
- **Tariff:** INR2.70-2.76/kWh (about USD0.03) – 23-year contract
- **Availability:** 95% annual and peak-hour

Note: Firm RE tariffs today span ~INR2.7–5.1/kWh, depending on storage depth and availability guarantees. But tariffs assume ideal operating conditions. Realised cost depends on how plants actually run.

Realised Cost Estimate

Project type	Tariff (INR/ kWh)	Real cost
Morena solar+BESS	2.7-2.8	~2.7-3
Typical RTC/ FDRE	4.5-5.1	~4.5-5.2

Figure 4: The table below shows a more pragmatic comparison between emerging coal plants and firm RE projects

Metric	New USC Coal	RE-RTC
Headline tariff	~INR5.8/kWh	INR2.7–5.1/kWh
Real delivered cost	**INR7.3–8.0/kWh**	**INR2.7–5.2/kWh**
Cost volatility	High (fuel, PLF, policy)	Low
Carbon exposure	Rising	None
Financing risk	Increasing	Declining
Long-term competitiveness	Weakening	Strengthening

We can draw two conclusions from this:

1. New supercritical coal has lost its cost advantage at the margin.
Morena's INR2.70/kWh FDRE tariff demonstrates that, under the right conditions, firm renewables can be materially cheaper than new coal over a 25-year horizon.

2. Coal's risk profile is skewed to the upside on costs.

- Domestic coal is increasingly lower quality and higher ash, raising fuel, transport, and ash-management costs over time.
- Environmental compliance requirements (for example, stricter particulate controls, water norms, potential future carbon pricing) are likely to push tariffs upwards, not downwards.
- By contrast, the capital costs of solar, wind, and batteries continue to fall, and India's domestic manufacturing push is explicitly aimed at reducing import dependence and volatility in renewable supply chains.

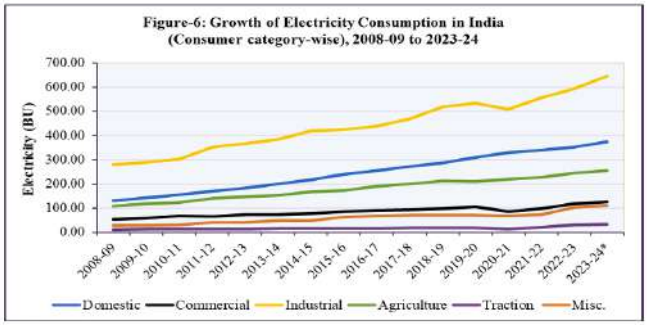
3. Land and execution risk is the true "swing factor" (depending on how far upstream we go).
At the project level, firm renewables can look land and logistics-intensive, requiring large land parcels, multi-agency permits, transmission evacuation, delivery risk on storage and hybrids. But coal is not execution-light either once the full chain is included: mine development/allocations, rail/port logistics, ash disposal land, water availability, emissions-control retrofits, and (increasingly) social licence constraints.

Today the land and execution uncertainties are arguably balanced at the margin. RE faces siting/evacuation/battery integration risk, while coal faces fuel logistics, compliance, and lifecycle constraints. The balance is likely to skew in favour of renewables over time, because RE supply chains and delivery models are becoming more standardised (hybrids/FDRE structures, improved forecasting, modular storage, better contracting and domestic manufacturing), whereas coal's land/water/ash and permitting constraints tend to compound rather than ease.

2. How the Power Sector is Evolving

India's power sector is in the midst of a structural shift. In terms of supply composition, electricity demand has grown at a CAGR of 4.7% in the last 10 years.[23] Long-term studies project India's electricity consumption could triple by 2035 (roughly ~9% CAGR), from around 1,400 TWh today to more than 4,000 TWh by 2035.[24] The electricity system is expanding fast, decarbonising in capacity terms, and evolving from single-technology renewables to hybrids and storage that can meet peak demand reliably.

Figure 5: Growth of Electricity Consumption in India by consumer category, 2008–09 to 2023–24



Source: Central Electricity Authority – CEA & Central Electricity Regulatory Commission (CERC)

Power demand is evolving

Electricity consumption has risen steadily across all consumer categories since 2008–09, with industry still the largest user and households the fastest-growing segment (driven by cooling and motor loads).

This shift increases evening and summer peaks, making time-of-day deliverability as important as annual energy. India hit an all-time peak of 250GW on 30 May 2024, illustrating how quickly system stress can escalate when heatwaves hit.

The overall message is simple: demand is larger, peakier, and more weather-sensitive than a decade ago.

Figure 5 reflects the growing demand across all segments, with industrial demand highest in absolute terms and domestic steepening most after the mid-2010s.

Industries and households, which together constitute more than 66%[25] of the demand, saw the highest increase from 2008–09 to 2023–24. While the industrial segment holds the highest share of consumption, domestic usage has been rising steeply since mid-2010s, reflecting air-conditioning, appliance ownership, and motor loads. With faster growth in domestic and commercial use, the evening ramp and summer peaks are becoming more pronounced.

This indicates that planning cannot rely on annual energy alone; meeting evening peaks and summer heatwaves requires hybrids, storage, and flexible capacity alongside pure solar or wind.

Capacity is tilting green

India crossed a milestone in 2025 when the country achieved half of total installed capacity from non-fossil sources (renewables plus large hydro). This is the capacity platform for the 2030 target of 500GW non-fossil, which is backed by CEA's large transmission buildout plan. New additions are overwhelmingly renewable, and the mix is moving away from pure solar towards hybrids (solar+wind) and hybrids with battery storage (solar+wind+BESS). This improves deliverability, implying that power can be made available when the system needs it.

Building Round-the-Clock, firm and dispatchable RE

India's first decade of renewable deployment was dominated by energy-only solar and wind PPAs that paid purely for kilowatt-hours delivered, with limited obligations on when that energy was supplied. This model was effective for scaling capacity quickly, but it left system operators managing increased variability and sharper evening ramps.

The current phase looks different. New tenders increasingly procure Round-the-Clock (RTC) and Firm & Dispatchable Renewable Energy (FDRE) products, where developers must guarantee delivery across specified time blocks and seasons. These products bundle solar and wind hybrids with storage and often include explicit availability targets and capacity-style payments, shifting value from cheap daytime energy towards reliable evening and peak-hour supply.

Recent auction data and disclosed contracts from NTPC, Adani Green Energy Ltd, JSW Energy, and Tata Power show that there is already a meaningful and fast-growing pool of RTC or availability-linked megawatts.

Figure 6 shows that:

- RTC MW values are growing rapidly as grid integration and firming become priority; majority of earlier installations (especially pre-2023) were delivered on energy-only basis without stringent availability requirements.
- New tenders and corporate PPAs across the sector are increasingly RTC-focused, especially for large commercia and industrial (C&I) off-takers and discoms seeking reliability and firm scheduling.
- The current mix highlights that while energy-only PPA volumes still dominate at all these companies, RTC-linked MW is the fastest-growing segment because of a recent regulatory and commercial push for dispatchable renewables.

Figure 6: Recent auction data and disclosed contracts

Company	RTC/Firm RE Capacity	Key RTC Contracts/ Projects	Takeaway
NTPC	2.7GW under development	Includes a 1.3GW flagship RTC project with hybrid renewables and storage	Large-scale pivot from energy-only RE to system-level, firm supply anchored by storage
JSW Energy	725MW awarded/executing	700MW under NTPC RTC tenders; 25MW RTC for captive green hydrogen	Fast transition towards RTC-led growth to improve cash-flow visibility
Adani Green / Adani Power	1GW marquee RTC	1,000MW RTC for Mumbai DISCOM, backed by renewables and firming assets	Ability to bundle renewables with firm capacity to win large urban tenders
Tata Power	1GW under development	966MW RTC hybrid for Tata Steel (wind + solar, availability-linked)	Scaling bankable RTC contracts with high-quality offtakers

Sources: Business Standard; PV-Tech; JSW Energy; EQMagPro; Tata Power.

Why this matters

- **Cashflow resilience:** Availability-linked and RTC contracts typically combine a fixed capacity charge with an energy component, turning part of revenue into an annuity-like stream and reducing exposure to curtailment and merchant price risk.
- **System reliability premium:** As India's demand becomes peakier and more weather-sensitive, assets that can reliably deliver into evening peaks and extreme heat events will command a premium, both from buyers and in equity valuations.
- **Leading indicators:** The growth in contracted RTC MW – still a minority of the total but the fastest-growing segment – is a practical indicator of which companies are successfully repositioning from "cheap intermittent MWh" to "firm, carbon-light MW".

Scaling renewables: current gaps against thermal power

- **Land & evacuation synchronisation:** Multi-GW parks need land aggregation, pooling substations and ISTS links aligned to storage delivery; slippage pushes IDC and COD.
- **Import dependence in solar supply chain:** Domestic module and cell capacity is expanding, but tariffs and Approved List of Models & Manufacturers (ALMM) rules mean short-term reliance on imports persists, impacting timelines and pricing compared with more domestic coal supply chains.
- **Storage supply chain ramp:** BESS procurement (cells, PCS, EMS) must scale alongside tenders; Viability Gap Funding (VGF) reduces first-of-kind cost, but vendor concentration remains an issue.

Figure 7: Lessons from other regions

Region	Hurdle	Financial Impact
EU	**Price swings and "cannibalisation":** As wind/solar surged, midday prices often fell (even went negative), squeezing merchant revenues when contracts didn't pay for reliability. Ancillary and flexibility products took time to deepen, so storage and demand response lagged additions.[26] **Grid congestion and interconnection limits:** Rapid buildout outpaced some cross-border links and internal reinforcements, raising redispatch/curtailment costs. Permitting backlogs added delay and uncertainty.	Projects without long-term, firmness-oriented contracts faced volatile cash flows and tougher debt terms.
China	**High early curtailment in wind/solar hubs:** Resource centres in the northwest grew faster than local demand and export capacity; curtailment rates were double-digits in mid-2010s before grid remedies.[27] Ultra-high-voltage (UHV) lines, minimum guaranteed-hours and quotas later pushed national curtailment down to low single digits.[28] **Market and dispatch fragmentation:** Provincial priorities and coal-based Combined Heat Power (CHP) inflexibility limited system-wide optimisation; spot/ancillary markets have expanded gradually.[29]	Bankability improved as curtailment fell, but returns still depend on local grid buildout and contracting terms.
ASEAN	**Grids and interconnections behind demand:** The ASEAN Power Grid vision is progressing, yet cross-border lines and domestic networks remain patchy, limiting the ability to move renewable power from where it's generated to where it's needed.[30] **Cost of capital and project prep:** Higher financing costs, limited early-stage de-risking, and smaller manufacturing bases slowed scale benefits compared with the EU and China.	Fewer firm offtake templates and uneven grid readiness translate into slower award-to-COD and higher perceived risk.

Lessons for India: What we can do

A. Pay for reliability, not just energy

India is procuring firmness directly through Round-the-Clock (RTC) and Firm & Dispatchable Renewable Energy (FDRE) tenders, which bundle hybrids (solar+wind) with storage. This prompts developers to design for evening peaks and availability, not only cheap daytime energy. Recent RTC/FDRE prices show firm renewables are already competitive with new thermal in many cases.[31] [32] Availability-linked PPAs look more "bond-like", reduce curtailment risk, and support longer, cheaper project debt.

B. Put public money where the bottleneck is: storage

India has issued a National Energy Storage framework and VGF guidelines for 30GWh of grid-scale BESS, with per-MWh caps and milestone-based disbursal.[33] This lowers first-of-a-kind cost and crowds in private capital for two-to-six-hour batteries that firm renewables.[34]

C. Build transmission ahead of renewables (not after)

The CEA transmission plan maps out the corridors needed to integrate more than 500GW of non-fossil capacity by 2030, including pooling stations and inter-state lines to move power from RE parks to demand centres. Planning signals and central procurement reduce the curtailment that plagued other regions.

D. Keep improving market plumbing while projects build

India has introduced a Real-Time Market, strengthened ancillary services, is moving toward finer-interval settlement, and is tightening grid-access rules. These upgrades improve dispatch quality for hybrids and storage over time, so the system can absorb more renewables without excessive volatility.

If India procures firm renewables, developers can lock availability-linked, long-tenor contracts, which stabilise cash flows compared with merchant or energy-only models seen elsewhere.

Installed RE capacity has gone up from ~80GW in 2014-15 to ~190GW in 2023-24, while non-RE installed capacity is flattening, bringing the RE to non-RE ratio close to a 50:50 split by FY24. This is the platform from which India must reach the 2030 non-fossil target.

Auction volumes accelerated sharply in FY24 and FY25 and the product mix shifted from single-technology solar or wind towards hybrids (solar+wind) and hybrids with storage (S+W+BESS).

This matters because hybrids lift the capacity value of renewables by smoothing diurnal and seasonal variability and reducing curtailment risk.

A 50:50 capacity split between RE and non-RE does not automatically deliver a 50% electricity consumption or generation share, but the move towards hybrids and storage increases the usable, on-peak contribution of renewables. To hit 50GW per year of additions through the decade, auction pace, grid connections and park readiness must stay tightly coordinated.

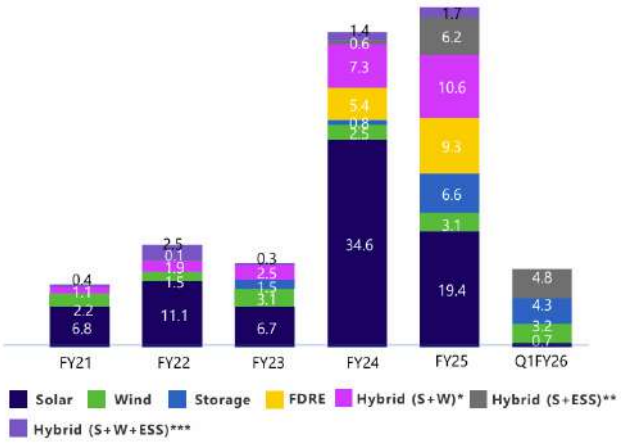
Prices are competitive, as storage enters the mainstream

Discovered tariffs for solar and wind have drifted back towards historic lows, while hybrid and hybrid-with-storage remain pricier but are on a downward trend as tender design improves and scale builds. Cheaper generation plus better product design (RTC, peak-linked, day-ahead-plus-storage) is making clean power more dependable through the day.

Figure 8: Cumulative installed capacity - RE vs Non-RE, FY2014–15 to FY2023–24

Source: Ministry of New & renewable sources, CEA and Companies

Figure 9: Renewable energy auction volumes, by product (GW), FY20-25

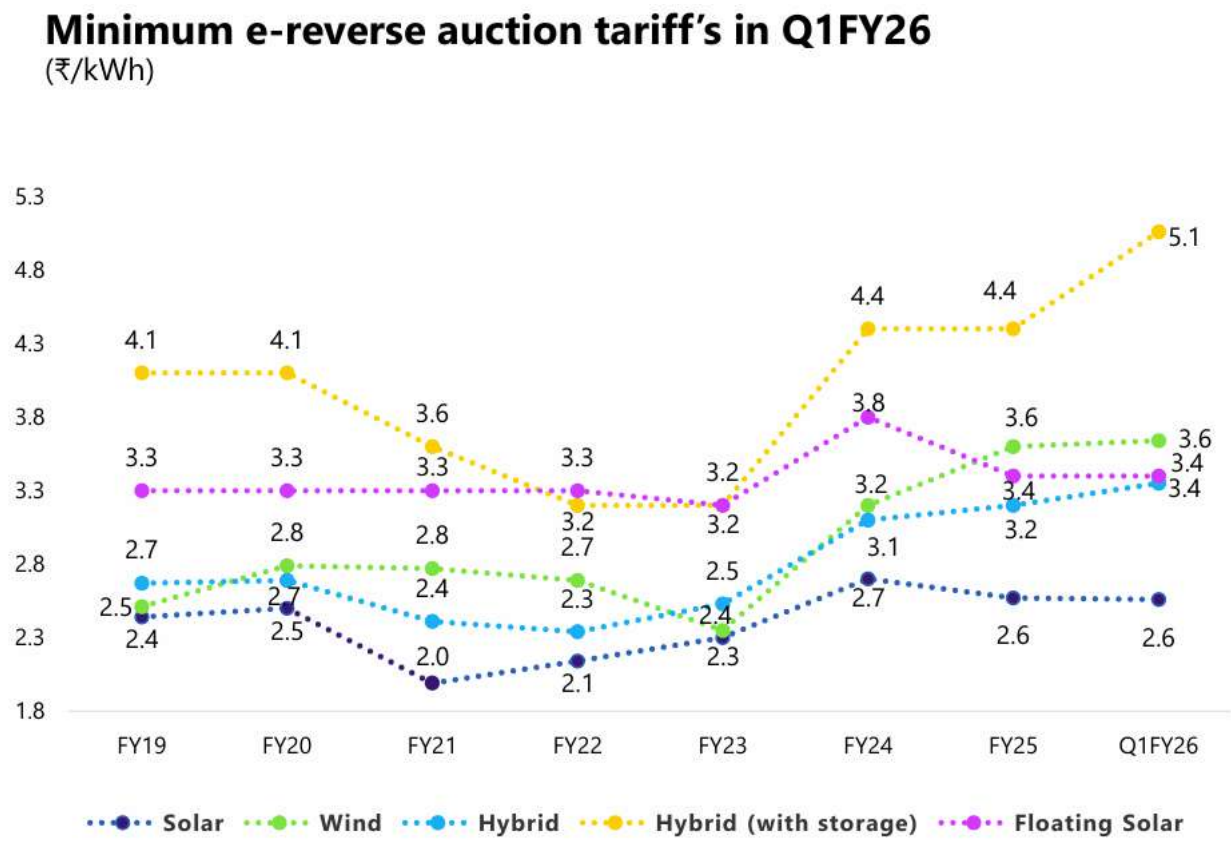


Source: JM Financials

As Figure 10 shows:

- **Low solar benchmarks sustained:** Minimum discovered solar tariffs have returned toward historic lows, settling around INR2.6/kWh mark in FY25.
- **Wind and hybrid in the low INR3 range:** Wind and hybrid sit in the INR3 to 3.4/kWh range, reflecting more balanced delivery profiles than pure solar.
- **Hybrid+storage premium narrowing:** Hybrid+storage remains pricier, but the spread narrows in FY24–FY25 as tenders scale, charge waivers apply, and developers optimise storage.
- **System implication:** Falling generation tariffs plus product innovation (RTC, peak-linked, day-ahead-plus-storage) enable decarbonisation without sacrificing affordability, while storage buys reliability at the system's most valuable hours.

Figure 10: First-quarter auction tariffs by type



Source: Equity Research, JM Financials

The enablers: transmission, flexibility, and compliance

The next phase of the transition is less about headline gigawatts and more about integration: moving power from new mega-parks to load centres, covering the evening peak, and tightening compliance so buyers actually consume renewables.

- **Transmission:** CEA's roadmap plans evacuation for ~537 GW of RE by 2030, including new 765-kV/400-kV corridors, HVDC lines, and pooling stations (e.g. Khavda).[35] This is the critical to unlocking park-scale additions through the next decade.
- **Flexibility:** Batteries and pumped-storage are scaling, with ISTS charge waivers extended for storage projects (alongside earlier waivers for RE), improving project economics for evening delivery.[36]
- **Market design:** India is shifting from RPO to RCO (Renewable Consumption Obligation). CERC has proposed a Buy-out Price backstop set at INR245/MWh (USD2.70) for FY2024–25 (about 5% above the FY25 weighted-average REC price), with an applied formula thereafter.[37] This creates a credible compliance floor for obligated entities and supports the REC market.

3. Utilities: Critical Levers on the Net-Zero Pathway

Figure 11: Overview of companies' net-zero goals

NTPC: Aligned to National Goal
- No specific goal but aligned to 2070 national target.
- "Green company" set up; capex heavily tilted to green.

Tata Power: Net Zero by 2045
Interim Goal: Aggressive 2030 goals, including 71% RE, no-coal capex, and no coal by 2045.

JSW Energy: Net Zero by 2050
Net zero goal set at group and company levels.

Adani Green: Net Zero by 2050
Net zero goal extends to most companies in group.

Adani Power: Net Zero by 2070
2050 goal extends to most group companies.

For this analysis, we selected the four companies with the highest market cap that generate green power: **NTPC** (India's most-valuable listed generator by market cap), **Adani Green**, **Tata Power**, and **JSW Energy**.

Power Grid Corporation (a transmission utility) and NHPC (hydro-centric) also feature among India's most valuable power companies but have been excluded to retain the focus on generation platforms where decarbonisation choices directly determine emissions outcomes and peak deliverability.

Rationale for company selection

Planned Capex: Across the group, the capex mix is tilting decisively towards renewables and storage, even for coal-heavy NTPC. This redeployment supports longer-tenor, availability-linked cash flows, lowers exposure to fuel price and FX volatility, and improves portfolio carbon intensity without relying on incremental coal.

Coal capacity owned: NTPC owns a material share of India's coal fleet. Improving heat rates, adding emissions controls, and operating flexibly (ramp rates, minimum load) reduces the carbon intensity of residual thermal, while new RE and storage crowd out peak coal dispatch.

Renewable pipeline: Adani Green, Tata Power, and JSW Energy are among the largest renewable developers. Pipelines are increasingly hybrid (solar+wind) and hybrid-plus-storage, aligning with India's need for ~50 GW p.a. of non-fossil additions this decade.

Storage commitments: All companies now prioritise BESS and pumped hydro, reflecting the system shift from megawatts to hour-matched megawatt-hours.

Residual Life of PPAs: Based on FY24–25 portfolio disclosures and analyst estimates, residual PPA life across the selected companies is long enough to support high leverage and multi-cycle capex plans:

NTPC: Operational projects have 20 years' average residual PPA life, of which more than 11,000MW of capacity under PPAs have longer than 25 years.
JSW Energy: Blended residual PPA life of about 15–18 years across key operating assets (thermal+hydro).
Adani Green: Most operational and under-construction renewable capacity is backed by 25-year PPAs, so company's portfolio skewed toward very long-dated contracts.
Tata Power: A mix of older thermal assets and newer renewables results in an estimated 15–18 years' residual PPA life on core capacity.

Figure 12: Utility companies' capacity, storage commitments, and capex policies

Company	Coal capacity owned (GW)	Non-fossil capacity (GW)	Storage commitments (BESS MWh/PSP)	Share of capex to green (%)
NTPC	54.7	32 (6 operating, 17 awarded / contracted. 9 in pipeline)	PSP 3–5GW by FY32	Not formally disclosed; management signals a *majority* of cumulative capex to non-fossil through 2032 (INR7 lakh crore [USD76.3 billion] total capex plan; large RE/PSP share).
Adani Green	0	16.7	PSP c.5% of 50GW (2.5GW) in FY30 resource mix	100%
Tata Power	8.8	17.5 (incl. 10.4 under construction)	PSP 2,800MW disclosed (Maharashtra 1,000MW + 1,800MW; Bhutan PSP in devt)	70% of FY25–29 capex to 'clean & green'
JSW Energy	5.66	23.2GW (7.55 operational + 10.9 under construction + 4.6 pipeline + 0.15 under acquisition) 6.7 in pipeline)	Energy storage 40GWh by 2030 (BESS+pumped hydro)	No % figure given. Management guides INR1.3 lakh crore (USD14.2 billion) capex FY26–30 for 30GW gen + 40GWh storage. States "majority to RE & storage".

4. Momentum Toward Net Zero

Executive Snapshot: Where each company stands

Financial lens	NTPC	Tata Power	JSW Energy	Adani Green
Growth visibility	Very high pipeline, slower execution	High, diversified	High, locked-in to 2030	Very high, RE-pure
Execution credibility	Moderate (scale drag)	Moderate–high	High	High
Cash-flow quality	Improving (RTC emerging)	Strong (FDRE, urban PPAs)	Improving	Strong (long PPAs)
Firming & storage readiness	Early but scaling	Advanced (PSP + BESS)	Very advanced (PSP-led)	Early-stage
Balance-sheet advantage	Strong (sovereign backing)	Strong (diversified capital)	Moderate–strong	Moderate
Transition positioning	Execution-dependent	System-integrator	Growth + storage play	RE scale leader

We identified a set of metrics for each power utility that's most significant for long-term momentum. Rather than focusing on stated net-zero ambitions alone, our assessment emphasises execution visibility, cash-flow quality, firming readiness, and balance-sheet resilience – factors that ultimately determine earnings durability and cost of capital as the power system decarbonises.

For financiers, the energy transition in power is less about distant net-zero dates and more about who can convert transition plans into contracted capacity, predictable cash flows, and returns. The metrics used in this chapter therefore answer four core questions:

1. **Is growth visible and executable?**
2. **Are revenues stable and bankable?**
3. **Can the company deliver firm power in a high-renewables grid?**
4. **Does the balance sheet support scale without diluting returns?**

Companies that score well across these dimensions are better positioned to compound value through the transition. To get an idea of where each company stands, we have ranked them across these four critical pillars.

The Four Pillars of Power Transition

Pillar 1: Growth visibility and execution

Why it matters: Contracted capacity and award-to-COD conversion determine revenue visibility and earnings growth.

- **1st NTPC** has the largest contracted renewable pipeline, but its scale introduces execution risk, particularly in land acquisition and transmission readiness.
- **2nd Tata Power** combines renewable growth with distribution and hydro, offering diversification but slower aggregate scaling.
- **3rd JSW Energy** stands out for visibility, with a clearly articulated pathway to 30GW by 2030 and a strong recent execution record.
- **4th Adani Green** continues to lead on speed of renewable deployment, supported by a pure-play focus.

Signal to watch: quarterly commissioning pace relative to awarded capacity.

Pillar 2: Cash-flow quality and contract strength

Why it matters: As energy prices compress, availability-linked revenues and long PPA tenors increasingly differentiate cash-flow quality.

- **1st Tata Power** leads on this metric, with a growing share of firm and dispatchable renewable energy (FDRE) contracts, particularly in Mumbai and industrial offtake.
- **2nd JSW Energy** is transitioning from energy-only PPAs to RTC and capacity-style contracts, improving earnings visibility.
- **3rd NTPC** is gradually shifting towards RTC structures, but remains exposed to state distribution company payment cycles.
- **4th Adani Green** benefits from long-tenor central agency PPAs, though with limited availability-linked upside so far.

Signal to watch: share of availability-linked or RTC contracts in total revenue.

Pillar 3: Firming and storage readiness

Why it matters: In a grid dominated by renewables, firm power and evening supply command increasing value.

- **1st JSW Energy** is the most advanced on long-duration storage, with large pumped-storage projects providing 40-year capacity-style revenues.
- **2nd Tata Power** combines pumped storage, hydro, and battery systems, positioning itself as a system-level integrator.
- **3rd NTPC** is scaling pumped storage and battery deployment, but remains in early execution stages.
- **4th Adani Green** is beginning to integrate storage, but remains primarily energy-only.

Signal to watch: storage capacity reaching financial closure and commercial operation.

Pillar 4: Balance sheet and financing advantage

Why it matters: Transition success depends on access to long-tenor, low-cost capital.

- **1st NTPC** benefits from sovereign backing and access to public-sector financing, but high capital work-in-progress can dilute returns if execution slips.
- **2nd Tata Power** leverages diversified funding, manufacturing integration, and strong lender confidence.
- **3rd JSW Energy** increasingly uses project-level financing and capital recycling to manage leverage.
- **4th Adani Green** relies on structured project finance and equity support to fund rapid expansion.

Signal to watch: cost of debt and capital recycling activity.

5. Company Review: Commitments, Action, Roadblocks

National Thermal Power Corporation (NTPC)

NSE Ticker: NTPC | **Market Cap:** INR336,523 Cr (USD36.7 billion)

About the company

NTPC Group is India's largest power generator with owned capacity of 84.9 GW38 (including JVs and subsidiaries) as of November 2025. The company generates 438.9 billion units (BU) of electricity annually. Within NTPC's own capacity, the split looks as follows:

- **Coal:** 55.17GW
- **Gas/Liquid fuel:** 4.02GW
- **Hydro:** 0.80GW
- **Solar:** 0.98GW (solar + small hydro)

NTPC Green Energy Ltd (NGEL) is the RE flag-bearer of the company. As of July 2025, NGEL disclosed a 32GW RE portfolio: ~6GW operational, 17GW contracted/awarded, 9GW pipeline (through NGEL and NTPC Renewable Energy Ltd).

Goals and strategy

Metric	Baseline	Interim Goal	Year
Net-Zero Target	NA	NA	2070 (aligned with India's National Goal)
Renewable Additions	7.3GW	60GW	2032
Renewable Targets	12%	46%	2032
Battery Storage/PHP/ H2 Targets	0GW	3-5GW/ 30 GWH	2032
LNG Target	6.5GW	0	NA
Coal Phase Out	Significant slowdown	N (slow down)	N
No New Coal	Slowdown & only Supercritical	N	NA

- **Scale target:** NTPC plans to be a 130GW company by 2032 of which 60GW will be renewables.
- **Energy-intensity target:** 10% reduction in net energy intensity by 2032 versus baseline.
- **Mix and markets:** The plan envisages a diversified portfolio (renewables, hydro, nuclear, storage) and a 25% market share in ancillary services & storage as those markets deepen.
- **Coal fleet decarbonisation:** Measures include flue-gas desulphurisation roll-out, flexible operation (ramp/min-load), biomass co-firing (5–10% target) — with a 20% torrefied biomass co-firing demonstration achieved at Tanda in March 2024 — and selective life-extension aligned to system adequacy.
- **Firming and long-duration storage:** NTPC Group is working on ~20GW of pumped-storage projects (PSP) across sites, aiming to commission 3–5GW by FY32. BESS is being deployed alongside hybrids and at key substations.
- **New vectors:** Options under evaluation/development include green hydrogen/derivatives, EV charging/V2G, waste-to-energy, and an exploratory SMR (small modular reactor) programme to replace ageing coal units at select sites.

Why NTPC's transition matters

- **Largest emissions lever:** NTPC operates India's largest coal fleet. Any shift it makes — from coal to renewables plus storage, or even to more flexible coal operations — has a major impact on national emissions and system costs.
- **Measurable decarbonisation:** At the current grid emission factor (~0.716 tCO_2/MWh), every 1TWh of firm renewable power added by NTPC avoids ~0.72 $MtCO_2$. This makes NTPC one of the most efficient vehicles for the reduction of financed emissions in Indian power.
- **Reliability and energy security:** Storage (pumped hydro and batteries) located near demand centres enables NTPC to firm evening supply, reduce curtailment of renewables, and lower exposure to imported coal during peak months, supporting both system reliability and FX stability.

Roadmap and strategic levers

- **Scale clean capacity:** Grow renewables to 60GW by 2032 with a clear tilt towards round-the-clock and peak-linked contracts.
- **Build firming RE capability:** Commission 3–5 GW of pumped-storage hydro by FY32 and expand battery deployments at renewable parks and key substations to monetise availability and ancillary services as these markets deepen.
- **Improve coal economics:** Complete flue-gas desulphurisation upgrades, enable faster ramping and lower minimum loads, and increase biomass co-firing to reduce emissions intensity and keep coal units viable in a renewables-heavy grid.
- **Optional growth vectors:** Pilot green hydrogen and EV charging, explore small modular reactors at end-of-life coal sites, and selectively pursue waste-to-energy where tariffs and feedstock economics are attractive.
- **Stabilise cash flows:** Shift from pure energy-sale tariffs towards availability-linked products (RTC, peak blocks, ancillary services), which typically improve collections and reduce working-capital stress.

Challenges and potential roadblocks

- **Execution delays:** NTPC has historically faced delays because of land acquisition, right-of-way clearances, contractor coordination, environmental approvals, and transmission readiness. As the company scales hybrids, pumped storage, and batteries, execution complexity rises, increasing the risk of slower award-to-COD conversion and higher interest during construction.
- **Biomass co-firing constraints:** Despite Ministry of Power guidelines targeting 10% biomass co-firing, NTPC remains materially below this level

because of supply-chain constraints in biomass aggregation, logistics, and pricing, limiting near-term decarbonisation of the coal fleet.

- **Discom counterparty exposure:** NTPC sells power across multiple state distribution companies, some of which remain financially stressed. While collections have been stable in recent years, growing contracted volumes increase potential working-capital and payment-cycle risks over time.
- **New coal economics and utilisation risk:** Capital costs for new ultra-supercritical coal projects are increasingly breaching INR100 million/MW (USD1.1 million), implying tariffs in the INR7–8/kWh range. At these levels, future coal capacity faces the risk of lower utilisation in a system where firm renewables with storage are becoming cost-competitive.
- **Return on equity pressure:** High project execution activity has resulted in capital work-in-progress at ~54% of net worth (FY24). Any further slippage in pumped storage hydropower or hybrid+BESS projects would extend gestation periods and weigh on returns on equity.

With both fixed costs (capital expenditure, emissions controls, and financing) and variable costs (coal quality, logistics, and compliance) rising, new coal is becoming structurally less competitive. Tariffs implied by current capital costs, often in the INR7–8/kWh range for new projects, are increasingly difficult to justify as solar and storage-backed renewable prices continue to decline.

For NTPC, this means coal is likely to play a diminishing role as a source of growth and instead serve primarily as a reliability and flexibility backstop, making the scale and execution of renewables and storage critical to sustaining returns and long-term competitiveness.

Tata Power Company Limited

NSE Ticker: TATAPOWER | **Market Cap:** INR112,875 Cr (USD12.3 billion)

About the company

Tata Power is India's largest private integrated utility, with operations spanning generation, transmission, distribution, trading, solar manufacturing and EPC, rooftop/distributed solar, EV charging, and energy services. The group has pivoted its growth engine decisively towards clean energy while running down thermal exposure over time.

- **Net-zero commitment:** carbon net zero before 2045; water neutral and zero waste-to-landfill by 2030.
- **Capacity mix today and where it's headed:** 44% "clean & green" today, rising to ≥70% by 2030 and 100% by 2045 as thermal PPAs expire and assets retire/sell down.
- **Manufacturing integration:** A 4.3GW cell-and-module plant ramped through FY25, deepening supply-chain control for utility-scale EPC and rooftop businesses.
- **Grid-side growth:** Clean capacity under implementation/pipeline lifts "clean & green" share to around 65% post-completion; capex mix is now dominated by renewables, pumped storage, and hydro.
- **Distribution footprint:** Close to 12.8 million consumers across DISCOMs (Odisha, Delhi, and Mumbai), giving direct access to retail load and premium urban demand pockets.

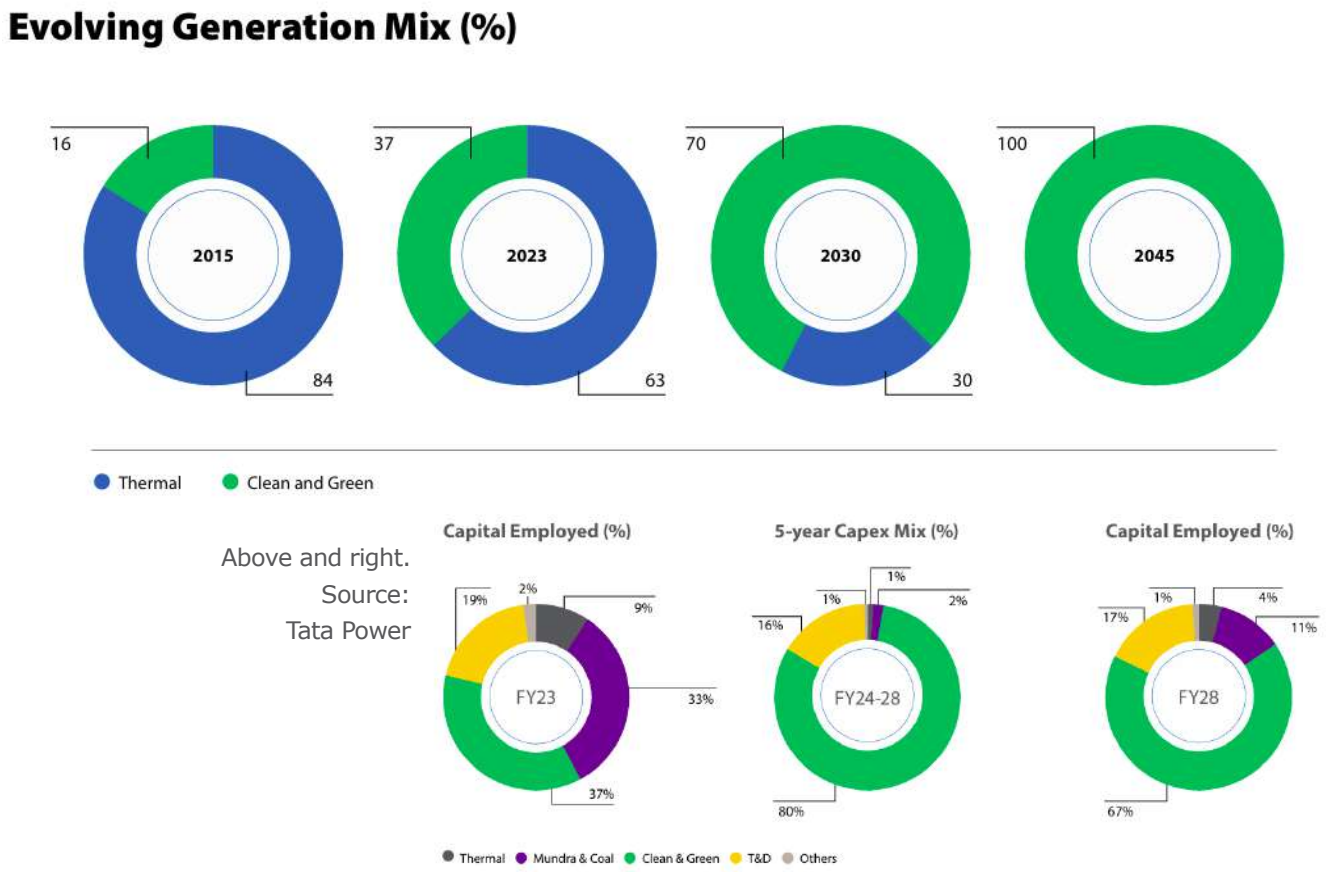
Goals & Strategy

Metric	Baseline	Interim target	Year
Net-zero target (Scope 1&2)	–	Net zero by 2045	2045
Clean & green share	44%	≥70% of capacity	2030
Utility-scale RE	–	Rapid scale-up via hybrids/FDRE and RTC products	2025–30
Pumped storage & hydro	–	5+GW under development/partnerships (incl. Bhivpuri PSP; Bhutan hydro)	2029+
Thermal growth	Legacy fleet	No greenfield coal; run-down to nil by 2045 (subject to PPA obligations/useful life)	2045

Why Tata Power's transition matters

- **Scale and signalling:** As India's most visible private-sector utility, Tata Power's 2045 net-zero and ≥70% clean by 2030 pathway provides sector leadership. Every 1GW of firmed RE/FDRE added at Tata Power replaces expensive peak coal or gas and de-risks DISCOM portfolios.[39]
- **Cash-flow quality:** The company is increasingly contracting availability-based FDRE PPAs rather than energy-only sales. Recent Mumbai hybrid+BESS PPAs deliver four-hour peak blocks at ≥90% availability, improving receivables discipline and reducing merchant exposure.[40]
- **Capex productivity:** The group's capex is skewing to renewables, PSP, and hydro (capex-heavy initially but backed by long-tenor cash flows). The 4.3GW cell/module plant strengthens EPC margins and delivery certainty.

Figure 13: Tata Power's clean generation and capital deployment – history and targets



Above and right. Source: Tata Power

- **Policy tailwinds:** National targets (500GW non-fossil by 2030), FDRE tenders and PSP approvals at record pace (7.5GW in FY25) raise the value of firm renewables and storage portfolios.[41]

Roadmap and strategic levers

- **Scale firm renewable products:** Prioritise RTC/FDRE hybrids (solar+wind+battery) with high-quality offtakers, leveraging Tata Power's distribution footprint in Mumbai, Delhi, and Odisha.
- **Build long-duration storage:** Advance pumped-storage projects (e.g., Bhivpuri PSP) and Bhutan hydro partnerships as the backbone for evening and monsoon-season firmness, complemented by BESS at grid nodes.
- **Manufacturing-led cost advantage:** Use the 4.3GW cell/module lines to secure modules for in-house EPC and third-party sales, cushioning margins through price cycles.
- **Managed thermal exit:** Maintain a no-new-greenfield coal stance, operate existing thermal assets at benchmark efficiency, and progressively retire or monetise capacity as PPAs roll off toward 2045.

Challenges and potential roadblocks

- **Thermal optics vs policy reality:** Short-term grid stress and directives to maximise coal output can temporarily elevate thermal utilisation, complicating the transition narrative; need to distinguish dispatch from new capital commitment.
- **Execution risk:** Hybrid, BESS, and PSP projects require tight land and transmission sequencing. PSP gestation (~4 years post-DPR) and state-level permitting remain critical to timely COD.
- **Contract bankability:** FDRE and RTC contracts reduce curtailment risk, but cash-flow certainty still depends on

metering standards and state-level market reform implementation.

- **Supply-chain sensitivity:** Battery pricing, availability, and domestic-content rules can affect project economics; manufacturing scale mitigates but does not eliminate this risk.
- **Hydrology and physical risk:** Hydro and PSP assets remain exposed to monsoon variability and site-specific geotechnical risks, requiring strong contingency and insurance frameworks.

JSW Energy Limited

NSE Ticker: JSWENERGY | **Market Cap:** INR79,017 Cr (USD8.62 billion)

About the company

JSW Energy is a diversified private utility with a fast-growing clean portfolio across wind, solar, hydro, and storage. The company and the wider JSW Group target carbon-neutrality by 2050 and have committed to science-based targets.

- **Platform today:** FY26 updates point to 13.2GW installed, with around 60% renewables (wind, solar, hydro) following sequential commissioning through 2025–26.
- **Locked-in growth:** JSW reports 30–30.5GW "locked-in" generation capacity (installed+under construction+pipeline), and 40GWh storage locked-in/targeted to 2030.
- **O2 Power acquisition:** A 4.7GW RE platform acquired in FY25 added 1.34GW operating, 1.46GW under construction, and around 1GW pipeline (to be complete by FY27), materially lifting the contracted runway.
- **Integrated storage strategy:** Long-duration pumped-storage (e.g., Bhavali, Maharashtra) with 40-year capacity contracts, complemented by BESS tied to FDRE/RTC offtake.

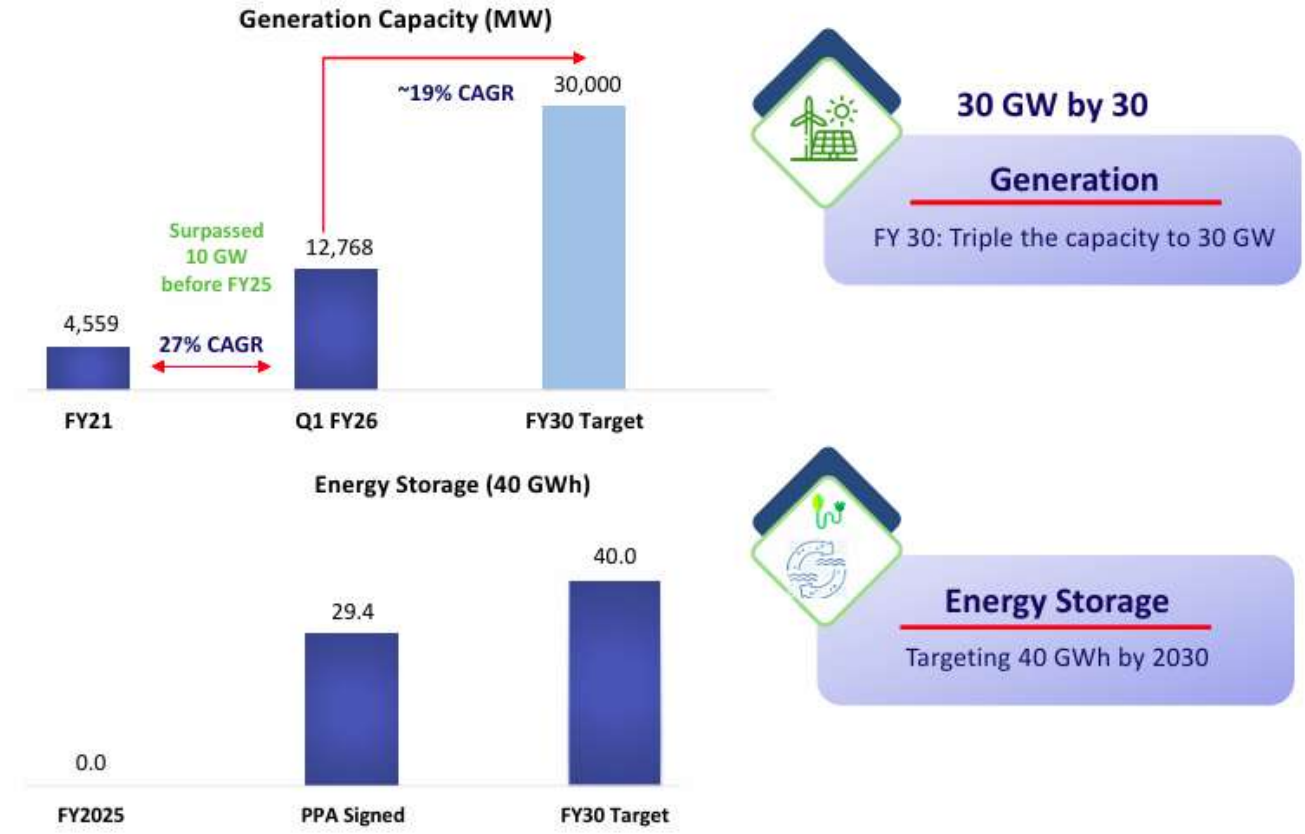
Goals and Strategy

Metric	Baseline	Interim target	Year
Net-zero (Scope 1&2)	–	Carbon-neutral by 2050	2050
Generation capacity	~13.2 GW	30GW "by 2030" (Strategy 3.0)	2030
Energy storage	–	40GWh by 2030 (BESS+ PSP)	2030
Near-term step-up	Surpassed 10GW pre-FY25	20GW "before 2030" on an earlier waypoint	2028–30
Coal additions	Legacy fleet; one brownfield (Ind-Bharat/Barmer chain)	No greenfield coal; minimal thermal in pipeline versus RE/storage	–

Why JSW's transition matters

- **Visible Growth to 2030:** With 30GW either operational, under construction or contracted (including O2 Power), JSW Energy offers unusual volume visibility in a market constrained by land and transmission, reducing growth risk relative to peers.
- **Storage-led earnings quality:** Long-tenor pumped-storage contracts (up to 40 years) provide fixed capacity revenues, anchoring cash flows and enabling profitable FDRE/RTC offerings, a key differentiator versus pure-play solar/wind developers.
- **Clear Capex to EBITDA linkage:** Management guides INR1.3 lakh crore (USD14.2 billion) capex from FY26–FY30 to reach 30GW/40GWh, with FY30 EBITDA targeted at 2.7–3.0? FY25. Value creation hinges primarily on disciplined execution rather than price assumptions.
- **Portfolio balance:** The addition of

Figure 14: JSW's strategy to 30GW generation



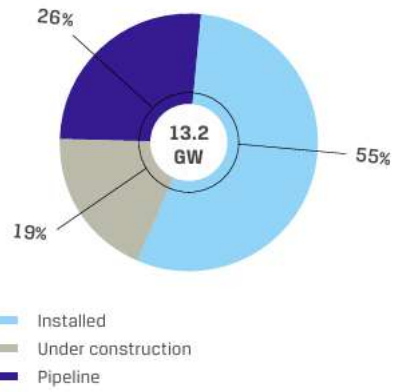
Source: JSW Energy

hydro and PSP smooths wind/solar volatility and lowers curtailment. The O2 Power portfolio (average tariff INR3.37/kWh, 23-year residual life) improves blended contract duration and revenue stability.

Roadmap and strategic levers

- **Prioritise contracted, firm capacity:** Focus new additions on FDRE/RTC and peak-block PPAs with availability payments, supporting predictable EBITDA rather than merchant exposure.
- **Deliver long-duration storage:** Fast-track Bhavali PSP and other pumped-storage assets as the backbone of firm supply, complemented by targeted BESS near load centres.
- **Integrate and monetise O2 Power:** Bring under-construction assets to COD on schedule and recycle capital through project-level debt or potential yield structures to fund the next growth leg.
- **Limit coal to flexibility:** Maintain limited new greenfield coal; operate residual thermal assets primarily for system adequacy and flexibility.

Figure 14: JSW Energy project status, on track to reach 20GW by 2030



Source: JSW Energy

Challenges and potential roadblocks

- **Execution risk:** Delays in hybrids, BESS or PSP projects push commissioning, raise interest during construction and directly impact IRRs.
- **PSP delivery risk:** Permitting, geology and monsoon constraints can extend timelines; returns depend on adequate contractual and cost contingencies.

- **Battery cost sensitivity:** Re-tightening BESS prices or domestic-content constraints could pressure FDRE economics if not fully buffered in bids.
- **Counterparty quality:** State DISCOM creditworthiness and metering standards remain critical for cash-flow certainty, even under availability-based contracts.
- **Coal perception risk:** Legacy thermal capacity remains part of the base; investor confidence rests on continued capital allocation discipline towards renewables and storage.

Adani Green Energy Limited

NSE Ticker: ADANIGREEN | **Market Cap:** INR133,257 Cr (USD14.5 billion)

About the company

Adani Green Energy Ltd (AGEL) is the Adani Group's dedicated renewables platform. It develops, owns, and operates utility-scale solar, wind, and hybrid projects and sells electricity largely under long-dated PPA.

- **Scale and trajectory:** Management targets 50GW of renewable capacity by FY2030, positioning AGEL amongst the largest global pure-play renewables IPPs. Recent disclosures indicate operational capacity above 16GW, with rapid additions keeping the 50GW pathway in view.
- **Group context and capital:** The wider Adani portfolio has announced more than USD100 billion of green investment by 2030 across renewables, manufacturing (modules, wind turbines, electrolyser), and enabling infrastructure, an important signal of sponsor support for AGEL's buildout.
- **Strategic mix:** The company's medium-term plan keeps solar as the anchor (around 70% share), with wind and solar-wind hybrids providing incrementally firm output. A nascent pumped-storage hydropower pipeline provides long-duration storage optionality within the Group.

Goals & Strategy

Metric	Baseline	Interim Goal	Year
Net-zero target (Group-level commitment)	2025 baseline year	Net-zero 2050 (Group)	2050
Renewable capacity	14–16GW operational FY25-FY26	50GW operational	2030
Resource mix	Solar-led (~70%); wind & hybrid balance	Maintain solar anchor; scale hybrids and PSP for firmness	2030
Contract mix	Predominantly 25-year fixed-tariff PPAs	75% firm PPAs, 25% open/merchant/C&I/CFD	Ongoing
Storage	Early-stage	PSP pipeline within Group + battery where economical	2026–2030

Why Adani Green's transition matters

- **System-scale contribution to India's 2030 pathway:** India's 2030 non-fossil capacity target implies ~50GW p.a. additions for the remainder of the decade. AGEL's 50GW by FY30, if delivered, accounts for a material slice of incremental utility-scale renewables, easing pressure on state procurement pipelines and de-risking national targets.
- **Contracted, cash-flowing growth:** The model is anchored in long-dated PPAs, reducing revenue volatility, and supporting asset-level project finance; the company signals a steady-state ~75% firm and ~25% open/merchant/C&I book as markets for corporate and mid-duration hedged offtake deepen.

- **Manufacturing and supply-chain hedges:** Adani Group's investments in modules, turbines and electrolysers lower execution risk and can improve delivered LCOE in a tightening domestic-content regime, supportive for equity IRRs.
- **Energy-security co-benefits:** Every incremental TWh of AGEL generation displaces thermal dispatch at the margin, reducing exposure to imported coal in peak months and improving the country's FX position, particularly as hybrid/PSP assets lift evening supply reliability.

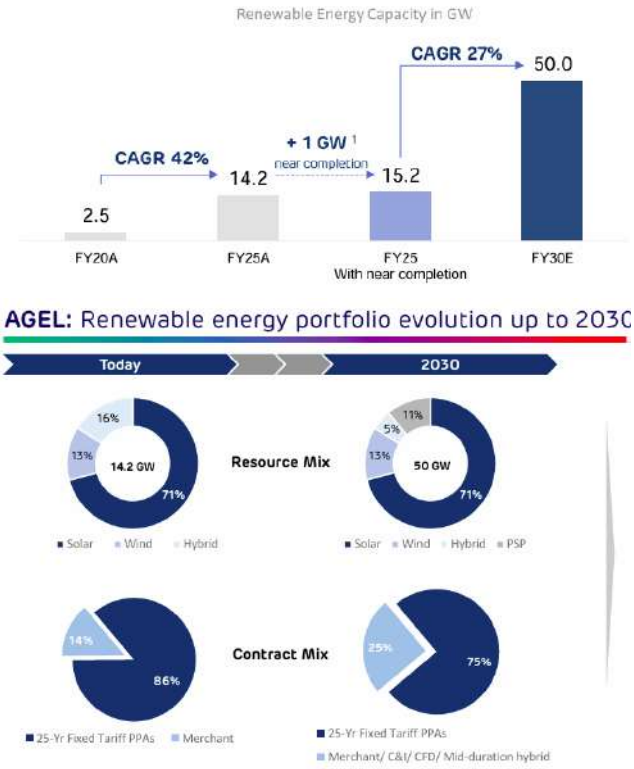
Roadmap and strategic levers

1. **Deliver the locked-in pipeline:** Focus on swift award-to-COD conversion across solar, wind, and hybrid projects with grid-readiness and RE park logistics planned upfront (land, pooling substations, evacuation).
2. **Tilt to firm products:** Scale hybrids and build PSP within the Group to offer round-the-clock (RTC) and peak-block products; selectively add batteries where merchant/ancillary and capacity-style revenues support returns.
3. **Maintain PPA quality while opening a corporate sleeve:** Keep the ~75% PPA base with strong central counterparties and high-grade state utilities; grow C&I/CFD channels for price optionality without losing portfolio stability.
4. **Integrated manufacturing:** Leverage group factories (modules, wind, electrolyser) to control cost and timelines; deploy standardised EPC blocks to compress gestation periods.

Challenges and potential roadblocks

- **Execution congestion:** Simultaneous build of multi-GW parks can face right-of-way, pooling substation and ISTS bottlenecks. Hybrid + storage projects require tight synchronisation across OEMs, EPCs and grid operators.
- **Counterparty & receivables:** While much capacity is tied to central agencies and stronger utilities, exposure to weaker state offtakers and any widening of payment cycles remains a working-capital risk.
- **Merchant exposure:** 25% non-PPA capacity introduces price volatility; hedging and mid-tenor contracts are critical during weather and fuel shocks.
- **Transmission readiness:** Transmission buildouts and green-hydrogen anchor loads are enabling assumptions for capacity expansion plans, which require timely General Network Access and hydrogen demand. Delays increase curtailment risk.
- **Scrutiny and governance:** Despite capital-market normalisation and continued TotalEnergies partnership activity, the Group remains under elevated investor diligence. Robust project-level disclosures and ring-fenced cash flows remain important.

Figure 15: Adani growth timeline and resource mix



Source: Adani Green

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