INDIA POWER SECTOR REVIEW 2025: RECORD CLEAN ENERGY DEPLOYMENT DRIVES HISTORIC DECLINE IN COAL GENERATION

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CREA

CREA is an independent research organisation focused on revealing the trends, causes, and health impacts, as well as the solutions, to air pollution.

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Solar panels in Jaisalmer, India, by **Oleh Slobodeniuk, iStock**

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Key findings

- India's coal-fired power generation fell in 2025 by 3%, only the second drop for a full calendar year in at least half a century, with the first one being associated with the Covid-19 pandemic.
- The drop in coal and gas-fired power generation was caused by record growth in clean power generation, which contributed to 44% of the drop, less demand for air conditioning due to milder weather (36%), and a longer-term slowdown in power demand growth for other reasons (20%), compared to the trend in 2019-24.
- Meeting India's 500 GW non-fossil capacity target means that there is no headroom for coal-based power generation to grow between now and 2030, even if power demand growth picks up in the coming years.
- Clean electricity sources are also increasingly covering demand peaks, making coal power capacity additions redundant.
- If under-construction coal power projects (36 GW) are completed, capacity utilisation could fall to unprecedented lows, causing financial distress for generators and excessive cost burden on power users.

Introduction

India's power sector is experiencing rapid change as renewable energy deployment accelerates year after year. India added 41 GW of renewable energy in the first eleven months of 2025, already making a record for capacity additions during a full year, and raising the share of renewables to 40% of the country's installed capacity (CEA, 2025a, 2025b). At the same time, rising electricity demand is increasingly being met by renewable generation, particularly during daytime hours when solar power is available. This further eases the replacement of coal power with renewables.

Despite the rapid acceleration of renewable energy, the government intends to add 100 GW of new coal-based capacity over the next seven years (Baruah, 2025). However, India's existing and under-construction coal fleet is already exceeding the coal capacity requirement projected by multiple resource adequacy assessments for 2030.

The challenge is not capacity adequacy but system flexibility. Most coal plants in India operate at minimum technical loads of around 55%, which forces them to run even during periods when low-cost renewable electricity is available (CEA, 2019). Long-term coal power purchase agreements continue to bind utilities to higher-cost thermal generation even when lower-cost renewable electricity is available.

This operational rigidity results in avoidable curtailment of solar and wind generation. Enabling higher renewable penetration will therefore require structural reforms that reduce flexibility constraints in the coal fleet, accelerate deployment of battery energy storage, and grid upgradation.

This annual power brief evaluates these shifting dynamics through reviewing India's generation capacity, ongoing thermal capacity construction, electricity demand trends, source-wise generation patterns, and plant utilisation levels. It also examines the structural reforms required to effectively integrate high renewable penetration, including coal flexibilisation, storage expansion, and grid strengthening, as well as outlines what must be done to prioritise renewable energy over new coal additions.

Installed capacity

As of November 2025, the total installed power capacity in India stands at 510 GW.[2] Thermal power in India comprises coal, gas, lignite, and diesel. Within this category, coal remains the single dominant source in the overall capacity mix, with around 220 GW, accounting for 43% of India's total installed capacity. Renewable energy sources (solar, wind, small hydro and bio power) collectively contribute 204 GW, accounting for 40% of the total capacity. Large hydropower adds another significant share of 50 GW, or 10%. Other sources, such as gas, nuclear, lignite, and diesel, contribute smaller portions, with gas at 20 GW (4%), nuclear at 9 GW (2%), lignite at 7 GW (1%), and diesel at <1 GW (<1%).

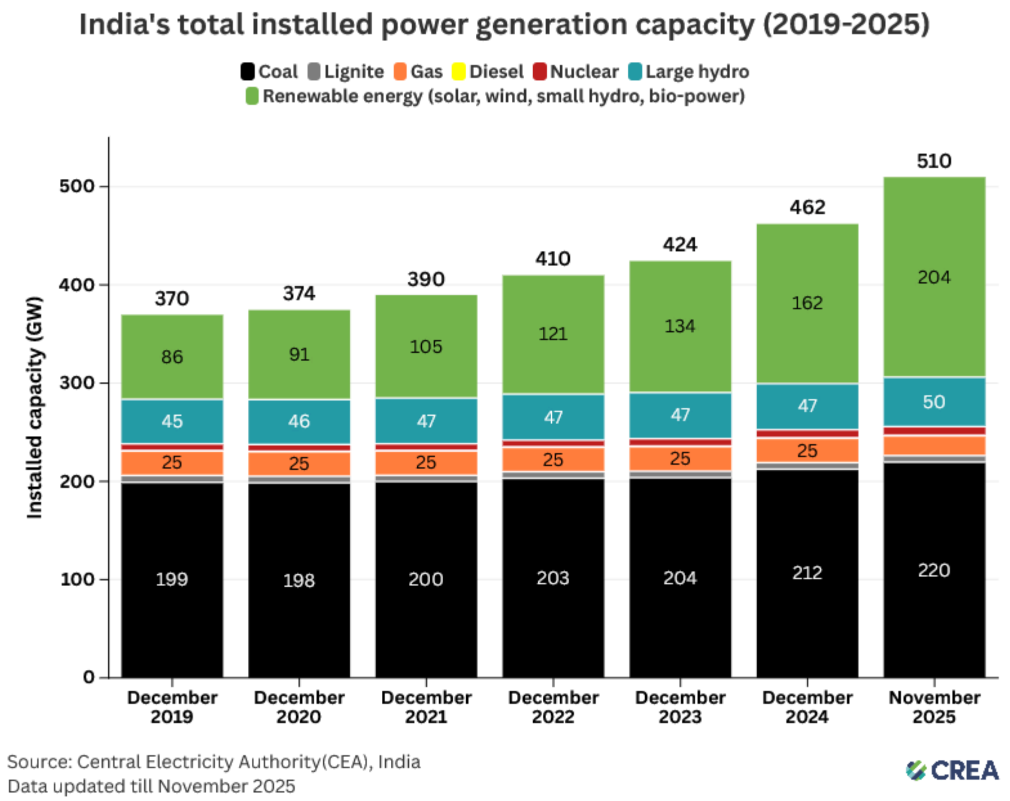

Figure 1 — India's total installed power capacity (2019-2025)

Within the renewable energy sector, solar power is the dominant source with a capacity of 133 GW, accounting for 65% of the total renewable capacity. This figure comprises 101 GW from ground-mounted installations, 23 GW from rooftop solar, 3 GW from solar components of hybrid projects, and 6 GW from off-grid systems (MNRE, 2025). Wind power has surpassed the 50 GW milestone, reaching 54 GW and making up 26% of the total renewable energy capacity. Biomass and other sources contribute 12 GW (6%), while small hydropower adds 5 GW (3%).

India's total installed power capacity is distributed across three main sectors: state, private, and central. The private sector leads with 279 GW, followed by the central sector at 119 GW and the state sector at 112 GW (CEA, 2025b).

In the central sector, coal leads with 73 GW (61%), followed by large hydro at 17 GW (14%), renewables at 9 GW (8%), and nuclear at 9 GW (8%). The remaining 7 GW (6%) is contributed by gas, and 4 GW (3%) by lignite.

In the state sector, coal dominates with 73 GW, accounting for 65% of its capacity. Large hydro power is the next significant contributor at 28 GW (25%), while gas contributes 7 GW (6%). Renewables make up 3 GW (3%), with lignite and diesel contributing minor shares.

The private sector's capacity mix is notably different, with renewables as the largest contributor at 192 GW, constituting 69% of the total. Coal follows at 73 GW (26%), while gas 6 GW (2%), large hydro 6 GW (2%), lignite, and diesel play smaller roles.

Capacity addition and retirement

During the first 11 months of calendar year (CY) 2025, India added a total of 54 GW of new power generation capacity (CEA, 2025a). The largest share of this addition came from the renewable energy category, which contributed 41 GW, accounting for 76% of the total new capacity. Coal followed with an addition of 9 GW (17%), while large hydro sources added 3 GW (5%). Nuclear sources added about 1 GW (2%). This 41 GW addition in renewables during CY 2025 represents a significant surge, marking the highest annual increase to date, even before considering capacity additions in December. It reflects a sharp acceleration compared to previous years, which saw additions of 28.6 GW in CY 2024, 13 GW in CY 2023, and 16 GW in CY 2022 (PIB, 2025).

In CY 2025, coal-based capacity additions rose sharply, reaching 9 GW[1], compared with 4 GW in CY 2024, 6 GW in CY 2023, and less than 1 GW in CY 2022 (Lee, 2023; Enerdata, 2024; Anand, 2024; CEA, 2025a). On the retirement side, in 2025, about 0.6 GW of gas capacity and 0.8 GW of coal capacity, for a total of 1.5 GW thermal capacity, were retired[1]. Additionally, coal-based capacity of 2 GW, gas-based capacity of 4 GW and nuclear capacity of 0.1 GW were temporarily removed from the installed capacity database due to an “outage for a very long time” (CEA, 2025b).

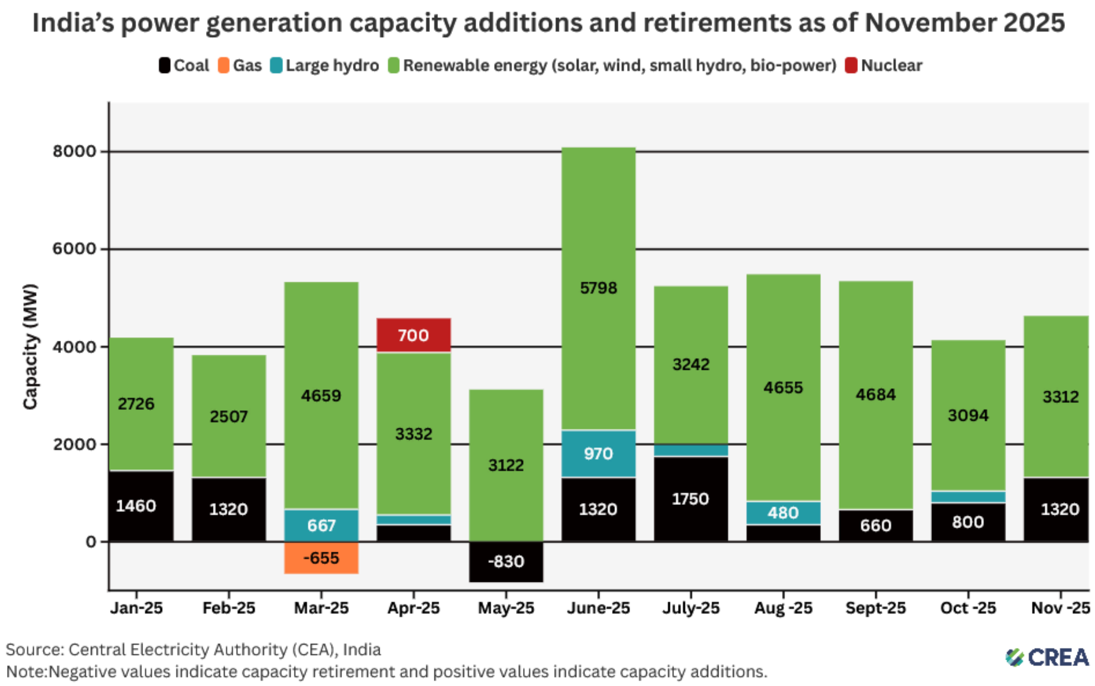

Figure 2 — India’s power generation capacity additions and retirements as of November 2025

Under construction and work on hold

India has 36 GW of thermal capacity under construction, distributed across 18 GW in the central sector, 12 GW in the state sector, and 6 GW in the private sector. Looking ahead, India plans to add substantial thermal power capacity over the next several years. Thermal capacity additions are projected to rise significantly in the medium term. After 7 GW in fiscal year (FY) 2025-26, additions are expected to moderate to 3 GW in FY 2026-27 and 5 GW in FY 2027-28, before picking up to 6 GW in FY 2028-29. A major jump is anticipated in FY 2029-30 with 14 GW, followed by a steep drop to 1 GW in FY 2030-31 (CEA, 2025c).

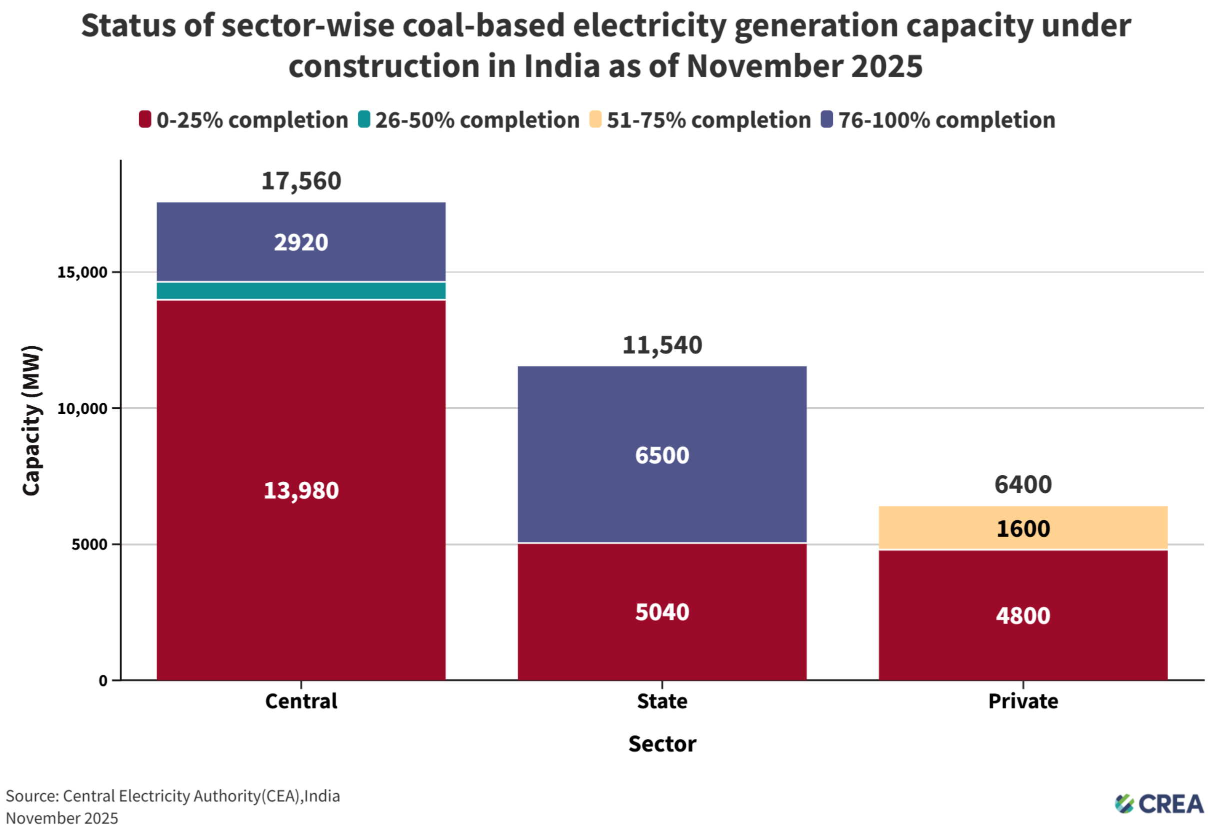

Figure 3 —Status of sector-wise coal-based electricity generation capacity under construction in India as of November 2025

In the current CY 2026, a total of 5 GW of power generation capacity is anticipated to be ready for trial runs across several states in India. Tamil Nadu accounts for the highest share, with 2.6 GW from three projects, followed by Telangana at 1.6 GW from two projects, and Madhya Pradesh with 0.8 GW (CEA, 2025c).

In addition, a large number of under-construction coal-fired power plants where work is on hold or not likely to be commissioned (stressed capacity) account for a total of 22 GW (1 GW in the central sector and 21 GW in the private sector).

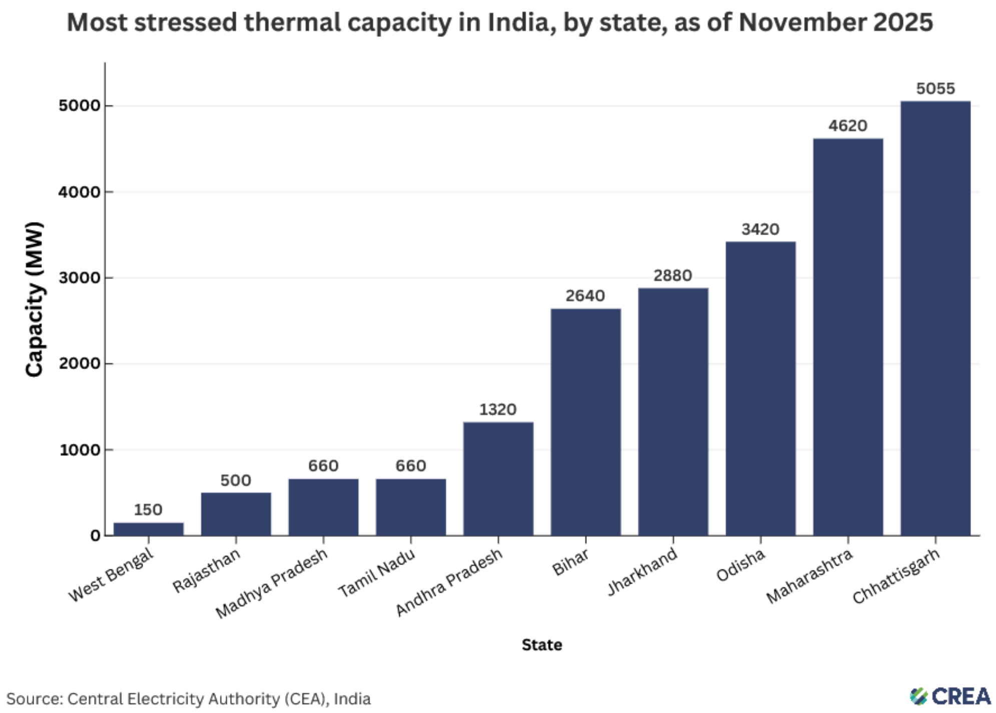

Figure 4 — Most stressed thermal capacity in India, by state, as of November 2025

Electricity demand

The highest peak demand met during the year 2025 was 242 GW on 12 June, marking a 3% decline compared to that of the previous year (Grid Controller of India, 2025). Nevertheless, it represents the second-highest demand recorded over the past eight years, following the peak demand in 2024 of 250 GW.

Table 1 — Categorisation of days based on demand met

Demand met (GW)	CY 2023 (Number of days)	CY 2024 (Number of days)	CY 2025 (Number of days)
<200	145	39	41
200-210	139	111	51
210-220	50	144	116
220-230	22	44	103
230-240	9	22	47
240-250	0	5	7
>250	0	1	0

On the peak demand day, the contribution of large hydro in electricity generation increased from 9% in CY 2024 to 11% in CY 2025. Meanwhile, the shares of coal and lignite decreased slightly from 70% to 69%, and renewables (wind, solar, small hydro, and biomass) showed a slight increase from 15.1% to 15.4%. Contribution from gas capacity also showed a decrease from 4% to 3%, while nuclear remained constant with its 2% contribution.

In CY 2025, daily electricity demand shifted to higher bands as shown in Table 1. The number of days with demand below 200 GW fell to 41 in CY 2025, down from 145 in CY 2023. At the same time, days in the 210–230 GW range increased substantially, with 219 days in CY 2025 compared to 72 days in CY 2023 and 188 days in CY 2024. Despite this shift, extreme peaks remained limited: demand crossed 240 GW in only seven days, and there were no days above 250 GW. However, even with this shift, the demand remains within the operational bandwidth of the current generation fleet. Furthermore, the non-solar demands are well within the range of what the existing and under-construction thermal capacity can handle, especially when combined with hydro and other dispatchable sources.

On 12 June 2025, the day of maximum demand at 242 GW, the peak occurred during solar hours, and only 215 GW of thermal capacity was online for generation. The rest was offline due to planned maintenance (5 GW) and forced outages (22 GW). This highlights the system's ability to meet even peak loads without utilising the full thermal fleet (Manojkumar, 2025).

Indeed, solar power alone is capable of contributing up to 60 GW and above during solar hours, reducing pressure on thermal resources during daytime peaks. India also has 234 GW of renewable energy in the pipeline and is targeting 500 GW of non-fossil capacity by 2030 (Lok Sabha question, 2024; Anand 2025; Ministry of Power, 2025). To meet the 500 GW goal, the government has declared a plan to add 50 GW of renewable energy capacity annually till 2027-28, further strengthening the case for meeting future demand without major new coal additions (PIB, 2023).

Temperature-adjusted demand trends

Our analysis of temperature-driven electricity demand, primarily from air-conditioning, showed a decline of 9.8% in 2025 compared with the previous year. This reduced overall power demand growth by 2 percentage points. If temperatures had remained comparable to last year, total electricity demand would have grown by an estimated 3.3% instead of

1.3%. Hence, while weather effects contributed to the slowdown, they were not the dominant driver.

Importantly, once the data is adjusted for temperature, it becomes clear that the deceleration in electricity demand began in late 2023. The heatwaves of 2024 temporarily elevated cooling loads and made demand appear stronger than it was, masking the emerging slowdown. When temperatures normalised, the underlying trend became evident. Thus, the slowdown in India's electricity demand started earlier for long-lasting reasons, and the 2024 heat spikes briefly masked it.

To understand the relative importance of the different causes of the sharp fall in thermal power generation in 2025, we compare the year-on-year changes to the trend in the preceding years, from 2019 to 2024. Total power generation from coal and gas increased at an average rate of 63 Terawatt-hours per year (TWh/year) from 2019 to 2024, and fell by 50 TWh/year from 2024 to 2025, a shift of 113 TWh/year relative to the earlier trend.

Non-fossil power generation increased at an average rate of 22 TWh/year from 2019 to 2024, speeding up to 71 TWh/year from 2024 to 2025. This acceleration in clean energy explains 44% of the reversal of growth in power generation from fossil fuels.

From 2019 to 2024, total annual power generation grew at an average rate of 85 TWh/year, of which an estimated 6 TWh was attributable to rising temperatures, giving a temperature-adjusted trend of 79 TWh/year. In 2025, total power generation grew 22 TWh, with milder temperatures leading to 34 TWh less generation than we would have expected with constant temperatures year-on-year, and a temperature-adjusted growth trend of 56 TWh/year. Hence, the effect of temperatures was to reduce total generation growth by 41 TWh/year between the two periods, explaining 36% of the reversal in power generation from fossil fuels. In addition, there was a slowdown of 23 TWh/year in total power generation growth due to reasons not related to weather, explaining the remaining 20% of the reversal.

We analysed electricity demand for air conditioning by building a regression model to link daily power generation with temperatures, using population-weighted cooling degree days as the independent variable. We allowed air conditioning prevalence to vary by state and linearly over time, to account for changes in AC usage. Daily power generation data was retrieved from the Central Energy Authority, and gridded temperature data from the U.S. National Centers for Environmental Prediction Climate Forecasting System v2 (India climate and energy dashboard, 2025; Climate Forecast System, 2025). The analysis was done using weather data until December 26, the last date of data at the time of writing.

Electricity generation

Electricity generation for the year 2025 stands at 1844 Billion Units (BU)[11], which is about 1% higher than the previous year's generation of 1825 BU. Over the years, electricity generation slowed from 11% in CY 2023 to 6% in CY 2024 and 1% in CY 2025.

In 2025, thermal and nuclear showed a decline in generation by 4% (1392 BU to 1340 BU) and 2% (55 BU to 54 BU), respectively, while large hydro and renewable energy grew by 15% (157 BU to 180 BU) and 22% (221 BU to 270 BU), respectively.

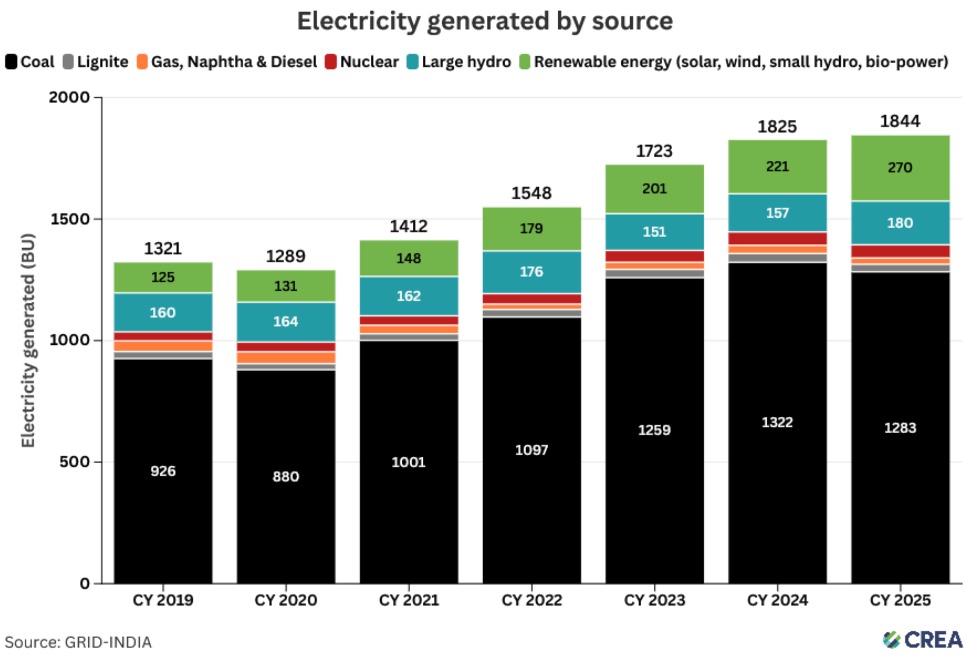

Figure 5 — Electricity generated by the source

Within the thermal segment, coal power generation fell by 3% year-on-year (1322 BU to 1283 BU), marking the sharpest decline among major power sources. This is a significant reversal from the positive growth observed in previous years: 5% in CY 2024, 15% in CY 2023, 10% in CY 2022, and 14% in CY 2021, indicating a clear slowdown in coal-based generation. Nuclear generation also experienced a notable downturn, falling by 2% in CY

2025 after growing by 12% in CY 2024. In contrast, large hydro and renewable energy maintained positive growth of 15% and 22%, respectively.

This is only the second time in over 50 years that coal-fired power generation has fallen for a full year, based on a time series of coal-fired power generation starting from 1971 in the International Energy Agency, World Energy Balances (IEA, 2025). This dataset uses fiscal years ending in March for India; calendar year data was available starting from 2000 from Ember's yearly electricity data (Ember, 2025).

Though the year-on-year percentage shows a decrease in the dependence of coal-generated power, the sector still supplies about 70% of the total generated electricity, indicating its dominance over clean energy.

Plant load factor

Plant Load factor (PLF) across India's power generation sectors in CY 2025 showed varied performance compared to CY 2024. The thermal sector's PLF increased from 68% in CY 2023 to 70% in CY 2024, before falling to 66% in CY 2025 (National power portal, 2025)

In contrast, the Capacity Utilisation Factor (CUF), for wind increased from 20% in CY 2024 to 25% in CY 2025, and for solar it decreased from 21% to 20% during the same period.

Large hydro PLF increased marginally from 34% in CY 2023 to 35% in CY 2024, before rising to 40% in CY 2025. This fluctuation in performance is likely due to variations in seasonal water availability and reservoir levels, which impact hydro generation.

Small hydro PLF has shown a consistent upward trend, rising from 27% in CY 2023 to 30% in CY 2024, and 33% in CY 2025. Nuclear PLF remained stable at 77% in both CY 2023 and CY 2024, before declining to 72% in CY 2025.

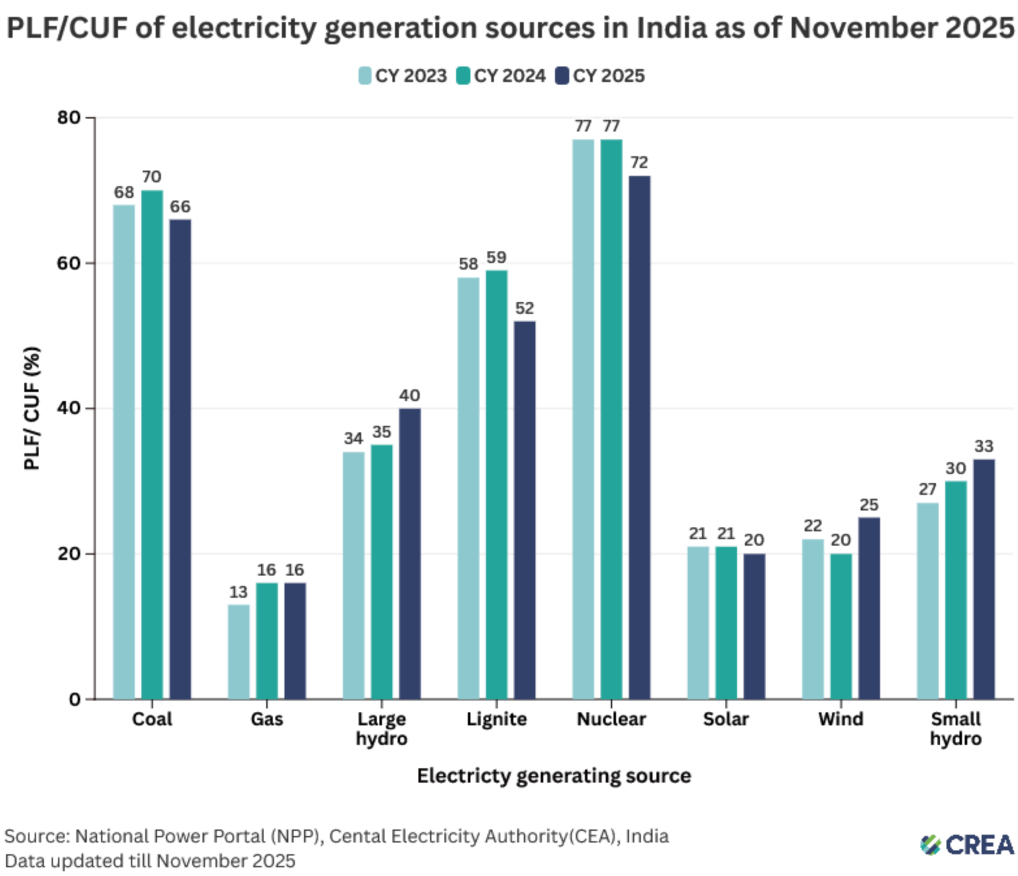

Figure 6 — PLF/CUF of electricity generation sources in India as of November 2025

No headroom for coal generation growth to 2030

Sustaining annual clean energy additions of around 50 GW, as required to meet the government's 500 GW non-fossil capacity target by 2030, is sufficient to absorb incremental electricity demand over the remainder of the decade, based on the Central Electricity Authority's (CEA) projection of power demand and supply (CEA, 2023; Aggarwal et al., 2025). This projection plans for 6% annual growth in total power generation from FY2022–2023 to 2029–2030, substantially exceeding the average growth of 4.8% recorded from 2019 to 2025.

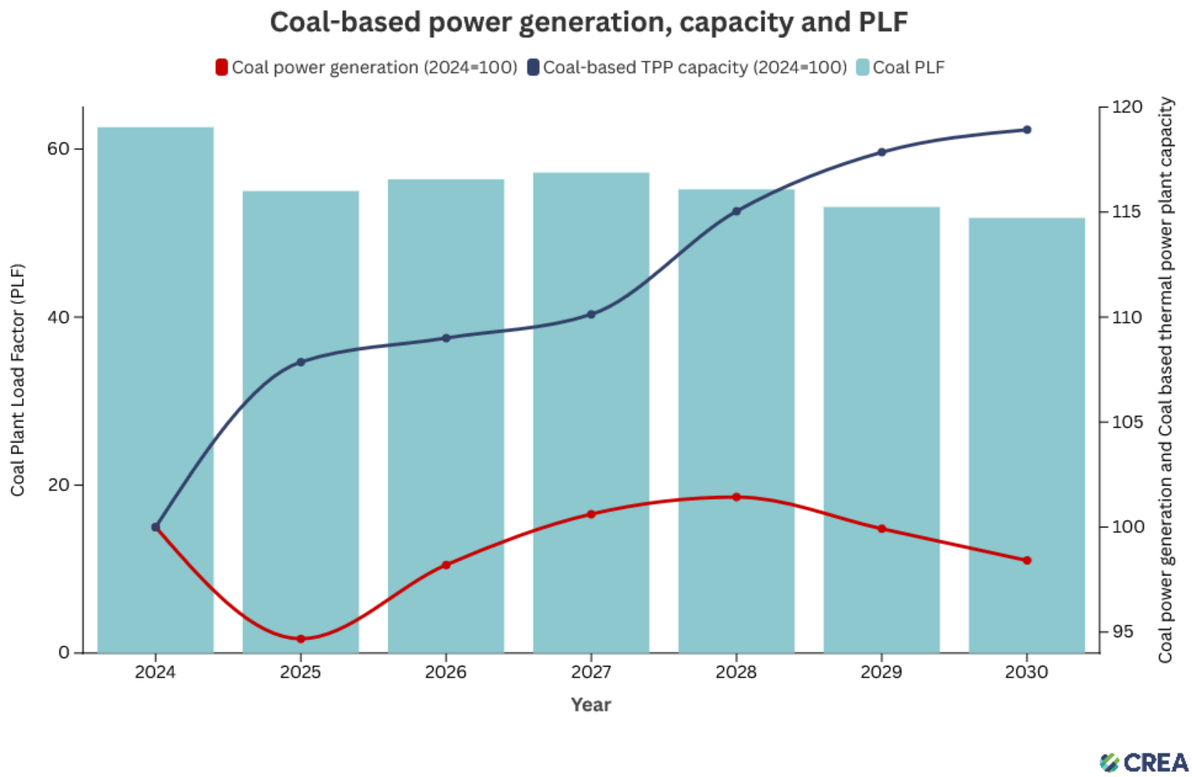

Figure 7 — Coal-based power generation, capacity and PLF

India has already crossed the 50% non-fossil capacity milestone well ahead of schedule, supported by competitive reverse auctions, long-term policy certainty, and a rapidly expanding domestic solar manufacturing base. Together, these factors position clean electricity to meet future demand growth, leaving no structural requirement for coal-based power generation to expand between now and 2030, even as total electricity consumption continues to rise.

This conclusion is reinforced by projections showing a widening divergence between coal capacity and coal generation through 2030. While coal-based power generation remains broadly flat relative to 2024 levels, coal-fired capacity continues to increase sharply. By 2030, coal capacity is projected to reach nearly 119% of 2024 levels, while coal generation declines to around 98%, driving a sustained fall in plant load factors from 62.6% in 2024 to 51.8% by 2030. This growing gap indicates that additional coal capacity would dilute utilisation across the existing fleet rather than serve incremental demand, increasing the risk of stranded assets and higher fixed-cost burdens for power consumers.

Thermal overcapacity, coal flexibilisation, and energy storage systems

As per the resource adequacy reports published by the CEA, the coal capacity required to meet the projected demand is 252 GW by 2030-31 (CEA, 2025d). Current installed capacity, together with 36 GW of coal projects under construction and about 22 GW of stressed capacity, would raise total coal capacity to roughly 278 GW, already exceeding these projected requirements. If all these plants come online, India risks significant overcapacity in coal, which would depress coal plant PLFs and, without greater system flexibility, could exacerbate curtailment of solar and wind generation

In light of this projected overcapacity, the government's plan to raise the targeted addition of coal-based power capacity to 100 GW over the next seven years reflects an intent to meet growing electricity demand (Baruah, 2025). This planned expansion makes it important to examine whether such additions are actually required during periods of maximum electricity demand. With regard to the previously cited highest demand day in June 2025, the thermal capacity online was 215 GW out of the total installed capacity of 242 GW. That means about 27 GW of thermal capacity was not used, and the rest of the demand was met by non-fossil energy even during the peak demand (National power portal, 2025).

Similarly, for a peak demand of 250 GW in 2024, about 24 GW thermal capacity was under maintenance, making only 219 GW out of 243 GW available for generation (National power portal, 2025). And, in 2023, the thermal capacity online was 207 out of the total 239 GW, implying that 32 GW of capacity was not available for meeting a peak demand of 239 GW.

Last year, on the peak demand day (12 June), 5866 MU of electricity was generated (Grid Controller of India, 2025). Of this, about 15.4% (904 MU) was from renewable energy sources, showing a slight increase from that of 2024's 15.1% (891 MU), while in 2023 the share of renewable energy was at 9% (499 MU). Also, renewable energy's share in electricity generation increased from 12% in CY 2023 - 2024 to 14% in CY 2025.

As renewable penetration continues to rise, India's 2030 electricity demand is expected to be increasingly met by clean energy. In such a scenario, additional thermal capacity additions appear unnecessary. The more critical point is that bringing new coal plants online would push PLF downward across the existing fleet. When PLFs fall, coal plants operate fewer hours but continue to receive fixed capacity payments under long-term power purchase agreements (PPAs). These contracts primarily provide payments for maintaining available capacity, rather than ensuring actual electricity generation. As a result, adding new units would increase the total fixed-cost burden while leaving a significant portion of coal capacity underutilised. Ultimately, this raises the overall cost to consumers by expanding a fleet whose output the system does not need but whose capacity charges must still be paid.

A recent study by Council on Energy, Environment and Water (CEEW) shows that India can meet its projected electricity demand by 2030 without adding any new coal capacity, if it achieves the 500 GW non-fossil energy target. Even under accelerated demand growth, a 600 GW non-fossil target (377 GW solar, 148 GW wind, 62 GW hydro, 20 GW nuclear) would be sufficient (CEEW, 2025) Another study by Ember finds that if battery storage costs decline by 15% annually, India can cap coal capacity at 260 GW by 2030, as planned in the National Electricity Plan, avoiding new coal entirely (Rodrigues & Khan, 2024). Renewables, even with integration and balancing costs, have already become cheaper than coal-based generation, reducing reliance on costly thermal plants (Chakravarty & Somanathan, 2021).

Currently, most coal plants in India are only able to bring operations down to around 55% minimum technical load (CEA, 2019). This limited flexibility often forces coal generation to run even when low-cost renewable electricity is available, leading to curtailment of cheaper solar and wind power. Reducing the minimum technical load of coal units to around 40% alongside accelerated deployment of Battery Energy Storage Systems (BESS) would enable deeper renewable penetration by allowing coal plants to ramp down further during periods of high renewable output and ramp up only when needed.

Accelerating the deployment of BESS is vital to complement coal flexibilisation and to fully utilise renewable generation. As of June 2025, India's installed energy storage capacity stands at 490 megawatt-hours (MWh); of this, 56% is solar-plus-storage systems, followed by 32% solar-plus-wind projects, 12% from standalone BESS, and the remaining from floating solar with storage and solar-plus-wind projects with storage capabilities. In addition to this, there is 5 GW of operational pumped storage capacity (Mercom India Research, 2025).

About 48.4 MWh of energy storage capacity was added in the first half of 2025, marking a 74% decline from 186 MWh added in the first half of 2024. However, the development pipeline indicates a strong upcoming scale-up. About 14 Gigawatt-hours (GWh) of standalone battery storage, 4 GWh of solar-plus-wind storage hybrids, 3 GWh of solar-plus-storage projects, and around 415 MWh of other renewable-plus-storage systems are progressing through various stages of development. Long-duration storage is also expanding rapidly, with more than 81 GW of pumped-storage capacity in the pipeline, including 12.4 GW under construction, 3.3 GW in pre-construction, and about 63 GW under survey and investigation. Policy momentum remains strong, with government agencies issuing 16 GW of storage tenders and auctioning more than 9 GW of projects in the first half of 2025, representing a 113% increase in auctions compared to the first half of 2024. Solar-plus-storage tenders, in particular, saw exceptional traction, recording a nearly 381% year-on-year surge. Overall, despite slow near-term additions, the robust pipeline and tendering activity highlight significant growth potential for storage capacity deployment in the coming years (Mercom India Research, 2025).

Conclusion

Given the existing coal fleet, the coal capacity already under construction, and the substantial renewable and storage pipeline, significant new coal additions are not required to meet India's 2030 electricity demand. Data shows that even on the system's highest demand days, the full coal fleet is not needed to meet national load, and renewable generation is playing an increasingly material role in supporting peak-hour supply. Annual renewable additions continue to accelerate, and year-on-year, a greater share of total demand is being met by solar, wind, and hydro. Battery storage capacity, though currently modest, is expanding rapidly and will further strengthen system reliability over the next few years. Although extreme heat in 2024 temporarily pushed up cooling loads, temperature-adjusted data show that demand growth has been slowing since late 2023 for deeper structural reasons. The heat spikes masked this underlying deceleration, reinforcing that future electricity demand does not warrant expanding the coal fleet.

While the existing and under-construction thermal fleet is already sufficient to meet non-solar-hour demand for the foreseeable future, the continued rise in renewable generation and the coming surge in storage deployment make the case for new coal capacity even weaker. Adding new coal plants would drive down the PLFs of both new and existing units, triggering a long-term financial burden. Long-term PPAs guarantee capacity payments, not actual generation; when plants run fewer hours due to higher renewable penetration, these fixed charges increase the overall cost to consumers while locking in under-utilised assets. Over time, this dynamic results in higher system costs and a growing risk of stressed thermal assets.

India's challenge is no longer one of total capacity adequacy. Rather, the priority is to strengthen flexibility across the power system. Reducing the minimum technical load of coal units, scaling battery storage, and upgrading transmission infrastructure are now essential to fully harness renewable generation and to avoid unnecessary investments in new coal capacity that the system does not need.

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