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Renewable energy to dominate India's grid by 2070, but 'structural challenges' are slowing the pace

As coal's role shrinks, nuclear power is expected to expand gradually, increasing its share from about 3% at present to 5-8% by 2070 under CPS, reflecting its growing role in displacing coal-based generation while providing carbon-free base-load power.

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Coal remains the backbone of India's electricity landscape, accounting for nearly 74% of generation and providing dependable, low-cost base-load power.

India's electricity mix could shift decisively from coal-heavy to renewable-led by 2070, the government's policy think tank NITI Aayog said in a study, even as it highlighted "structural challenges" due to which actual electricity generation by renewables has been modest so far.

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But, the NITI study titled 'Scenarios Towards Viksit Bharat and Net Zero', said that this dominance could erode steadily as India accelerates its clean energy transition.

Under the Current Policy Scenario (CPS) — which assumes continuation of existing policies and realistic deployment trends — renewable energy's share in electricity generation could rise from around 20% in 2024-25 to more than 80% by 2070.

In the same scenario, coal's share in electricity generation could decline sharply to 6-10 per cent by 2070.

Meanwhile, under the more ambitious Net Zero Scenario (NZS) — an accelerated pathway aligned with India's 2070 net-zero emissions target — coal-based generation could drop to zero.

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based generation while providing carbon-free base-load power.

RE constraints

Over the past decade, India's renewable capacity has more than tripled, rising from 76.38 GW in March 2014 to 258 GW by December 2025.

Out of India's total installed capacity of 513 GW, fossil-based capacity accounts for 48%, renewable energy sources account for 50%, and the balance 1.7% from nuclear.

Renewables have registered spectacular growth with the overall share increasing from 29% in 2014-15 to 50% by December 2025.

However, despite this impressive growth in capacity, the contribution of renewable energy to actual electricity generation has remained modest, with the share increasing from 19.6% in 2013-14 to 22% in 2024-25.

According to the study, this gap is largely attributed to structural challenges associated with renewable energy sources like solar and wind power.

These sources typically operate at lower Capacity Utilisation Factors (CUF) — the ratio of actual generation to maximum possible output — and are affected by intermittency, variability-driven curtailment, as well as grid constraints, limited system flexibility and dispatch challenges.

This intermittency of renewable energy often poses challenges for round-the-clock electricity supply. As a result, coal fired generation remains essential to ensure grid stability and meet rapidly growing electricity demand.

A renewables-heavy grid also means a massive expansion in storage.

The study projects Battery Energy Storage Systems (BESS) to scale up from less than 50 GW in 2030 to about 1,300-1,400 GW under CPS and up to 2,500-3,000 GW under NZS by 2070. Pumped Storage Plants are also expected to play a crucial role in providing long-duration storage and grid stability, growing from 13-19 GW in 2030 to about 110 GW in CPS and 150-165 GW in NZS.

N-power crucial in RE-dominated grid

With renewable energy forming the backbone of India's future electricity system, the study sees nuclear power emerging as a strategic pillar of India's long-term power transition and essential for maintaining system reliability in a renewables-dominated grid.

It projects nuclear power capacity to grow from the current 8.18 GW in 2025 to 90-135 GW by 2070 under CPS — an increase of 10 to 15 times.

Under the NZS, nuclear capacity could touch 295-320 GW.

"Nuclear power is crucial to achieving long-term goals of power sector decarbonisation," it said, adding that nuclear energy can provide firm low-carbon electricity, high-temperature industrial heat and a reliable power supply for electrolyzers supporting green hydrogen production.

It noted that expanding clean and flexible resources will require effective grid management, as the rising share of variable renewable energy is increasing intermittency risks while long-duration energy storage and nuclear capacity are yet to scale sufficiently to provide balancing support.

To address these challenges, the study suggested scaling nuclear capacity to 100 GW by 2047 and 200-300 GW by 2070, including the advanced reactors and Small Modular Reactors (SMRs) to deliver reliable 24×7 clean power. It proposed encouraging large industrial and captive power consumers to transition from coal-based captive plants to SMRs, enabling cleaner baseload generation.

"This shift would support national low-carbon transition goals while maximising the use of existing land, transmission connectivity, and industrial infrastructure," it said.

Coal matters in transition

Despite the push for clean energy, coal is expected to remain critical in the near to medium term, the study said.

Large-scale renewable deployment depends on long-duration storage technologies, which remain expensive and are yet to be deployed at scale, while nuclear projects face high capital costs and long gestation periods.

Under CPS, coal capacity is projected to rise from 268 GW in 2025 to a peak of 450-470 GW by 2050. In the Net Zero Scenario, coal capacity could peak earlier at around 420-435 GW by 2045 before gradually declining as storage technologies and clean alternatives become more competitive.

Over time, new coal additions are expected to slow and parts of the existing fleet may operate at low utilisation as reserve capacity.

A substantial share of this residual capacity in the Net Zero Scenario is expected to operate at low utilisation and may remain as reserve capacity, it added.

Decarbonising coal

The study outlines multiple pathways depending on how quickly clean technologies scale.

In one pathway, a sizable coal fleet continues even in 2070, with deep decarbonisation relying on large-scale deployment of carbon capture, utilisation and storage (CCUS) technologies at coal plants. CCUS refers to technologies that capture carbon dioxide emissions and either store them underground or reuse them, preventing them from entering the atmosphere.

This pathway becomes relevant if renewable or nuclear expansion slows due to high costs, land and clearance challenges, grid constraints or delays in nuclear project development.

In another scenario, limited nuclear growth would require a far sharper scale-up of renewables — especially solar, potentially exceeding 5,500 GW — significantly increasing the need for energy storage to maintain grid reliability and flexibility.