

5. Renewable Energy - Economy

NITI Aayog projects a radical shift in India's power sector by 2070, with renewable energy replacing coal as the dominant source (rising to over 80%). However, achieving this requires urgent structural reforms in grid modernization, energy storage, and tariff policies to overcome the current low utilization of clean energy.

Study Title - "Scenarios Towards Viksit Bharat and Net Zero" by NITI Aayog.

Core Projection - The study projects a fundamental structural shift in India's electricity mix, transitioning from coal dominance to renewable energy (RE) leadership by the year 2070.

Present Electricity Landscape of India

A. Dominance of Coal

Backbone of Power - Coal remains the primary source of India's power system.

Generation Share - It accounts for nearly 74% of actual electricity generation.

Role - It ensures dependable, low-cost, and round-the-clock base-load supply.

B. Global Standing (IRENA RE Statistics 2025)

Category	Global Rank
Solar Power Installed Capacity	3rd
Wind Power Capacity	4th
Total Renewable Energy Capacity	4th

Installed Capacity vs. Actual Generation

Total Installed Capacity - Stands at 513 GW.

Capacity Mix -

Renewable Energy - ~50%

Fossil-based - ~48%

Nuclear Energy - 1.7%

The Utilisation Gap - Despite 50% capacity, renewable energy's share in actual generation has increased only marginally from 19.6% (2013-14) to 22% (2024-25). This discrepancy highlights significant utilisation challenges.

Projections Under Current Policy Scenario (CPS)

Parameter	Current Status (2024-25)	Projection (2070)
Renewable Energy Share (Generation)	~20%	> 80%
Coal Share (Generation)	~74%	6-10% (Sharp Decline)

Constraints in Renewable Energy Generation

Low Capacity Utilisation Factor (CUF)

Clean energy sources are inherently intermittent and weather-dependent. Their actual output is significantly lower than their installed capacity compared to thermal sources.

Energy Source	Capacity Utilisation Factor (CUF)
Solar	~20%
Wind	~25-30%
Coal	~60%
Nuclear	~80%

Base Load Dependency on Coal

Night-time Demand - Coal supplies over 75% of electricity demand, particularly at night when solar energy is unavailable.

Grid Stability - The Indian grid remains heavily dependent on thermal sources for Round-the-Clock (RTC) power stability.

Infrastructure Limitations

Storage Deficit – There is a lack of grid-scale battery storage to capture surplus solar energy generated during the day.

Transmission Lag – Transmission planning is currently not in sync with the rapid pace of Renewable Energy (RE) installation.

Structural and Regulatory Issues

Time-Insensitive Tariffs – India lacks widespread Time-of-Day (ToD) pricing, which discourages consumers from shifting load to daytime solar peaks.

Uniform Pricing – Current structures provide no incentive for Discoms or consumers to align usage with solar generation hours.

Land & Approvals

Aggregation – Challenges in acquiring large land parcels for solar/hybrid projects.

Delays – Regulatory clearances for hybrid systems and storage infrastructure face procedural delays.

Government Initiatives to Improve Clean Energy Utilisation

Green Energy Corridor (GEC) – Aimed at strengthening transmission infrastructure to efficiently evacuate renewable energy from generation points to demand centres.

PM-KUSUM Scheme – Promotes decentralised solar power (solar pumps and grid-connected plants) in rural areas to reduce diesel consumption and support farmers.

National Green Hydrogen Mission – Focuses on producing and using green hydrogen to decarbonise hard-to-abate sectors like refining, steel, and fertilisers.

Production Linked Incentive (PLI) Scheme – Provides financial incentives to boost domestic manufacturing of high-efficiency solar PV modules and advanced battery storage systems.

Renewable Energy Hybrid Policy – Encourages the co-location of solar and wind energy projects to improve overall capacity utilisation and reliability.

Way Ahead

A. Grid Modernisation and Smart Management

Smart Grids – Investment in grids capable of real-time demand-supply balancing.

Dynamic Pricing – Enable Time-of-Day (ToD) pricing to incentivize daytime solar usage.

B. Battery and Storage Infrastructure

Deployment – Accelerate Battery Energy Storage Systems (BESS) deployment using Viability Gap Funding (VGF) or PLI schemes.

Hybridization – Fast-track hybrid projects that combine Solar-Wind-Hydro with BESS.

C. Decentralised Renewable Energy

Promote **rooftop solar**, solar pumps, and **mini-grids**. This strategy helps relieve pressure on the centralised base-load grid.

D. Market Design Reforms

Differential Tariffs – Introduce distinct tariffs for peak vs. off-peak periods. Green Markets – Establish green power markets on energy exchanges that allow open access for industries.

E. Nuclear Power as a Strategic Pillar

Base-Load Support – Nuclear capacity must be scaled in a phased and financially sustainable manner to provide firm, low-carbon base-load power.

Technology Focus – Prioritise Small Modular Reactors (SMRs) and advanced reactors for flexible deployment and enhanced safety.

Source – <https://indianexpress.com/article/explained/explained-economics/renewables-to-dominate-indias-grid-by-2070-but-structural-challenges-are-slowing-the-pace-10527462/>