INDIA'S JOURNEY TOWARDS NET ZERO BY 2070

Abstract

India has promised to achieve net-zero greenhouse gas (GHG) emissions by 2070. This goal requires striking a balance between rapid development and significant reductions in emissions. This article outlines the development of policies related to this pledge. It explains India's updated targets for 2070, identifies pathways for each sector, including power, industry, transport, buildings, and land use, and looks at finance, technology, and market mechanisms. These include the National Green Hydrogen Mission and the new carbon credit trading framework.

CMA (Dr.) Amit Kumar Arora
Associate Professor
School of Business and Management
CHRIST University, Delhi-NCR
amitaroraicwa@gmail.com

Priyanka Sharma
Independent Researcher
Ghaziabad
sharma.priyanka@mba.christuniversity.in

Why Net Zero?

India is the most populous country in the world and has a rapidly growing economy. It accounts for approximately 7% of global CO_2 emissions. However, its per-capita emissions are still significantly lower than those of developed countries, at around 2 tonnes of CO_2 per person, compared to levels several times higher in many OECD nations (based on energy-related CO_2 emissions). The International Energy Agency (IEA) indicates that coal is the main source of energy-related CO_2 emissions in India. This highlights the significant changes needed in both power and industry.

At COP26 in Glasgow, Prime Minister Narendra Modi announced that India aims for net zero by 2070. This date marks the recognition of the need for development, including energy access, job creation, and infrastructure, while also promising a significant long-term transformation. Official communications that followed have confirmed this commitment.

The journey to 2070 is built on shorter-term goals. In 2022, India updated its Nationally Determined Contribution (NDC) to:

- reduce the emissions intensity of GDP by 45% by 2030 from 2005 levels, and
- achieve about 50% of cumulative electric power installed capacity from non-fossil sources by 2030.

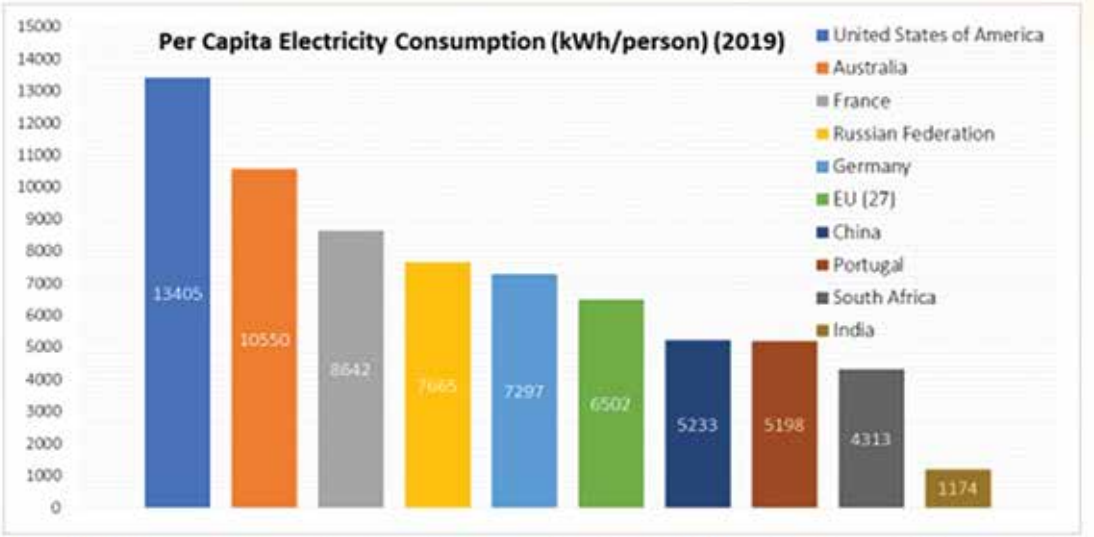

Figure 2.1 Country wise per capita electricity consumption *(Climate Equity Monitor, n.d.)*. The year 2019 is chosen as it provides a better cross-country comparison from the year prior to the pandemic.

India has made significant progress toward its power capacity goal. Recent data indicate that the 50% non-fossil installed capacity milestone has been reached ahead of schedule, primarily due to the addition of solar, wind, hydro, and nuclear sources. However, actual power generation still depends heavily on coal. This presents a major challenge: replacing coal in the merit order while ensuring reliability. India's Long-Term Low-Carbon Development Strategy (LT-LEDS), submitted to the UNFCCC at COP27, outlines the plan for decarbonization. This includes cleaner electricity, green transportation, sustainable urban development, low-emission industries, CO_2 removals, increasing forest cover, climate finance, and Mission LiFE (Lifestyle for the Environment).

Initiatives Taken by the Government

1. Decarbonising Power

- Power decarbonisation is essential. By mid-2025, India's renewable energy (RE) capacity, excluding large hydro, had exceeded approximately 119 GW of solar and notable wind power. Non-fossil installed capacity made up over half of the total. The Ministry of New and Renewable Energy (MNRE) monitors this growth and progress by state.
- The policy task now is twofold:
  1. Sustain high annual renewable energy additions, including solar, wind, and hybrid sources.
  2. Scale firming battery energy storage systems, pumped storage, and grid modernization. This will ensure that clean capacity results in clean generation hour by hour. Recent months have seen record monthly additions of renewable energy, indicating strong momentum.
- Hard-to-abate industries like steel, cement, fertilizers, and refining need molecules, not just electrons. The National Green Hydrogen Mission (NGHM) is crucial in this regard, as it aims to produce at least 5 million metric tonnes (MMT) of green hydrogen annually by 2030, along with a corresponding expansion of ~125 GW of renewable capacity, substantial investments, job creation, and import savings. Use cases covered by pilot support include shipping, mobility, and green steel.

Markets and Pricing Signals

- The Energy Conservation (Amendment) Act, 2022, empowered the Union government to establish a Carbon Credit Trading Scheme (CCTS), with detailed rules emerging in 2023–24 to operationalise a compliance carbon market potentially evolving beyond existing PAT/RPO/RGO regimes to economy-wide signals. This can lower abatement costs

and mobilise private capital when aligned with robust MRV (monitoring, reporting, verification).

2) Sector Pathways to 2070

Power: Clean, Firm, Affordable

- **2030–2040**: Triple the investment in solar and wind. Scale pumped storage and battery energy storage systems to integrate over 35 to 40 percent of variable renewable energy in generation. Expand transmission within states and between states. Adopt market products for flexibility, such as ancillary services and capacity markets. Accelerate coal flexibility and retrofits to reduce the emissions intensity of remaining coal generation.
- **2040–2055**: Deepen renewables and firming to replace coal in baseload segments. Add green ammonia as seasonal storage. Evaluate new nuclear options and small modular reactors (SMRs) if they are cost-competitive. Deploy CCUS carefully at industrial clusters with shared CO_2 transport and storage.
- **2055–2070**: Achieve a mostly clean power system. This will enable the full electrification of transportation and buildings. It will also support the use of green hydrogen in industry.

3) Electrify, Switch Fuels, Re-make Materials

- **Steel**: Transition from blast furnace, basic oxygen furnace to DRI-EAF routes using green hydrogen and high-quality scrap. Implement CCUS at the remaining BF-BOF sites.
- **Cement**: Tackle process emissions by reducing the clinker factor, using alternative binders, implementing CCUS, and improving energy efficiency.
- **Chemicals & Fertilisers**: Substitute green hydrogen for grey. Electrify heat where possible. Use process intensification and circularity.
- **Cross-cutting**: Scale energy efficiency in motors, drives, and waste-heat recovery. Use digital twins and heat pumps for low-temperature heat.

Transport: Avoid–Shift–Improve

- **Avoid**: Managing demand through transit-oriented development, using telepresence for service sectors, optimizing logistics.
- **Shift**: Mass public transport, such as metro and e-buses, and non-motorized transport; expanding rail freight share.
- **Improve**: Quick adoption of electric vehicles for two-wheelers and three-wheelers; electrifying bus fleets and last-mile transport; using biofuels and synthetic fuels for aviation; green hydrogen for long-haul trucking and shipping pilots.

Buildings & Cities: Efficiency First

- National and state energy conservation building codes.
- Super-efficient appliances.
- Cooling through building envelope, district cooling, and high-efficiency ACs.
- Rooftop solar and storage.
- Smart meters and demand response.

Land Use, Forests, and Carbon Removals

- **Forestry**: Improve forest and tree cover. Support biodiversity and livelihoods.
- **Nature-based solutions**: Restore mangroves. Manage watersheds.
- **Engineered removals (long term)**: Use Direct Air Capture and BECCS where land and water allow. Follow LT-LEDS guidance on social and ecological factors.

Financing the Transition

- **The Investment Scale**
  - Multiple analyses point to a requirement in the multi-trillion-dollar range. A widely cited CEEW study estimates a cumulative investment of USD 10.1 trillion is needed for a net-zero pathway by 2070 across electricity, hydrogen, and vehicles. This comes with an investment gap of USD 3.5 trillion and requires USD 1.4 trillion in external support. As we look ahead to 2030, Indian authorities and market observers

highlight significant needs for funding aimed at adapting to and reducing climate impacts. Regulators are also starting to see climate as a systemic financial risk.

- **Mobilising Capital: Five Levers**
  1. Domestic Green Finance Architecture: Taxonomy-aligned green bonds, credit enhancements, and blended finance; improve disclosures and stress testing for climate risk. RBI signals on climate risk and disclosure highlight this direction.
  2. Public-Private Partnerships (PPPs): For grid, transmission, storage, and urban transit.
  3. Carbon Markets/CCTS: To create price signals for emissions reductions.
  4. International Climate Finance: Concessional pools, guarantees, and project preparation facilities.
  5. State-Level Instruments: Green municipal bonds for transit, water, and resilience.

Policy Instruments and Governance

- **The Policy Spine to 2030**
  - Updated NDC (2022): 45% cut in emissions intensity, about 50% of power capacity from non-fossil sources by 2030.
  - LT-LEDS (2022): The long-term plan for various sectors, including Mission Life for sustainable consumption.
  - National Green Hydrogen Mission (2023): Annual target of 5 MMT by 2030 with around 125 GW of renewable energy connected; pilots in steel, mobility, and shipping.
  - Carbon Credit Trading Scheme (2023–24): New compliance carbon market designed to support economy-wide efforts to reduce carbon emissions.

- **Federalism and the Role of States**
  - Energy is a practical subject that involves several factors. The financial health of state utilities, land acquisition, permitting, and renewable energy procurement policies affect success on the ground. State Electricity Regulatory Commissions (SERCs) can help achieve net zero by:
    - Recognizing storage as infrastructure.
    - Enabling time-of-day tariffs and demand response.
    - Streamlining open access and rooftop procedures.
    - Increasing green procurement for public fleets and buildings.

Technology and Innovation Bets

- **Storage, Grids, and Flexibility**
  - Scale BESS using clear revenue sources like arbitrage, ancillary services, and capacity. Use transparent tariffs for pumped storage.
  - Smart grids involve AI-based forecasting, dynamic line rating, and improved distribution management for high-RE grids.
- **Hydrogen and Its Derivatives**
  - Green hydrogen is used for steel, fertilizers, and refineries. Green ammonia is for shipping and long-duration storage.
  - Manufacture electrolysers domestically through technology partnerships, standards, and safety codes.
- **CCUS Where It Matters**
  - Use a cluster approach with steel, cement, and refining belts that share CO_2 transport and storage. Focus on sites with suitable geology and value chains.
- **Demand-Side Digitalisation**
  - Smart meters and user-focused apps can reduce peak demand. Building energy analytics and industrial digital twins help optimize processes.

Equity, Jobs, and a Just Transition

1. Reskill coal and thermal power workers for jobs in renewables, storage, and grid services.
2. Make modules, cells, batteries, and electrolysers in the country to benefit from

value chains.

3. Support MSMEs with credit, toolkits, and vendor development to spread efficiency and clean technology in the Indian industry.

Milestone Map to achieve Net Zero

2025–2030: Foundation and Scaling

Sustain over 35 to 40 GW per year in renewable energy additions, commission utility-scale storage and pumped storage projects, and enable time-of-day pricing across the country.

- Implement CCTS compliance pathways, expand corporate renewable energy purchasing, and track green attributes.
- Achieve 5 MMT per year in green hydrogen production through phased incentives and demand creation in steel, fertilizers, and refining, and complete port and pipeline pilot projects.
- Double urban electric bus fleets, require efficient cooling standards, and make energy audits common in small and medium enterprises.
- Keep the 2030 Nationally Determined Contribution on track, with a 45% reduction in intensity and about 50% of non-fossil capacity maintained in operation, not just on paper.

2030–2040: Integration and Substitution

- Renewable energy plus storage replaces a significant portion of coal-fired generation, and gas peakers, if necessary, are used sparingly as ancillary services markets develop.
- Hydrogen demand increases, making India a competitive manufacturer of electrolysers and hydrogen derivatives.
- Rail freight share increases, electric vehicles take over two-wheelers, and a significant portion of buses and last-mile fleets.

2040–2055: Deep Decarbonisation

- Carbon capture, utilization, and storage (CCUS) operates at industrial clusters, and green steel becomes common.
- Most buildings are energy efficient, district cooling is implemented in large cities, and vehicle-to-grid services are widely available. 2055–2070: Net Zero Landing
- Remaining emissions in agriculture, aviation, maritime, and some industrial processes are balanced by high-integrity removal methods, which include nature-based and engineered solutions, along with strong monitoring, reporting, and verification measures and permanence safeguards highlighted in Long-Term Low Emission Development Strategies.

2055–2070: Achieve a mostly clean power system. This will enable the full electrification of transportation and buildings. It will also support the use of green hydrogen in industry.

Risks and Remedies

Risk	Why it matters	Remedy
Grid integration lag	Clean capacity without clean generation	Fast-track transmission (GEC corridors), storage tenders, ancillary services, and flexibility markets
DISCOM finances	Weak utility balance sheets impede RE PPAs and payments	Tariff rationalisation, loss reduction, direct benefit transfers, escrow mechanisms
Capital cost & access	High cost of capital can stall projects	Sovereign guarantees/first-loss facilities, blended finance, green taxonomy clarity
Technology uncertainty	Cost/ availability of H_2, CCUS, long-duration storage	Portfolio approach; results-based incentives; public R&D and standards
Social transition	Regional job impacts in coal belts	Place-based just-transition packages; reskilling; local manufacturing hubs
Policy fragmentation	Centre–state misalignment delays delivery	Cooperative federalism platforms; outcome-linked funds; national-state compacts

Conclusion

India's path to net zero by 2070 is not linear; it follows an S-curve of technology, finance, and governance. The country has established firm targets for 2030: a 45% reduction in emissions intensity and about 50% of its power capacity from non-fossil sources. India is already achieving important milestones in capacity while recognizing the significant work still needed in generation mix, reliability, and affordability.

Achieving net zero by 2070 is both a development strategy and a climate pledge. If executed effectively, it can position India at the forefront of a low-carbon economy in the 21st century electrified, efficient, and fair. MA

References

1. *Government of India – Updated NDC (2022): Targets 45% emissions intensity reduction by 2030 vs 2005 and ~50% non-fossil installed power capacity by 2030. (unfccc.int)*
2. *Government of India – LT-LEDS (2022): Long-term low-carbon strategy (electricity, transport, urban design, industry, removals, finance, Mission LiFE). (unfccc.int)*
3. *MNRE Renewable Capacity Data (2025): Ongoing physical progress of solar/wind and non-fossil capacity. (Ministry of New and Renewable Energy)*
4. *Reuters/FT Coverage (2025): India reaching ~50% non-fossil installed capacity and monthly RE additions momentum; generation still coal-heavy. (Financial Times, The Economic Times)*
5. *National Green Hydrogen Mission: Targets (≥5 MMT/yr by 2030) and associated RE capacity (~125 GW). (Hareda, Ministry of New and Renewable Energy)*
6. *Energy Conservation (Amendment) Act & CCTS: Enabling framework and adoption of compliance carbon market regulations (2023–24). (Bee India, ICAP Carbon Action)*
7. *IEA – India Emissions Profile: Per-capita emissions and fuel contributions. (IEA)*
8. *CEEW – Investment Sizing for Net Zero: USD 10.1 trillion cumulative need and financing gap estimates. (CEEW)*
9. *RBI/Policy Discourse on Climate Finance: Financing needs and disclosure frameworks. (Reuters)*