NEXT IAS

DAILY EDITORIAL ANALYSIS

TOPIC

INDIA'S NET ZERO IMPERATIVE: ELECTRIFYING THE ECONOMY

www.nextias.com

INDIA'S NET ZERO IMPERATIVE: ELECTRIFYING THE ECONOMY

Context

- India needs to undergo a transformative shift — one that hinges on the widespread electrification of its economy, to meet its ambitious **Net Zero target by 2070**.

Why Electrification Matters?

- Electrification refers to **replacing fossil fuel-based systems with electric alternatives** powered by clean energy. This transition is essential for several reasons:
  - **Energy Efficiency:** Electric systems are inherently more efficient than combustion-based ones. For example, electric vehicles (EVs) convert over 77% of electrical energy into motion, compared to just 12–30% for internal combustion engines.
  - **Emission Reduction:** According to a joint report by the **Indo-German Energy Forum** and the B**ureau of Energy Efficiency (BEE)**, electrifying 90% of India's energy needs could slash emissions by 55%.
  - **Renewable Integration:** Electricity can be generated from renewable sources like solar, wind, and hydro, making it a cleaner alternative to fossil fuels.
  - **Air Quality, Energy Efficiency, and Climate Gains:** The International Energy Agency (IEA) projects that **global energy consumption could fall by 15% by 2035**, even with growing GDP, largely due to electrification.
    - Lower energy consumption directly reduces carbon emissions, and switching from fossil fuels to clean electricity improves air quality.

Phases of India's Electrification Journey

- **Phase I (2020–2030):** Focus on deploying high **Technology Readiness Level (TRL 7–9)** solutions:
  - Round-the-clock renewable power;
  - Electric heavy vehicles, small boats, and air cargo delivery;
  - Electric melting furnaces
  - Simultaneously, India needs to invest early in emerging technologies such as electric kilns for cement; green hydrogen for shipping and industry; and electrolytic reduction of mineral ores.
- **Phase II (2030–2050):** As clean technologies mature, full electrification becomes feasible for railways; fertiliser production; and textile industries.
  - It supports emerging investments in small modular nuclear reactors; electric blast burners; and clean-energy-powered direct air capture.
- **Phase III (2050–2070):** By this period, India deploys a scalable and cost-competitive domestic technology base:
  - **3,500 GWh of battery storage;**
  - **55 million tonnes of green hydrogen annually;**
  - Sectoral transformation aims to accelerate in shipping, steel, aluminium, glass, and cement. Roughly **75% of all mobility**, including tractors and possibly aviation, could be electrified.
  - Breakthrough technologies — fusion, space-based energy, advanced geothermal, and next-generation air capture — begin reaching critical mass.

Sector-Wise Transformation

- **Power Generation:** Transitioning from coal to renewables is foundational. India has already made strides, with solar and wind capacity growing rapidly.
- **Industry:** Electrifying industrial processes — especially in steel, cement, and chemicals — can drastically cut emissions.
  - Technologies like electric arc furnaces and green hydrogen are key enablers.

- **Transport & Mobility:** EV adoption is accelerating, but infrastructure like charging stations and battery supply chains need to scale up.
  - India needs to prioritise rapid renewable energy expansion; removal of transmission and grid bottlenecks; investment in storage systems; expansion of EV affordability and access; development of hydrogen fuels and smart grids; and buy-back and performance guarantee frameworks;
- **Buildings:** Electrifying heating, cooling, and cooking through efficient appliances and smart grids can reduce urban emissions.
- **Agriculture**: Solar-powered irrigation and electric tractors can reduce diesel dependence in rural areas.

Key Concerns and Challenges

- **Grid Infrastructure Limitations:** The current electricity grid is not equipped to handle the surge in demand from widespread electrification.
- **High Upfront Costs:** Transitioning to electric systems—especially in transport and industry—requires significant capital investment.
  - Electric vehicles, green hydrogen, and electric furnaces all come with steep initial costs.
- **Policy and Regulatory Gaps:** Fragmented policies across states and sectors hinder progress.
- **Dependence on Fossil Fuels for Revenue:** Fossil fuels contribute heavily to government revenues through taxes.
  - Electrification, especially in transport, could reduce this income, creating fiscal tensions.
- **Technological Readiness and Adoption:** Many industries still rely on legacy systems. Electrification demands new technologies and retraining of the workforce and redesigning supply chains.
- **Green Hydrogen Trade Barriers:** International trade restrictions on green hydrogen could slow India's decarbonization efforts and hurt its competitiveness.
- **Agricultural Sector Complexity:** Electrifying agriculture is particularly challenging due to its decentralized nature and reliance on diesel-based equipment.

Way Forward

- **Building Domestic Capability and Resilient Supply Chain:** Electrification isn't only about deploying devices — it requires manufacturing them in India.
  - It includes building secure supply chains for copper, nickel, cobalt, and rare earth metals.
  - These minerals often have long payback periods, necessitating **strategic government-led global mining partnerships**.
- **Policy and Financial Architecture for the Transition:** India's energy transition will require a balanced mix of incentives, disincentives, and strategic public investment. Key interventions are:
  - Sustained policy support for renewable energy growth;
  - Incentives for users shifting to electrified technologies (e.g., EV subsidies);
  - Introduction of carbon pricing at meaningful rates;
  - Use of carbon revenue to fund decarbonisation programs;
  - Government as an entrepreneurial investor:
    - Strengthening early-stage technologies through the national **R&D-Innovation Fund;**
    - Crowd-in private capital while securing equity returns and geopolitical advantage;

Source: BL

Daily Mains Practice Question

[Q] Discuss the role of electrification in achieving India's Net Zero goals. What are the key challenges and opportunities associated with transitioning to an electrified economy?

■■■■