NEXT IAS

DAILY EDITORIAL ANALYSIS

TOPIC

TRANSFORMING INDIA'S NUCLEAR POWER LANDSCAPE

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Context

- India, set to expand nuclear power capacity to 100 GW by 2047, as highlighted in the Union Budget 2025–26, needs supportive rules and regulations aligned with the transformative spirit underlying the SHANTI Act, 2025.

Why Nuclear Energy Matters for India?

- **Rising Energy Demand:** India's per capita electricity is around **1,418 kWh**
  - Around 7,097 kWh in China and 12,701 kWh in the USA indicates huge growth potential.
- **Energy Transition Challenge:** Installed capacity in 2025 is around **476 GW in which around 50% non-fossil fuel.**
  - But generation share: Thermal (~75%); Renewables (~22%); and Nuclear (~3%)

India's Nuclear Power Landscape

- **Current Status:**
  - **Installed capacity**: About **8.7–8.8 GW**; Share in total electricity generation is about **3%**
  - Operated mainly by: **Nuclear Power Corporation of India Ltd. (NPCIL)**
  - Regulated by: **Atomic Energy Regulatory Board (AERB)**
- **Institutional Framework:**
  - **Department of Atomic Energy (DAE)** for policy & strategic control;
  - **Nuclear Power Corporation of India Ltd. (NPCIL)** for construction & operation of nuclear plants;
  - **Atomic Energy Regulatory Board (AERB)** for safety regulation (now moving toward statutory autonomy under reforms)
- **Reactor Types in India:**
  - Indigenous **Pressurised Heavy Water Reactors (PHWR)**
  - **Boiling Water Reactors (BWR)**, oldest in Tarapur
  - Voda-Vodyanoi Energetichesky Reaktor (VVER) ie **Russian PWR** in Kudankulam
- **Key Features of India's Nuclear Programme**
  - Based on **3-stage nuclear programme**: PHWRs (natural uranium); Fast Breeder Reactors; and Thorium-based reactors (long-term goal)
- **Cost Advantage:** Indian PHWR is globally competitive (**~$2 million/MW**)

Key Policy Support

- **SHANTI Act, 2025:** It aligns with two national goals i.e. **Viksit Bharat by 2047,** and **Net-zero emissions by 2070.**
  - **Structural Reforms:** Ends monopoly of the **Department of Atomic Energy (DAE);** allows **private and foreign participation** in nuclear power and permits **build-own-operate (BOO)** models.
  - **Regulatory Strengthening:** Grants statutory status to **Atomic Energy Regulatory Board (AERB)**; and moves toward an **independent regulatory framework.**
  - **Legal Changes:** Repeals Atomic Energy Act, 1962; Civil Liability for Nuclear Damage Act, 2010; and introduces a **revised liability regime** to attract investment.

Challenges in Scaling to 100 GW

- **High Capital Cost & Financing Constraints:** Nuclear plants require **huge upfront investment** (more than $200 billion for India);
  - Long gestation periods lead to delayed returns, and foreign reactor projects pending for years.
  - Private investors face **high financial risks and uncertainty**

- **Renewable Limitations:** Solar and wind becoming cheaper; policy focus shifting towards renewables; and nuclear seen as **capital-intensive and slow.**
- **Long Construction Timelines:** Typical nuclear projects take **8–10 years.** Delays increase cost overruns, and investor risk.
- **Challenges Deployment of Small Modular Reactors (SMRs):** SMRs are in early stages of commercialization, facing regulatory and financing uncertainties.
- **Regulatory & Institutional Bottlenecks:** Complex approvals lead to project delays.
  - Lack of streamlined processes for site clearance, and environmental approvals.
- **Policy Gaps:** Need clarity on liability, tariffs, waste management, and fuel ownership.
  - Earlier liability laws i.e Civil Liability for Nuclear Damage Act (CLNDA), 2010 discouraged foreign participation. Even after reforms, concerns remain regarding accident liability, and insurance costs.

Strategic Pathways (Three-Front Strategy)

- **Indigenisation of Large Reactors:** Reduce dependence on expensive foreign designs; and learn from China's cost reduction model.
- **Development of Small Modular Reactors (SMRs):** Suitable for industrial captive power and remote areas.
- **Expansion of PHWR Fleet:** Proven indigenous technology (220–700 MW); potential for modularisation, and faster construction.

Conclusion & Way Forward

- For SHANTI Act success, India needs to address **clear separation** of civilian vs strategic nuclear activities, transparent framework for tariffs insurance & liability, waste disposal, and dispute resolution.
  - There is a need to reform **exclusion zone norms** for small reactors.
- It requires strong regulatory clarity, private sector confidence, technological innovation, and efficient project execution.

Source: TH

Daily Mains Practice Question

[Q] Discuss the role of nuclear energy in achieving India's twin goals of 'Viksit Bharat 2047' and 'Net Zero 2070'. Evaluate how recent reforms aim to address structural bottlenecks in the sector.

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