Advanced Nuclear Energy for Enriched Life (ANEEL)

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Why in News?

Recently, NTPC and Clean Core Thorium Energy are exploring the deployment of thorium-based ANEEL fuel in India's PHWRs.

- **ANEEL –** It is a ***thorium-based advanced nuclear fuel*** designed for use in India's Pressurised Heavy Water Reactors (PHWRs).
- **Developed by –** Clean Core Thorium Energy (CCTE), in collaboration with National Thermal Power Corporation (NTPC).

As of 2026, India operates 24 nuclear reactors with a combined installed capacity of about 8,780 MW.

- **Features – Fuel Composition – *Thorium blended with small amounts of enriched uranium (HALEU).***
- **Reactor Compatibility –** Can be deployed directly in India's existing PHWRs.
- **Cost Impact –** Current nuclear power cost in India is about Rs. 6/kWh.
- With ANEEL fuel, electricity cost is expected to drop by 20–30%.
- **Waste Reduction –** Thorium-based ANEEL fuel can reduce nuclear waste by over 85%.
    - Lowers the generation of long-lived radioactive nuclear waste.
- **Significance – Energy Security –** Uses domestically available thorium to reduce dependence on imported nuclear fuel.
- **Safety –** Improves reactor safety and proliferation resistance.
- **Cost Efficiency –** Greater energy output within existing safety margins and lowering operating costs.

Quick Facts

Thorium –

• It is a naturally occurring weakly radioactive metal (Th, atomic no. 90) found in rocks and soil.

• **Nuclear Potential –** Fertile element, meaning it is ***not fissile*** on its own but converted into fissile Uranium-233 in reactors.

• **Abundance –** Mainly obtained from monazite; found in India, Brazil, Australia, USA.

- **Indian Reserve –** Coastal monazite sands in Kerala, Tamil Nadu, Odisha, Andhra Pradesh, Maharashtra, Gujarat.

- Inland deposits in Jharkhand, West Bengal, and Tamil Nadu.

• Monazite contains ~9–10% thorium oxide.

SHANTI Act, 2025 –

• **Stands for –** Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India.

• **Permits –** Private Indian companies and joint ventures to build, own, operate, and decommission nuclear power plants.

• **Repeals –** Atomic Energy Act (1962) and Civil Liability for Nuclear Damage Act (2010) to create a unified modern nuclear framework.

References

1. IE | ANEEL
2. ET | ANEEL