



Revisiting the Need of Nuclear Energy

This editorial is based on [Should India consider phasing out nuclear power?](#) which was published in The Hindu on 28/04/2023. It talks about the key opportunities and challenges associated with the adoption of Nuclear Energy in India.

For Prelims: [Nuclear Energy](#), Uranium, Thorium, [Kudankulam NPP](#), Small Modular reactor, [Nuclear Power Corporation of India Limited \(NPCIL\)](#), Disposal of nuclear waste.

For Mains: Nuclear Energy - opportunities and challenges.

As [renewable energy](#) sources like [solar](#) and [wind power](#) gain popularity globally and supply of nuclear fuel continuously being a **big burden on country's finances**, questions arise on whether nuclear power is still relevant in a fossil-free future, particularly in India where safety and cost concerns persist.

- Recently, **Germany has closed its last nuclear plant**, and **France struggles to replace its aging reactors** despite being a nuclear powerhouse.
- On one hand, **Nuclear energy provides low carbon, firm and reliable source of energy** but on the other hand, it creates **challenges regarding safety of reactors and safe disposal of nuclear waste**. Also, supply of nuclear fuel is a constraint in growth of nuclear energy.

What is the Current Status of Nuclear Power Globally?

Nuclear power is witnessing a renaissance post Ukraine war, as many countries from Europe and USA have started increasing the share of Nuclear energy in their energy mix.

- **South Korea's** new president has changed the energy policy and **committed to increasing the share of nuclear power** in the country's energy mix to 30% by 2030.
- **Japan**, which should have completely shut down reactors after the Fukushima (accident), **is restarting the reactors to diversify from coal and natural gas**. Currently, 10 nuclear reactors have resumed operation while 17 are in the pipeline in Japan.
- **U.K.** has said that without **scaling up nuclear power**, it won't be possible to decarbonise the electricity sector.
- **China** has anyway been **surging ahead on nuclear power**.

What is the Status of Nuclear Energy in India?

- Nuclear energy is the **fifth-largest source of electricity in India**, contributing about **2% of the country's total electricity generation**.
- India currently has over **22 nuclear reactors in 7 power plants** across the country, which together produce **6,780 MW of nuclear power**.

- Of these reactors, 18 are Pressurised Heavy Water Reactors (PHWRs) and 4 are Light Water Reactors (LWRs).
- In January 2021, **the Kakrapar Atomic Power Project (KAPP-3), India's first 700 MWe unit and the biggest indigenously developed variant of the PHWR**, was connected to the grid.
- The Indian government has allowed joint ventures between the [Nuclear Power Corporation of India Limited \(NPCIL\)](#) and public sector undertakings (PSUs) to enhance India's nuclear program. NPCIL is now in joint ventures with the National Thermal Power Corporation Limited (NTPC) and the Indian Oil Corporation Limited (IOCL).
- The government is promoting the expansion of nuclear installations to other parts of the country. For example, an **upcoming nuclear power plant in Gorakhpur town in Haryana** will become operational in the near future.
- India is also **working on an entirely indigenous thorium-based nuclear plant, "Bhavni,"** which will be the first of its kind using Uranium-233. The **experimental thorium plant "Kamini"** already exists **in Kalpakkam**.

Why is Nuclear Energy a Necessity?

- **Cheaper to Operate:**
 - Nuclear power plants are cheaper to operate than coal or gas plants, despite the cost of managing radioactive fuel and disposal. Estimates show that **nuclear plants cost only 33-50% of a coal plant and 20-25% of a gas combined-cycle plant.**
- **Availability of Thorium Reserves:**
 - Thorium availability makes nuclear energy a promising solution for India's energy needs. It is considered the fuel of the future, and **India is a leading country in Thorium resources.** This could help India achieve its goal of being a fossil fuel-free nation.
- **Reduction in Petroleum Imports:**
 - Nuclear energy can help India **reduce its import bills by up to \$100 billion annually,** which is currently spent on importing petroleum and coal.
- **Firm and Dispatchable Power:**
 - Unlike solar and wind power, which are dependent on weather conditions, nuclear power provides a **reliable, high-density source of energy that is widely available.**
 - **Firm/dispatchable power** is the power that can be sent to the electric grid **to be supplied whenever needed. It can be turned on or off whenever needed.**
- **Cleaner Form of Energy:**
 - A 1,000 megawatts plant operating at 90% plant load factor **requires over a year only 25 tonnes of low enriched uranium fuel.**
 - **Uranium enriched to concentrations above 0.7% but less than 20% uranium-235 is defined as low enriched uranium (LEU).** Most nuclear reactors use LEU that is about **3-5% uranium.**
 - Compared to it, a **coal plant (of similar capacity) will require approximately five million tonnes of coal,** and coal produces ash.

Why are there Calls for Phase out of Nuclear Energy?

- **Sourcing of Nuclear Fuel:**
 - India's nuclear plan is premised on working around **its limited supply of enriched uranium,** which is difficult to source and is a burden on finances.
 - Though India has sufficient reserves of Thorium, we have not yet shifted to Thorium based Nuclear plants.
- **Fears About Safety:**
 - Nuclear industry is moving towards **'passive safety' designs** (for nuclear reactors) and are safer than older designs of nuclear plants.
 - For Instance, **Fukushima reactor** based on older design led to disaster in Japan.
- **Nuclear Waste:**
 - Another side effect of nuclear power is the amount of **nuclear waste** it produces. Nuclear waste can have drastically bad effects on life, causing cancerous growths, for instance, or causing genetic problems for many generations of animals and plants.
 - **For instance, Kudankulam plant in Tamil Nadu** has met with **several delays due to the land acquisition and protest from villagers.**

- **Capital Intensive:**
 - Nuclear power plants are capital intensive and recent nuclear builds have suffered **major cost overruns**. An illustrative example is the V.C. Summer nuclear project in South Carolina (U.S.) where costs rose so sharply that the project was abandoned — after an expenditure of over \$9 billion.

What can be the Way Ahead?

- **Open up the Market:**
 - Allow **other government companies like the [National Thermal Power Corporation \(NTPC\)](#) to get into nuclear** on their own to break the monopoly held by the Nuclear Power Corporation of India Limited (NPCIL) and promote competition.
- **Focus on a Portfolio of Technologies:**
 - Energy, especially electricity, is not going to be solved by one technology alone. India should **focus on a mix of supply-side and demand-side options, both within and outside the nuclear sector such as solar and hydro energy.**
- **Encourage an Enabling Policy Framework:**
 - Instead of setting targets for nuclear energy growth, the government should focus **on creating frameworks and support mechanisms** that encourage the growth of low-carbon, firm, and reliable energy sources, including nuclear.
- **Invest in Research and Development:**
 - India should invest in **research and development of advanced nuclear technologies, such as small modular reactors**, to improve efficiency, reduce costs, and address safety concerns and make use of Thorium reserves.
- **Small Modular Reactor:**
 - Small Modular Reactors present numerous advantages, such as the reduction of costs and construction time. They also present a **high level of inherent safety**, since they use passive safety factors.

Conclusion

- From environmental perspective, **shutting down cement plants or other assets before their full life term means wasting the carbon already sunk in them.** Hence, it is better to **use them until their end of life.**
- Hence, India should involve a **balanced approach that addresses the challenges** and opportunities of the sector and enables the growth of a **portfolio of low-carbon, firm, and reliable energy sources.**

Drishti Mains Question

Discuss the opportunities and challenges of nuclear energy sector in India. Would it be right on India's part to look for Phase down of Nuclear energy?

UPSC Civil Services Examination Previous Year's Question (PYQs)

Q1. Consider the following countries: (2015)

1. China
2. France
3. India
4. Israel
5. Pakistan

Which among the above are Nuclear Weapons States as recognized by the Treaty on the Non-Proliferation of Nuclear Weapons, commonly known as Nuclear Non-Proliferation Treaty (NPT)?

- (a) 1 and 2 only
- (b) 1, 3, 4 and 5 only
- (c) 2, 4 and 5 only
- (d) 1, 2, 3, 4 and 5

Ans: (a)

- France and China along with USA, UK and Russia are the five Nuclear Weapons States as recognized by the Treaty on the Non-Proliferation of Nuclear Weapons or the Nuclear Non-Proliferation Treaty (NPT). **Hence, 1 and 2 are correct.**
- The NPT is a landmark international treaty whose objective is to prevent the spread of nuclear weapons and weapons technology, to promote cooperation in the peaceful uses of nuclear energy and to further the goal of achieving nuclear disarmament.
- India, Israel, Pakistan and North Korea are the countries that have nuclear weapons, but have not signed the NPT. **Hence, 3, 4, 5 are not correct.**
- **Therefore, option (a) is the correct answer.**

Q2. To meet its rapidly growing energy demand, some opine that India should pursue research and development on thorium as the future fuel of nuclear energy. In this context, what advantage does thorium hold over uranium? (2012)

1. Thorium is far more abundant in nature than uranium.
2. On the basis of per unit mass of mined mineral, thorium can generate more energy compared to natural uranium.
3. Thorium produces less harmful waste compared to uranium.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (d)

- According to the UN nuclear agency IAEA (International Atomic Energy Agency), there are many benefits with Thorium compared to Uranium, which is currently used in nuclear reactors.
- Thorium is four times more abundant in nature than Uranium, and is widely distributed throughout the Earth's crust. **Hence, statement 1 is correct.**
- Thorium fuel generates less harmful waste compared to natural Uranium and most importantly, no new weapon-grade material is present in the waste profile; the waste consists of the radioisotope Uranium-233, or U233, which is virtually impossible to weaponise. **Hence, statement 3 is correct.**
- Thorium fuel generates more energy per unit of mass than Uranium fuel by a factor of approximately 30. **Hence, statement 2 is correct.**
- **Therefore, option (d) is the correct answer.**