



## Shift of Tech Giants Towards Nuclear Energy

**For Prelims:** [Small Modular Reactors \(SMRs\)](#), [Startup Oklo](#), [Wind and Solar Energy](#), [Carbon Footprints](#), [Greenhouse Gas Emissions](#), [Nuclear Power](#), [Rural Electrification Corporation](#), [Nuclear Power Corporation of India](#), [Nuclear Fission](#), [Bharat Small Modular Reactor](#), [Uranium](#), [Chernobyl Disaster \(1986\)](#), [Fukushima Accident \(2011\)](#), [Nuclear Waste](#).

**For Mains:** Growing significance of nuclear energy for meeting energy needs and climate goals.

[Source: TH](#)

### Why in News?

Recently, some **big tech companies** including [Google](#) signed agreements to **purchase nuclear energy** to meet rising electricity demands for [Artificial Intelligence](#) data centres.

### Which Big Tech Companies Investing in Nuclear Energy?

- **Google:** Google has entered into a corporate agreement to purchase nuclear energy from multiple [Small Modular Reactors \(SMRs\)](#) being developed by **Kairos Power**.
  - It will provide **500 MW** of carbon-free power for development of **AI technologies**.
- **Microsoft:** Microsoft signed a 20-year power purchase agreement with **Constellation Energy** to restart the [Three Mile Island nuclear power plant in the US](#).
  - It will provide approximately **835 MW of carbon-free energy**, supporting Microsoft's goal of becoming carbon negative.
- **Amazon:** Amazon has formed **three agreements** to support nuclear energy. It includes, partnership with **Energy Northwest** for **SMRs in Washington**, investing in **SMR** development with **X-energy**, and collaborating with **Dominion Energy in Virginia**.
- **OpenAI:** OpenAI CEO **Sam Altman** has backed the nuclear [startup Oklo](#), aiming for operational status by 2027.
  - Altman also invested in **Helion**, a **nuclear fusion company**, in 2021.

### Why Are Big Tech Companies Shifting to Nuclear Energy?

- **Increasing Energy Demands from AI:** The **Electric Power Research Institute (EPRI)**, a non-profit organisation, highlighted that **data centres' electricity consumption could more than double by 2030**.
  - Data centres, which are critical for AI operations, are projected to **consume up to 9% of the United States' electricity by 2030**, more than double their current usage.
- **Limitations of Renewable Energy:** Nuclear energy provides **continuous and carbon-free power** around the clock as AI companies scale their operations.
  - Renewable energy sources such as [wind](#) and [solar](#) are **intermittent** in nature.
- **Sustainability:** Major tech companies are increasingly focused on reducing their [carbon footprints](#) and achieving **sustainability goals**.
  - E.g., Google reported a **13% rise in global greenhouse gas emissions in 2023**,

highlighting the challenges of balancing growth with sustainability.

- **Strategic Partnerships and Investments:** Tech giants are forging strategic partnerships with energy companies to invest in [nuclear power projects](#).
  - E.g., Microsoft partnered with **Constellation Energy** to revitalise the Three Mile Island nuclear plant in the US for securing long-term carbon-free energy.
- **Potential for Economic Advantage:** Investing in nuclear power now enables tech firms to secure a **reliable energy source**, which will be increasingly **valuable** as energy **competition intensifies**.
- **Climate Change Concern:** Concerns about [climate change](#) and energy reliability make nuclear power **more appealing**, prompting tech companies to justify their investments in this sector.

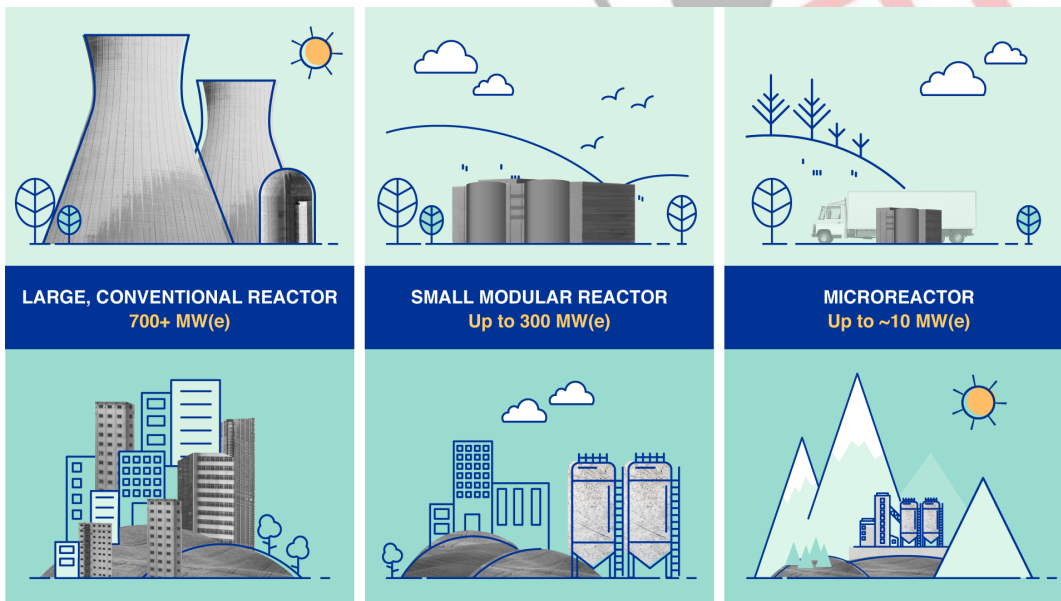
## What is the Nuclear Energy Scenario in India?

- India aims to **triple its nuclear power capacity to 22,480 MW by 2032**, with a goal of deriving **25%** of its electricity from **nuclear sources by 2050**.
- [REC \(Rural Electrification Corporation\)](#) plans to allocate **Rs 6 trillion** to renewable and nuclear projects by **2030**.
- [NTPC](#) is partnering with [NPCIL \(Nuclear Power Corporation of India\)](#) to form **Anushakti Vidhyut Nigam**, focusing on building and operating **nuclear power plants**.
- India plans to establish **10 new reactors** and collaborate with private players to explore SMRs and innovate in nuclear technologies.

## What are Key Points about Small Modular Reactors (SMRs)?

- **About:** SMRs are advanced nuclear reactors that are about **one-third the size** of traditional nuclear reactors.
  - **Small Size (S):** Power capacity of up to **300 MW(e)**.
  - **Modular (M):** Components are **prefabricated and transported** to the installation site.
  - **Nuclear Reactors (R):** Use [nuclear fission](#) to generate low-carbon electricity.
- **Advantages:**
  - **Smaller Footprint:** SMRs can be installed in locations **unsuitable for larger reactors**.
  - **Cost and Construction Efficiency:** Prefabrication and modular design **reduce construction time and costs**.
  - **Off-Grid Potential:** SMRs, especially **microreactors (up to 10 MW)**, can provide power in remote areas.
  - **Reduced Refuelling Frequency:** SMRs may only need refuelling every **3 to 7 years**, with some designs lasting up to **30 years** without refuelling.
- **Global Adoption:** Russia's floating SMR power plant, the **Akademik Lomonosov**, began commercial operation in **2020**.
  - India aims to deploy 40-50 SMRs named [Bharat Small Modular Reactor](#) to replace captive thermal power plants
  - Other countries like **Argentina, Canada, China, South Korea, and the U.S.** are also advancing SMR projects.
  - More than **80 commercial SMR** designs are being developed globally for various applications, including **electricity generation, heating, water desalination, and industrial steam**.
- **Challenges:** Although SMRs have a lower upfront capital cost per unit, their economic competitiveness **still needs to be proven in real-world deployments**.

## Advantages of Small Modular Reactors



### What are Advantages of Nuclear Energy?

- **Low-Carbon Solution:** Nuclear energy is a **reliable and consistent source** of power that is not affected by weather conditions, making it suitable for meeting energy demands continuously.
- **Small Land Footprint:** Nuclear facilities occupy **significantly less land** compared to other renewable energy sources.
  - A typical **1,000 MW nuclear plant requires only about one square mile**, whereas wind farms and solar plants need **360 and 75 times more land**, respectively.
- **High Power Output:** Nuclear power plants have a **high capacity factor**, producing maximum output approximately **93%** of the time.
- **Minimal Waste Production:** Nuclear energy produces **relatively small amounts of waste** compared to other energy sources.

- Advanced reactor designs are being developed that can utilise used fuel, potentially reducing waste even further.

## What Concerns are Associated with Nuclear Energy?

- **Carbon Dioxide Emissions:** Nuclear power reactors themselves do not produce direct carbon dioxide emissions during operation but the processes of **mining and refining uranium ore**, as well as constructing nuclear power plants, require significant energy sourced from fossil fuels.
- **Reputation Issues:** Nuclear energy is often linked to **nuclear weapons**, which contributes to public fears about **proliferation and security risks**.
- **Safety Concerns:** High-profile accidents, such as **Three Mile Island Incident (1979)**, **Chernobyl Disaster (1986)** and **Fukushima Accident (2011)** have instilled fear about the safety of nuclear power plants, leading to widespread scepticism about their safety.
  - Environmental groups, such as '**Friends of the Earth**,' have criticised nuclear energy highlighting issues like **accidents, radioactive leaks**, and the challenges of **nuclear waste management**.
- **Cost and Financial Viability:** Nuclear power is often associated with **high initial construction and operational costs**, making it less appealing compared to alternative energy sources.

## Way Forward

- **Enhancing Safety Protocols:** Adopt advanced reactor designs, such as **Generation IV reactors and Small Modular Reactors (SMRs)**, which prioritise **safety and efficiency**.
- **Innovative Waste Management:** Invest in advanced **nuclear waste management** solutions, such as **deep geological storage**, which has been successfully implemented in countries like **Finland**.
- **Integration with Renewables:** Promote nuclear energy as a **complementary resource** to intermittent renewable sources, enhancing overall **grid stability and energy security**.
- **Regulatory Improvements:** Implement stringent regulatory frameworks and **international safety standards** to restore public confidence in nuclear facilities.

### **Drishti Mains Question:**

Small Modular Reactors (SMRs) are being hailed as the future of nuclear energy for their adaptability and efficiency." Critically examine.

## UPSC Civil Services Examination, Previous Year Questions (PYQs)

### **Prelims**

**Q. The function of heavy water in a nuclear reactor is to (2011)**

- (a) Slow down the speed of neutrons
- (b) Increase the speed of neutrons
- (c) Cool down the reactor
- (d) Stop the nuclear reaction

**Ans: (a)**

### **Mains**

**Q. With growing energy needs should India keep on expanding its nuclear energy programme? Discuss the facts and fears associated with nuclear energy. (2018)**

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