Mains Practice Question

Q. Evaluate the viability of nuclear power as a clean and sustainable energy source for India. Discuss challenges associated with nuclear energy. **(250 words)**

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Approach

- Introduce by mentioning the state of India’s energy demand and consumption.
- Discuss the viability of nuclear power as a clean and sustainable energy source for India
- Related Challenges & Way Forward
- Conclude Positively

Introduction

India, the world's **third-largest energy consumer**, has seen its energy demand surge rapidly, with total consumption rising by approximately 6.5% annually since 2020. Coal currently dominates India's energy mix, accounting for about 40%. To meet this growing demand while addressing climate change concerns, there is a pressing need to explore sustainable energy options, particularly nuclear energy.

- Nuclear energy is the fifth-largest source of electricity in India, contributing about 2% of the country's total electricity generation.

Body

Economic Viability

- **Cost Advantages**: 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 Raw Material:** Though nuclear energy generation in India is currently dominated by the use of uranium which is imported, the country possesses 25% of the world's thorium reserves, the largest share globally.
    - Thorium has the potential to serve as an alternative fuel in nuclear plants, which could reduce import burdens and make nuclear energy more affordable.
- **Foreign Collaboration:** Collaborations with countries possessing advanced nuclear technology can enhance India's nuclear capacity and help build a domestic industrial ecosystem. This can reduce costs and improve technological capabilities.
- **Economic Spin-offs**: The development of the nuclear sector can provide collateral benefits to the Micro, Small, and Medium Enterprises (MSME) sector, supporting the 'Make in India' initiative and creating a skilled workforce.

Environmental Viability:

- **Low Greenhouse Gas Emissions**: Nuclear power is a low-carbon energy source. Each unit of nuclear power replacing coal-based power saves about 1 kg of CO_2 emissions. In 2015-16, India's nuclear power generation saved over 37 million tonnes of CO_2.

    - India has committed to go Net Zero by 2070, According to Anil Kakodkar, former chairperson of the Atomic Energy Commission, India cannot meet the net-zero target without nuclear power
- **Life Cycle Emissions:** The average life cycle greenhouse gas emissions for nuclear power plants are among the lowest of all energy sources, significantly lower than those of solar power plants.
- **Land Use Efficiency:** Nuclear power plants require much less land compared to solar power plants for the same installed capacity, making them suitable for densely populated countries like India.

Challenges:

- **Safety Concerns**: Public apprehension persists due to the potential for catastrophic accidents, exemplified by historical **events like Bhopal Gas Tragedy, Chernobyl and Fukushima**. Building and maintaining public trust through stringent safety measures and transparent communication is paramount.
- **Waste Management:** Radioactive waste disposal remains a critical issue. Developing secure, long-term storage solutions that ensure minimal environmental impact and public health risks is imperative.
- **Insufficient Nuclear Installed Capacity**: In 2008, the Atomic Energy Commission projected that India would have 650GW of installed capacity by 2050; the current installed capacity is only 6.78 GW.
- **Regulatory Framework:** India's Civil Liability for Nuclear Damage Act, 2010, has been a contentious issue for foreign suppliers who fear being held liable for accidents beyond their control. This liability concern has hindered international cooperation and investment.
- **Public Acceptance**: Overcoming societal resistance requires proactive engagement, education, and awareness campaigns. Addressing misconceptions and demonstrating the benefits of nuclear power in terms of energy security and climate change mitigation are crucial steps.

Way Forward

- **PHWR Expansion:** The indigenous 700 MWe PHWR, with the first unit already operational, should be the primary source for increasing base load electrical capacity. Currently, fifteen more units are under construction using a fleet approach.
    - The implementation of multiple fleets should involve various public sector undertakings (PSUs) in addition to NPCIL.
- **SMRs and Coal Plant Replacement**: Indigenous Small Modular Reactors (SMRs) should be constructed at numerous sites that will be vacated by retiring coal plants in the coming decades. Importing these units would make electricity production unaffordable.
    - NTPC, which owns the largest number of coal plants in the country, is a natural partner in this process, and additional industrial partners could also be involved.
- **Integrate Nuclear with Renewables**: Adopt a balanced energy strategy that integrates nuclear power with renewable energy sources. This can help in meeting the large and diverse energy demands of the country in a sustainable manner.
- **Thorium Energy Development:** Speed up **second and third stage nuclear-power programme development** to unleash thorium energy potential in accordance with the pre-existing plans for long-term sustainable energy supply.
    - **Bhabha Atomic Research Centre has the requisite capability.**
- **Policy Support:** Ensure strong policy support from the government to facilitate the growth of the nuclear power sector. This includes favorable policies for foreign investment, public-private partnerships, and incentives for innovation.

Conclusion

With visionary policy frameworks and a commitment to innovation, India can unlock the transformative potential of nuclear power, propelling towards a future where energy security converges seamlessly with environmental stewardship. Through collective action and foresight, India charts a course to lead the global charge in sustainable energy solutions, ensuring a brighter tomorrow for generations to come.