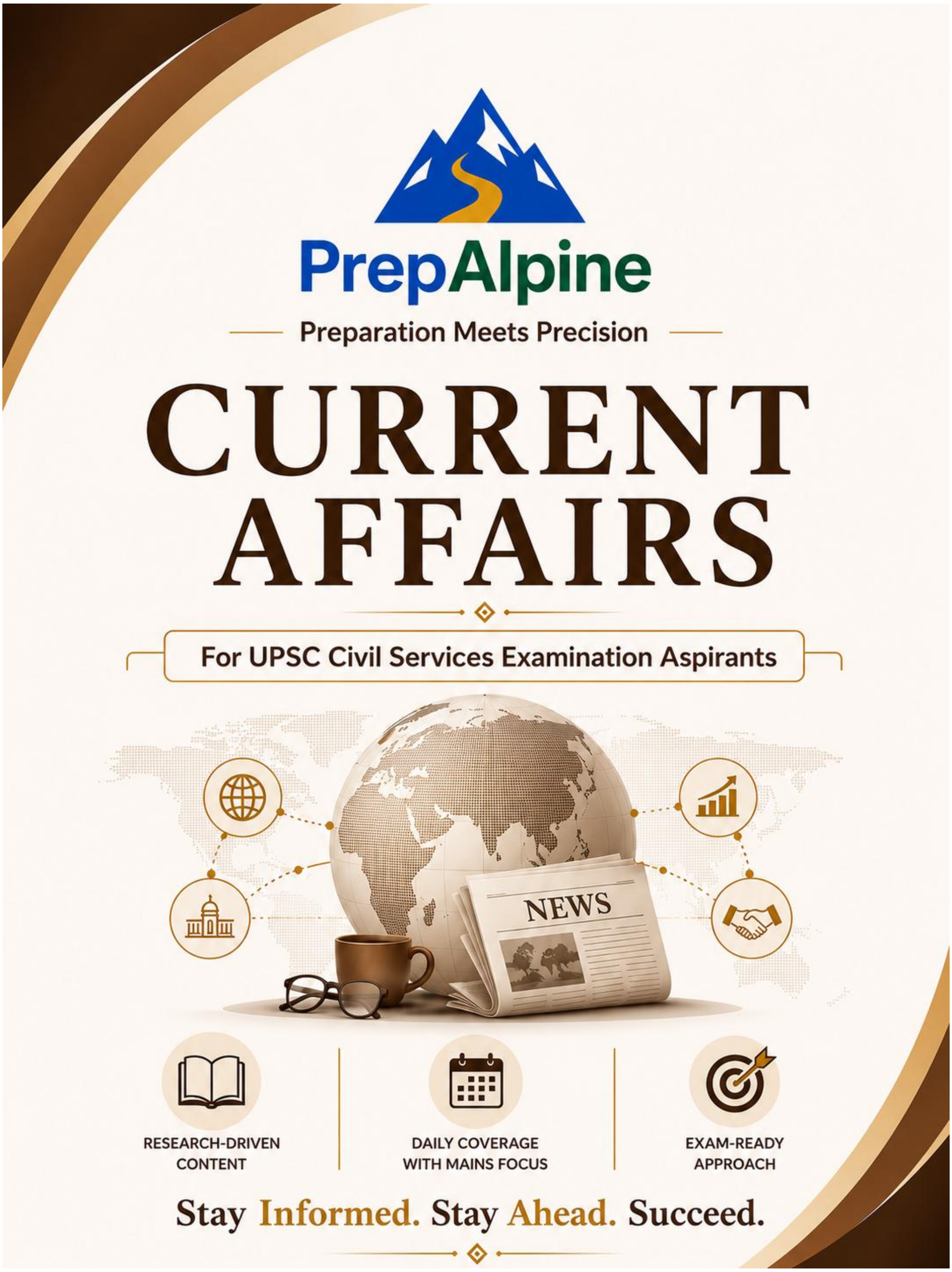
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DAILY CURRENT AFFAIRS DATED 14.07.2026

GS Paper II: Current Affairs

1. Compressed Biogas and India's Energy Security

a. Introduction

India imports nearly 85% of its crude oil requirements and remains vulnerable to geopolitical disruptions, especially in West Asia. Although the government has promoted Compressed Biogas (CBG) through schemes, blending mandates and financial support, progress in establishing plants has remained considerably below target.

b. What is Compressed Biogas?

Biogas is produced through the anaerobic digestion of organic matter such as animal dung, agricultural residue, food waste and municipal organic waste. It primarily contains methane and carbon dioxide.

After purification and compression, it becomes Compressed Biogas, which is chemically similar to Compressed Natural Gas. It can be used as:

- Transport fuel.
- Cooking and heating fuel.
- Source of electricity.
- Substitute for imported natural gas and LPG.

CBG is renewable and can potentially be close to carbon-neutral when produced from waste feedstock.

c. Government Initiatives

The government launched the Sustainable Alternative Towards Affordable Transportation initiative in 2018, with a target of establishing 5,000 CBG plants. However, only 132 plants had been completed by June 3, 2026, indicating a wide implementation gap.

Under the GOBARdhan Scheme, financial assistance has been provided to establish community biogas and waste-processing plants. Government support has also included:

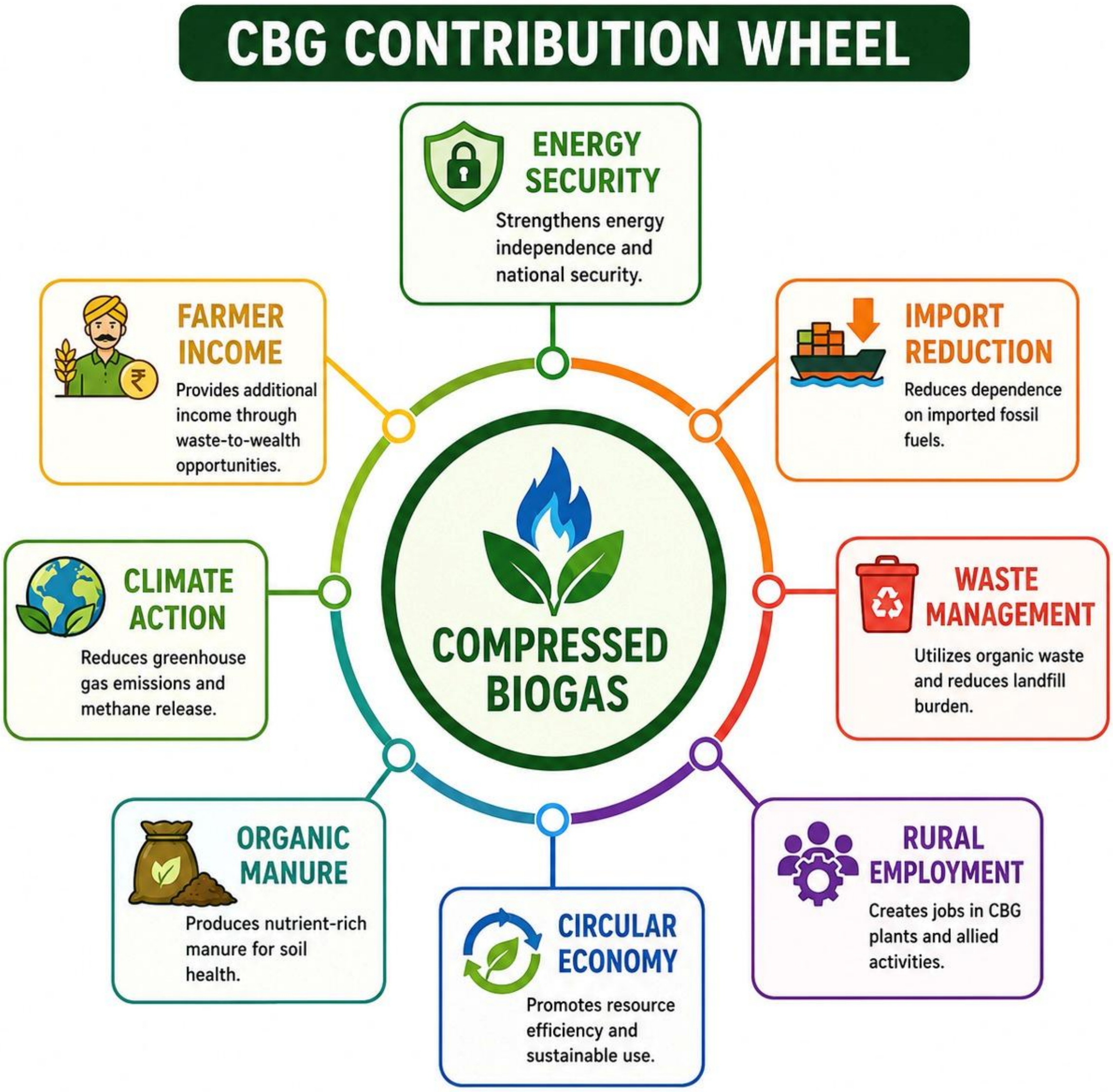
- Grants for biomass aggregation machinery.
- Assistance for pipeline connectivity to gas grids.
- Assured procurement and market access.
- Support for waste collection and processing infrastructure.

In 2023, the National Biofuels Coordination Committee approved a mandatory CBG blending obligation. Gas distributors are required to blend CBG with their supplies from FY26, beginning at 1% and rising to 5% by FY29.

d. Significance for India's Energy Security

- **Reduction in import dependence:** Domestic CBG production can partially replace imported natural gas, LPG and transport fuels, reducing exposure to global oil and gas price shocks.
- **Diversification of the energy basket:** CBG can complement solar, wind, ethanol and green hydrogen, thereby improving the resilience of India's energy system.
- **Productive use of agricultural waste:** Crop residue, cattle dung and organic municipal waste can be converted into commercially useful energy rather than being burnt or dumped.

- **Rural income and employment:** Biogas plants can generate additional income for farmers, cattle owners, rural entrepreneurs and local bodies through feedstock supply and decentralised energy production.
- **Environmental benefits:** CBG can reduce methane emissions from unmanaged waste, lower stubble burning and improve municipal waste management.
- **Support for circular economy:** Apart from energy, biogas plants also produce organic manure, reducing dependence on chemical fertilisers and closing nutrient cycles.



e. Why Has Progress Remained Limited?

- **High capital and technology costs:** Biogas plants require substantial investment in digesters, purification units, compression systems and storage infrastructure.
- **Inadequate access to formal credit:** Banks often perceive CBG projects as commercially risky because of uncertain feedstock supply, technology performance and long gestation periods.
- **Weak feedstock supply chains:** Agricultural residue and organic waste are geographically dispersed. Their collection, transport, segregation and storage increase production costs.
- **Limited gas-grid and pipeline connectivity:** Many plants are located far from city gas distribution networks, making evacuation and sale of CBG difficult.

- **Poor private-sector participation:** Policy uncertainty, delayed payments and uncertain returns have discouraged investment despite ambitious targets.
- **Coordination challenges:** CBG development requires cooperation among ministries, oil and gas companies, local bodies, farmers and State governments. Fragmented implementation has slowed progress.

f. Risks to Agriculture and Food Security

The experience of some countries shows that generous bioenergy incentives can alter cropping patterns. In Germany, profitable biogas production encouraged extensive maize cultivation, leading to concerns over monoculture and displacement of food crops.

India faces a similar risk because administered prices have made maize increasingly attractive for ethanol production. The area and output under maize have expanded, while pulses, oilseeds and some other cereals have grown more slowly.

An excessive shift towards energy crops may:

- Reduce crop diversity.
- Compete with food and fodder production.
- Increase dependence on imported pulses and edible oils.
- Intensify pressure on water and land resources.
- Expose domestic food prices to global supply shocks.

Therefore, CBG expansion must remain predominantly waste-based rather than crop-based.

g. Lessons from International Experience

European countries such as Germany, France and Denmark have developed large biogas sectors through stable incentives, assured purchase arrangements and grid connectivity.

However, Denmark's approach offers an important lesson. It has discouraged the extensive use of food crops as feedstock and relies mainly on:

- Livestock manure.
- Agricultural residue.
- Organic industrial waste.
- Municipal biodegradable waste.

India should similarly promote second-generation feedstocks and avoid creating incentives that encourage diversion of food crops towards energy production.

h. Can India Replicate the Ethanol Blending Model?

India rapidly increased ethanol blending in petrol from around 1.5% in 2014 to 20% by December 2025. The success was supported by assured procurement, administered prices and expansion of production capacity.

However, CBG is more complex than ethanol because:

- Feedstock is more dispersed.
- Gas purification and compression require advanced technology.
- Pipeline and storage infrastructure are inadequate.
- Plant-level economics are more uncertain.

- Feedstock quality varies considerably.

Thus, the ethanol model cannot be mechanically replicated. CBG requires a more decentralised and infrastructure-intensive policy framework.

i. Way Forward

- Provide viability-gap funding, concessional credit and credit guarantees for new plants.
- Ensure timely payments and long-term purchase agreements by gas distributors.
- Develop decentralised biomass collection, segregation and storage systems.
- Expand pipeline connectivity and permit flexible transport through cascades where grids are unavailable.
- Prioritise cattle dung, crop residue, sewage and municipal waste over food crops.
- Introduce sustainability criteria to prevent monoculture and diversion of agricultural land.
- Encourage accelerated depreciation, tax incentives and risk-sharing mechanisms to attract private investment.
- Improve coordination among local bodies, State governments, oil companies and rural institutions.
- Promote small and medium-sized plants suited to local feedstock availability rather than relying only on large centralised facilities.

Conclusion

Compressed biogas can contribute significantly to India's energy security by reducing import dependence, improving waste management and creating rural income. However, its success will depend on resolving financing, feedstock and infrastructure constraints. A carefully designed, waste-based CBG strategy can strengthen energy resilience without compromising food security or agricultural diversity.

GS Paper II: Current Affairs

2. India's Nuclear Power Development: Balancing Expansion, Self-Reliance and Safety

a. Introduction

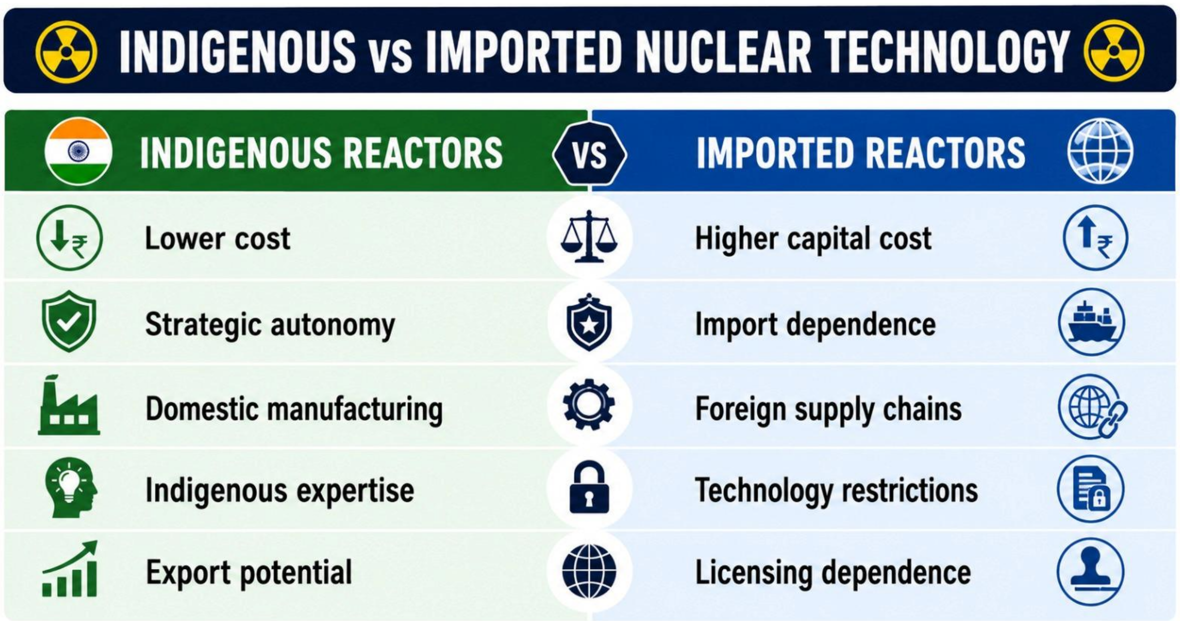
India has set a target of developing about 100 GW of nuclear power capacity by 2047 and is considering wider participation by public and private entities. The debate centres on whether India should rely primarily on its indigenous reactor capabilities or import foreign technologies, including emerging Small Modular Reactors (SMRs).

b. Evolution of India's Nuclear Programme

International sanctions imposed after India's 1974 nuclear test restricted access to uranium, reactor technology and equipment. These constraints compelled India to develop a largely indigenous nuclear ecosystem through cooperation between the Atomic Energy Commission (AEC) and domestic industries.

The India–U.S. Civil Nuclear Agreement of 2008 and the Nuclear Suppliers Group waiver enabled India to import uranium and engage in civilian nuclear commerce. However, restrictions on the transfer of sensitive enrichment and reprocessing technologies have continued, reinforcing the need for technological self-reliance.

India has progressively increased the capacity of its indigenous Pressurised Heavy Water Reactors (PHWRs) from about 200 MW to 500 MW and subsequently to 700 MW. It has also developed a 500 MW Prototype Fast Breeder Reactor, an important component of its three-stage nuclear programme.



c. Case for an Indigenous-Led Strategy

- **Cost competitiveness:** Indigenously designed nuclear plants are claimed to be significantly cheaper than many foreign reactor systems. This makes domestic technology better suited for large-scale capacity expansion in a price-sensitive electricity market.
- **Energy security:** Reliance on domestic design, manufacturing and fuel-cycle capabilities limits exposure to geopolitical sanctions, technology denial and foreign supply-chain disruptions.
- **Industrial development:** A large indigenous programme can strengthen Indian manufacturing, engineering, precision equipment and specialised materials industries.
- **Export potential:** Cost-effective Indian reactors, especially smaller PHWR-based units, could eventually be offered to developing countries seeking reliable low-carbon power.
- **Continuity of technological capability:** Sustained domestic development preserves institutional knowledge built over decades under the Department of Atomic Energy.

d. Concerns Regarding Large-Scale Imports

Foreign reactor projects may involve substantially higher capital costs, leading to expensive electricity and long-term financial commitments. Import dependence may also create new vulnerabilities in maintenance, spare parts, fuel supply and intellectual property.

The commercial difficulties encountered during earlier negotiations with Western reactor suppliers indicate that imported plants may not always be economically viable for India.

Therefore, foreign collaboration should supplement rather than displace indigenous capability, particularly in areas where India faces genuine technological gaps.

e. Role of New Public and Private Entrants

Opening the nuclear sector to new entities can:

- Mobilise additional capital.

- Increase manufacturing capacity.
- Reduce project delays and execution costs.
- Encourage competition and innovation.
- Accelerate progress towards the 2047 target.

However, nuclear power differs from conventional infrastructure because operational failure can have severe and long-lasting consequences. New entrants should initially undertake a limited number of projects using proven domestic technologies and establish strong technical and safety credentials before rapid expansion.

The AEC can provide reactor designs and technical support, while Indian firms contribute manufacturing, construction and project-management capabilities.

f. Small Modular Reactors: Opportunities and Limitations

SMRs are being explored globally for industrial clusters, remote regions and energy-intensive facilities such as data centres. Their smaller size may offer:

- Lower initial capital requirements.
- Modular construction.
- Flexible siting.
- Faster incremental capacity addition.
- Potential use for captive industrial power.

However, most foreign SMR designs are yet to achieve widespread commercial operation. India should avoid becoming an experimental deployment ground for unproven foreign technologies.

A prudent approach would be to:

- Develop indigenous smaller reactors using existing PHWR expertise.
- Permit foreign-designed SMRs only after satisfactory commercial operation elsewhere.
- Undertake bilateral contracts based on economic viability and safety.
- Ensure that intellectual property and fuel dependence do not create strategic vulnerabilities.

g. Safety as the Central Challenge

India’s nuclear power programme has maintained a relatively strong safety record. Rapid capacity expansion and the entry of multiple new operators could, however, strain regulatory and institutional oversight.

A serious accident could create public opposition, delay projects and undermine the legitimacy of nuclear power, as occurred in several countries after major global nuclear disasters.

Safety must therefore remain more important than speed of capacity addition.

h. Way Forward

- Prioritise proven indigenous PHWR and fast-breeder technologies for large-scale expansion.
- Develop domestic Light Water Reactor and SMR capabilities through dedicated research programmes.
- Allow private and public entrants to scale gradually after demonstrating technical and safety competence.
- Strengthen the independence, capacity and transparency of nuclear regulation.

- Institutionalise continuous external safety audits and mandatory public disclosure of safety standards.
- Use foreign collaboration selectively for advanced technology, components and research rather than complete dependence on imported plants.
- Standardise reactor designs to reduce construction time and exploit economies of scale.
- Build a robust domestic supply chain for nuclear-grade equipment, fuel fabrication and waste management.
- Ensure transparent public consultation and credible emergency-preparedness systems around nuclear sites.

Conclusion

Nuclear energy can support India’s energy security, industrialisation and low-carbon transition. However, the path to 100 GW by 2047 should not be driven by capacity targets alone. India’s most viable strategy lies in combining indigenous technological strength, carefully regulated private participation and uncompromising safety standards. Expansion must reinforce, rather than dilute, the self-reliance built through decades of technological effort.

GS Paper II: International Relations

3. India–Australia Uranium Supply Arrangements

a. Introduction

India and Australia have finalised the administrative arrangements required to operationalise uranium exports from Australia to India under the Australia–India Nuclear Cooperation Agreement (2015). The move is expected to facilitate commercial contracts, including with private sector entities, and strengthen India's long-term nuclear energy programme.

b. Background Context

Following the India–U.S. Civil Nuclear Agreement (2008), India concluded a safeguards agreement with the IAEA and received an NSG waiver, enabling international civil nuclear cooperation despite being a non-signatory to the NPT.

Building on this framework, India and Australia signed the Civil Nuclear Cooperation Agreement in 2014, which entered into force in 2015. The latest administrative arrangements operationalise the commercial implementation of that agreement.

c. What Do the Administrative Arrangements Mean?

The arrangements establish the operational framework for uranium exports by ensuring that:

- Australian uranium is supplied exclusively for peaceful civilian purposes.
- All transfers remain under IAEA safeguards.
- Australian mining companies can enter into commercial contracts with Indian public and private entities.
- Bilateral safeguards and end-use verification mechanisms are strengthened.

These arrangements convert the existing political agreement into an effective commercial mechanism for sustained uranium trade.

d. Significance for India

- **Strengthens energy security:** Reliable uranium supplies support the expansion of nuclear power, reducing dependence on imported fossil fuels and improving energy diversification.
- **Supports clean energy transition:** Nuclear power provides stable, low-carbon baseload electricity, complementing renewable energy in achieving India's climate commitments.
- **Deepens India–Australia strategic partnership:** The agreement expands cooperation beyond defence and critical minerals into long-term energy security.
- **Facilitates private participation:** With India's nuclear sector gradually opening to private investment, easier access to imported uranium can improve commercial viability.
- **Enhances supply-chain resilience:** Diversifying uranium imports reduces dependence on a limited number of suppliers and strengthens long-term fuel security.

e. Challenges

- Nuclear power projects involve high capital costs and long gestation periods.
- Expansion requires strong nuclear safety, waste management and regulatory oversight.
- Imported uranium alone cannot address broader technological dependence in reactor design and fuel-cycle technologies.
- Nuclear energy must complement, rather than replace, renewable energy and energy-efficiency measures.

f. Way Forward

- Secure diversified long-term uranium supply agreements with multiple partner countries.
- Accelerate indigenous reactor development alongside imported fuel availability.
- Strengthen nuclear safety regulation and waste management systems.
- Promote technology collaboration while preserving strategic autonomy.
- Integrate nuclear power with India's broader clean energy and net-zero strategy.

Conclusion

The operationalisation of the India–Australia uranium supply arrangements marks an important step in strengthening India's long-term energy security. By ensuring reliable fuel supplies under international safeguards, the agreement supports India's expanding civilian nuclear programme while reinforcing the broader India–Australia Comprehensive Strategic Partnership.

GS Paper III: Security

4. INS Mahendragiri and India’s Indigenous Shipbuilding Capacity

a. Introduction

The Indian Navy has commissioned INS Mahendragiri, the sixth indigenous stealth frigate under Project 17A, into the Eastern Fleet at Visakhapatnam. Its induction reflects the rapid expansion of India’s indigenous warship-building capacity and growing emphasis on maritime self-reliance.

b. Key Features of INS Mahendragiri

INS Mahendragiri is a multi-mission stealth frigate with a displacement of nearly 6,670 tonnes and more than 75% indigenous content.

Its major capabilities include:

- BrahMos supersonic surface-to-surface missiles.
- Medium-range surface-to-air missile systems.
- Multifunction radar for detection and engagement of aerial threats.
- Improved stealth, survivability and combat-management systems.
- Ability to undertake anti-air, anti-surface and anti-submarine operations.

Project 17A represents an advanced version of the earlier Shivalik-class frigates and marks a generational improvement in naval design and combat capability.

c. Drivers of Faster Warship Induction

- **Timely procurement approvals:** A larger number of Acceptances of Necessity and timely contract approvals enabled projects to begin without prolonged administrative delays.
- **Learning effects:** Experience gained from constructing earlier Project 17A vessels helped shipyards standardise processes and shorten subsequent construction cycles.
- **Modular construction:** Warship sections are built separately and integrated later, improving efficiency, precision and parallel execution.
- **Advanced digital design:** Simulation tools and digital modelling allow early identification of design flaws and reduce costly modifications during construction.
- **Continuous naval involvement:** Dedicated Navy teams participate in design, construction and systems integration, improving coordination between users and shipyards.
- **Public-private partnerships:** Greater participation by private firms in equipment supply, construction and integration has reportedly reduced delivery periods from around 90 months to nearly 72 months.

d. Strategic Significance

- **Maritime preparedness:** Rapid induction of modern frigates strengthens India’s ability to protect sea lanes, island territories and maritime trade.
- **Response to regional competition:** The expansion of naval capability is important amid China’s growing presence in the Indian Ocean and increasing strategic activity in the Indo-Pacific.
- **Defence self-reliance:** High indigenous content reduces dependence on foreign suppliers and limits vulnerability to sanctions and supply-chain disruptions.
- **Industrial capability:** Warship construction supports domestic shipyards, electronics, metallurgy, weapons systems and thousands of small and medium enterprises.
- **Technology absorption:** Indigenous production enables long-term capability in naval architecture, stealth technology, propulsion and systems integration.
- **Export potential:** A mature shipbuilding ecosystem can help India emerge as a supplier of patrol vessels, frigates and associated systems to friendly countries.

e. Continuing Challenges

- Dependence on imported engines, propulsion systems and some critical sensors remains.
- Cost and time overruns continue in certain defence projects.
- Public shipyards face capacity and productivity constraints.
- Private-sector participation is still limited in high-value naval platforms.
- Rapid induction requires adequate trained manpower, maintenance facilities and logistics support.
- Technological self-reliance must extend from platform construction to critical subsystems.

f. Way Forward

- Develop indigenous marine engines, propulsion systems, radars and electronic warfare equipment.
- Expand modular construction and common-platform design across ship classes.
- Strengthen long-term partnerships between the Navy, shipyards, research institutions and private firms.
- Provide predictable procurement pipelines to support investment in domestic capacity.
- Increase private-sector participation in complex warship construction and systems integration.
- Improve project management, quality assurance and lifecycle maintenance.
- Promote defence exports through lines of credit, training and long-term service support.

Conclusion

INS Mahendragiri reflects India’s transition from assembling warships to designing and building increasingly sophisticated naval platforms. Sustained investment in indigenous technology, efficient procurement and stronger public-private collaboration can transform naval shipbuilding into both a pillar of maritime security and a globally competitive industrial sector.

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