" We help you reach for the star "

VIDHVATH IAS KAS ACADEMY
&
STUDY CENTRE

DAILY CURRENT AFFAIRS

FOR UPSC CIVIL SERVICE EXAMINATION

DATE: 08/04/2026 (WEDNESDAY)

9972258970 & 9740702455

#317/A SKB Arcade, D. Subbaiah Road,
Ramaswamy Circle, Mysuru-570004

Table of Contents

1. The BA.3.2 'Cicada' Variant: Evolution and Implications

The SARS-CoV-2 virus continues its evolutionary trajectory with the emergence of BA.3.2, a sub-lineage of the Omicron strain. Dubbed 'Cicada' due to its period of dormancy followed by a sudden rise in detection, this variant has drawn global attention due to its highly divergent genetic profile. While it exhibits significant mutations in the spike protein, which theoretically enhance cell entry and immune evasion, early clinical data suggests symptoms remain consistent with previous Omicron sub-variants. Global health bodies, including the WHO and CDC, are currently maintaining a status of heightened surveillance without escalating it to a high-priority threat, emphasizing that existing hybrid immunity and updated vaccines continue to offer substantial protection against severe disease.

- **Evolutionary Origin:** BA.3.2 is a descendant of the Omicron lineage, first identified in South Africa in 2024; it remained largely inactive before surfacing globally in early 2026, leading to its 'Cicada' moniker.
- **Genetic Divergence:** The variant is characterized as "highly divergent," possessing a significantly higher number of mutations in the spike protein compared to the LP.8.1 strain used for the 2025-26 vaccine formulations.
- **Transmission and Evasion:** High spike protein mutations are critical as they dictate the virus's ability to bind to human ACE2 receptors and potentially bypass antibodies generated from prior infections or older vaccine doses.
- **Geographic Spread:** As of early 2026, the variant has been detected in over 23 countries and 29 US states, primarily identified through advanced genomic surveillance and traveler-based screening programs.
- **Clinical Severity:** Current reports indicate that BA.3.2 symptoms—including fever, fatigue, and upper respiratory issues—align with earlier Omicron descendants, with no current evidence of increased virulence or mortality.
- **Global Response:** The WHO has classified BA.3.2 as a "Variant Under Monitoring" (VUM), signaling the need for robust data collection while maintaining that it does not yet meet the criteria for a "Variant of Concern" (VOC).

Key Definitions & Concepts

- **Spike Protein:** The protrusion on the virus surface that facilitates entry into host cells; it is the primary target for most neutralizing antibodies and vaccines.
- **Genomic Surveillance:** The process of monitoring pathogens by sequencing their genetic material to identify mutations and track the spread of specific variants.
- **Variant Under Monitoring (VUM):** A WHO category for variants with genetic changes suspected to affect virus characteristics, requiring close monitoring and repeated assessment.

- **Immune Evasion:** The ability of a virus to remain undetected or un-neutralized by the host's immune system, often due to structural changes in its antigens.

Constitutional & Legal Provisions (India)

- **Entry 29, List III (Concurrent List):** The Constitution of India empowers both the Union and States to legislate on the "Prevention of the extension from one State to another of infectious or contagious diseases."
- **Epidemic Diseases Act, 1897:** Provides the legal framework for the government to take special measures and prescribe regulations to prevent the outbreak or spread of dangerous epidemic diseases.
- **Disaster Management Act, 2005:** Utilized during the pandemic to provide a hierarchical structure for disaster response, including the management of biological disasters and health emergencies.
- **Article 21:** The Right to Life includes the Right to Health, placing an obligation on the State to ensure public health safety through vaccination and surveillance.

Additional Key Points

- **Vaccine Efficacy:** While BA.3.2 is divergent, T-cell immunity (cellular immunity) often remains robust even when antibody-mediated (humoral) immunity is challenged by new mutations.
- **INSACOG Role:** In India, the Indian SARS-CoV-2 Genomics Consortium (INSACOG) is the nodal agency responsible for sequencing samples to detect the entry of such variants like BA.3.2.
- **Global Meeting:** The WHO Vaccine Composition Group is scheduled to discuss BA.3.2 in May 2026 to determine if future booster shots require further adjustment.

Conclusion The emergence of BA.3.2 highlights the "Red Queen Hypothesis" in virology, where the virus must constantly mutate to survive against increasing global immunity. While its high mutation rate warrants scientific vigilance, the lack of increased clinical severity suggests that the shift from a pandemic to an endemic phase remains stable. Public health strategy must prioritize sustained genomic surveillance and "vaccine realism" rather than alarmism.

UPSC Relevance

- **Prelims:** Science & Technology (Virus structure, Mutations, Vaccination), International Bodies (WHO classifications), and Government Acts (Epidemic Diseases Act).
- **Mains (GS Paper II & III):** Issues relating to development and management of Social Sector/Health; Science and Technology- developments and their applications; Role of international organizations in global health governance.

2. Comprehensive Maritime Reforms in India: Strengthening the Blue Economy

The Ministry of Ports, Shipping, and Waterways is set to initiate 20 sectoral reforms in early FY27 to overhaul India's maritime landscape. This strategic push aims to reduce logistics costs—which remain higher in India compared to global benchmarks—by enhancing regulatory oversight and boosting domestic capacity. Central to this plan is the transition of the Directorate General of Shipping into a more empowered "Directorate General of Maritime Administration" and the operationalization of the ₹25,000 crore Maritime Development Fund. By addressing the critical shortage of Indian-flagged vessels and domestic shipbuilding capacity, the government seeks to plug the massive foreign exchange drain of approximately $75 billion annually paid to foreign shipowners.

- **Establishment of a Dedicated Regulator:** The reform proposes transforming the DG Shipping into the Directorate General of Maritime Administration, granting it wider powers over safety, training, and ship registration to align with global standards.
- **Financial Incentives for Shipbuilding:** A revamped Shipbuilding Financial Assistance Policy and the creation of shipbuilding clusters aim to propel India into the top tier of global shipbuilding nations by 2047.
- **Maritime Development Fund (MDF):** The government will operationalize a ₹25,000 crore fund to provide long-term, low-cost financing specifically for maritime infrastructure and fleet expansion.
- **Reduction in Logistics Costs:** By shifting cargo from road/rail to coastal shipping and inland waterways, the reforms target doubling the share of these modes from 6% to 12% by 2047.
- **Enhancing Indian Tonnage:** Policy changes in taxation and registration are intended to encourage shipowners to fly the Indian flag, reducing the current dependence where less than 5% of EXIM cargo is carried by Indian vessels.
- **Strategic Vision Integration:** These reforms are integrated with the "Maritime Amrit Kaal Vision 2047" and the "Sagarmala Programme" to modernize port connectivity and port-led industrialization.

Key Definitions & Technical Terms

- **Shipping Tonnage:** A measure of the cargo-carrying capacity of a ship or a fleet; increasing India's tonnage means increasing the number and size of ships owned/registered in India.
- **Indian-Flagged Vessels:** Ships registered in India and subject to Indian laws, safety standards, and taxes.
- **Blue Economy:** The sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of the ocean ecosystem.
- **EXIM Cargo:** Export-Import cargo; the total volume of goods moving in and out of a country via international trade routes.

Constitutional & Legal Provisions

- **Article 246 & Seventh Schedule:** "Maritime shipping and navigation, including shipping and navigation on tidal waters" and "Major ports" fall under the **Union List (List I, Entries 25 and 27)**, giving the Parliament exclusive power to legislate.
- **Merchant Shipping Act, 1958:** The primary legislation governing the registration of Indian ships, safety, and the welfare of seafarers.
- **Major Port Authorities Act, 2021:** Provides for the regulation, operation, and planning of major ports in India and provides them with greater autonomy.
- **Inland Vessels Act, 2021:** Aims to harmonize the registry and movement of inland vessels across states to promote inland water transport.

Additional Key Points for Examination

- **Economic Impact:** Currently, India pays nearly $75 billion in freight to foreign entities; retaining even 10-15% of this through domestic shipping can significantly improve the Current Account Deficit (CAD).

- **Sustainability:** Coastal shipping is significantly more fuel-efficient and has a lower carbon footprint compared to road transport, aiding India's "Net Zero" commitments.
- **Strategic Autonomy:** Dependence on foreign vessels during global supply chain disruptions (like the Red Sea crisis) poses a security risk; a robust domestic fleet ensures supply chain resilience.

Conclusion India's maritime sector is at a pivotal junction where structural reforms can convert its vast coastline into an engine of high-speed growth. The transition from a passive participant in global shipping to a dominant maritime power requires the successful execution of these 20 reforms. By lowering logistics costs and fostering a self-reliant shipbuilding ecosystem, India can achieve the goals of 'Atmanirbhar Bharat' while becoming a global maritime hub by 2047.

UPSC Relevance

- **GS Paper III (Economy):** Infrastructure: Energy, Ports, Roads, Airports, Railways etc.; Logistics costs and their impact on manufacturing competitiveness.
- **GS Paper II (Governance):** Statutory, regulatory and various quasi-judicial bodies (The new Maritime Regulator).

3. India Ramps Up Venezuelan Crude Imports: Strategic Energy Diversification

India is set to import over 12 million barrels of Venezuelan crude oil in April 2026, marking a six-year high since February 2020. This strategic pivot comes as the world's third-largest oil importer seeks to mitigate supply disruptions in West Asia, where the ongoing Iran-Israel conflict has severely hampered traffic through the Strait of Hormuz. Traditionally, nearly 40% of India's oil imports passed through this chokepoint, but recent hostilities have forced Indian refiners—led by Reliance Industries—to look toward South America. The resumption of trade is facilitated by the easing of US sanctions following a major geopolitical shift in Caracas earlier this year, allowing India to tap into Venezuela's heavy, sulfur-rich crude, which is a perfect technical fit for Indian complex refineries.

- **Strategic Supply Shift:** India is projected to receive 10-12 million barrels of Venezuelan crude this month to offset lost volumes from the Middle East caused by the Hormuz blockade.
- **Geopolitical Facilitation:** The lifting of US sanctions on Venezuela's state-run PDVSA in early 2026, following the ouster of the previous regime, has cleared the legal hurdles for direct Indian procurement.
- **Refining Synergy:** Venezuelan "Merey" and "Boscan" blends are heavy crudes that yield high proportions of middle distillates like diesel and jet fuel, crucial for India's domestic and export energy markets.
- **Bypassing Chokepoints:** Diversifying to the South American producer allows India to secure energy via Atlantic-Cape routes, reducing exposure to the volatile Strait of Hormuz.
- **Private Sector Leadership:** Reliance Industries (RIL) has resumed direct imports at its Sikka port, utilizing its specific US licenses to bypass third-party intermediaries and stabilize supply chains.

- **Economic Cushion:** By broadening its sourcing to over 40 countries, India is utilizing "strategic realism" to prevent domestic fuel price spikes despite global crude volatility.

Key Definitions & Technical Terms

- **Strait of Hormuz:** A vital maritime chokepoint between the Persian Gulf and the Gulf of Oman; it is the world's most important oil transit route, through which a significant portion of Indian imports pass.
- **Heavy Crude Oil:** Dense oil that does not flow easily and often contains high sulfur; it requires complex refining but often yields valuable products like diesel.
- **Middle Distillates:** A range of refined petroleum products including jet fuel, heating oil, and diesel fuel.
- **Strategic Autonomy:** India's foreign policy approach of maintaining independent decision-making in its energy and trade relations despite external geopolitical pressures.

Constitutional & Legal Provisions

- **Entry 53, List I (Union List):** The Seventh Schedule of the Constitution gives the Union government exclusive power over "Regulation and development of oilfields and mineral oil resources; petroleum and petroleum products."
- **Petroleum Act, 1934:** The primary legal framework governing the import, transport, and storage of petroleum in India.
- **Article 73:** Extends the executive power of the Union to international treaties and trade agreements, allowing the Ministry of External Affairs and Ministry of Petroleum to negotiate energy security deals.

Additional Key Points for Examination

- **Forex Implications:** Venezuela often offers attractive pricing compared to Middle Eastern grades, helping India manage its massive oil import bill, which covers nearly 88% of domestic demand.
- **Energy Transition:** While India is pushing for renewables, the immediate "supply crunch" reinforces the need for a "Multi-Alignment" energy policy to fuel industrial growth.
- **Refining Hub:** India's refining capacity (over 250 MMTPA) acts as a "shock absorber," allowing it to process diverse crude grades from Russia, the US, and now Venezuela.

Conclusion India's return to Venezuelan crude is a textbook example of "Energy Realism." By leveraging shifting geopolitical alignments in the Americas to counter disruptions in West Asia, New Delhi is insulating its economy from a potential energy paralysis. This move not only secures physical supply but also provides price leverage in a tightening global market.

UPSC Relevance

- **GS Paper II (International Relations):** Effect of policies and politics of developed and developing countries on India's interests; India's relations with Venezuela and the US.
- **GS Paper III (Economy/Security):** Energy Security; Infrastructure: Energy; Diversification of supply chains; Impact of West Asian instability on Indian economy.

4. China-Iran Oil Trade: Navigating Sanctions and Geopolitical Shifts

The strategic partnership between China and Iran has evolved into a sophisticated mechanism to bypass Western economic pressure. While the U.S. "maximum pressure" campaign sought to cripple Iran's economy by targeting its oil exports, Tehran has found a resilient lifeline in Beijing. Currently, China absorbs nearly

the entirety of Iran's oil production, utilizing an intricate web of "teapot" refineries, small-scale banks, and shadow shipping fleets to facilitate trade. This relationship not only ensures Iran's fiscal survival and funding for its regional military objectives but also secures discounted energy for China's industrial engine, highlighting a significant challenge to the efficacy of unilateral global sanctions.

- **Dominant Trade Partnership:** China now purchases nearly 100% of Iran's oil exports, a massive increase from approximately 30% a decade ago, effectively neutralizing U.S. efforts to isolate Tehran's energy sector.
- **The "Teapot" Refinery Network:** Smaller, independent Chinese refineries (teapots) have replaced state-owned giants as primary buyers; these firms lack significant U.S. exposure, making them immune to traditional financial sanctions.
- **Financial Bypass Mechanisms:** Transactions are routed through smaller institutions like the Bank of Kunlun, which operate using the Yuan rather than the Dollar, thereby avoiding the U.S.-dominated SWIFT system and financial oversight.
- **The Shadow Fleet & Subterfuge:** A clandestine fleet of over 50 vessels employs "dark activities"—turning off transponders, falsifying cargo origins (labeling oil as Malaysian or Omani), and ship-to-ship transfers—to disguise the Iranian origin of the crude.
- **Barter and Infrastructure Deals:** Beyond cash, the trade involves a "services-for-oil" model where Chinese state-backed companies build Iranian infrastructure as compensation, amounting to billions in non-monetary trade.
- **Geopolitical Leverage:** For China, the trade fulfills energy security needs at discounted rates while simultaneously frustrating U.S. strategic objectives in the Middle East without overtly violating international law.

Key Definitions & Concepts

- **Maximum Pressure Campaign:** A U.S. foreign policy strategy initiated in 2018 aimed at forcing Iran to renegotiate the nuclear deal by imposing the strictest possible economic sanctions.
- **Teapot Refineries:** Small, independent oil refineries in China that operate outside the direct control of state-owned enterprises like Sinopec or CNPC.
- **Sanctions Evasion Network:** A complex system of front companies, ghost ships, and non-transparent financial channels used to move goods and money in violation of international or unilateral restrictions.
- **Ship-to-Ship (STS) Transfer:** The process of transferring cargo between seagoing ships positioned alongside each other, often used in this context to mix sanctioned oil with "clean" oil to hide its source.

Constitutional & Legal Provisions (India)

- **Article 73:** Extends the executive power of the Union to matters involving international treaties and trade, which governs how India navigates secondary sanctions imposed by other nations.

- **Section 3 of the United Nations (Security Council) Act, 1947:** Empowers the Indian government to apply measures (including economic ones) to give effect to decisions of the UN Security Council, though India typically does not recognize "unilateral" sanctions (like those from the U.S.).
- **FATF Compliance:** India's legal framework (including PMLA, 2002) is aligned with Financial Action Task Force standards to prevent money laundering and terror financing, which are often at the heart of sanctions-busting discussions.

Additional Key Points

- **Impact on Global Oil Prices:** The U.S. is often hesitant to strictly enforce sanctions against Chinese buyers for fear of a sudden drop in global supply, which would trigger a spike in fuel prices.
- **Regional Security:** The revenue generated from this trade is a primary source of funding for Iran's Islamic Revolutionary Guard Corps (IRGC) and its regional proxies.
- **Strategic Autonomy for India:** The China-Iran model serves as a reference point for other nations (including India) on how to balance energy security with the risk of secondary sanctions.

Conclusion The China-Iran oil nexus demonstrates the limitations of economic statecraft in a multipolar world. As Beijing provides the financial and logistical infrastructure for Tehran to bypass the dollar-based economy, the effectiveness of "maximum pressure" diminishes. This "sanctions-proof" ecosystem reflects a broader shift toward a fragmented global financial order where energy security and geopolitical alliances outweigh Western-led regulatory norms.

UPSC Relevance

- **Prelims:** Strategic chokepoints (Strait of Hormuz), Oil trade terminology (Brent vs. WTI, Teapot refineries), and International groupings (BRICS, SCO).
- **Mains (GS Paper II):** Effect of policies and politics of developed and developing countries on India's interests; India-China-Iran trilateral dynamics; Challenges to the U.S.-led global order.

5. US-Iran Military Standoff and the Hormuz Crisis: A Critical Turning Point

The ongoing conflict between the United States and Iran reached a zenith on April 7, 2026, with U.S. President Donald Trump issuing a high-stakes ultimatum to Tehran. Demanding the immediate reopening of the Strait of Hormuz—a global maritime chokepoint—the U.S. administration threatened the destruction of Iran's core "civilisational" infrastructure, including power grids and transportation networks. The deadline triggered an intense exchange of rhetoric and military action, including reported strikes by U.S. and Israeli forces on Kharg Island, Iran's primary oil export hub. However, in an eleventh-hour diplomatic breakthrough mediated by Pakistan, both nations agreed to a two-week mutual ceasefire, averting a full-scale regional war while leaving the long-term status of the Strait and regional security in a state of fragile transition.

- **The Presidential Ultimatum:** President Trump set a definitive 8 p.m. ET deadline for Iran to end its blockade of the Strait of Hormuz, characterizing the moment as a choice between "total regime change" and "complete demolition" of Iranian infrastructure.
- **Geopolitical Chokepoint:** The Strait of Hormuz is the world's most vital oil transit route; its closure by Iran led to a global supply crunch, prompting the U.S. to define its reopening as a non-negotiable military priority.

- **Strikes on Critical Infrastructure:** Prior to the ceasefire, U.S. and Israeli forces conducted "restrikes" on Kharg Island, targeting military assets, bunkers, and radar stations to degrade Iran's ability to monitor and control the Persian Gulf.
- **Iranian Retaliation Doctrine:** Tehran warned of a "new phase" of war involving "twin-launch" missile systems and threatened to destroy the energy infrastructure of U.S. allies in the Gulf, potentially making regional cities uninhabitable.
- **Diplomatic Breakthrough:** A two-week ceasefire was brokered just before the deadline via Pakistani mediation, with Iran agreeing to pause its blockade in exchange for a temporary cessation of hostilities.
- **Allegations of War Crimes:** The UN and international legal experts have flagged threats against civilian infrastructure and entire "civilisations" as potential incitement to war crimes and genocide under international humanitarian law.

Key Definitions & Technical Terms

- **Strait of Hormuz:** A narrow waterway between Oman and Iran connecting the Persian Gulf with the Gulf of Oman and the Arabian Sea; it carries roughly 20% of the world's total oil consumption.
- **Kharg Island:** A small Iranian island in the Persian Gulf that serves as the principal sea terminal for the export of Iranian oil, handling nearly 90% of its crude shipments.
- **Proportionate Response:** A principle in international law (jus ad bellum) stating that the use of force must be proportional to the injury suffered or the threat posed.
- **Genocide (Legal Definition):** Acts committed with intent to destroy, in whole or in part, a national, ethnical, racial or religious group, as defined under the 1948 Genocide Convention.

Constitutional & Legal Provisions

- **UN Charter, Article 2(4):** Prohibits the "threat or use of force against the territorial integrity or political independence of any state," which is the cornerstone of international law regarding ultimatums.
- **Article 51 of the UN Charter:** Recognizes the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations.

6. Supreme Court Review of Sabarimala Reference: Constitutional Liberty vs. Religious Autonomy

A nine-judge Constitution Bench of the Supreme Court, led by Chief Justice Surya Kant, has commenced hearings on a landmark reference stemming from the 2018 Sabarimala verdict. The proceedings aim to establish a definitive "judicial policy" regarding the intersection of individual fundamental rights and collective denominational freedoms. Central to the debate is the "Essential Religious Practices" (ERP) doctrine, with the Court examining whether judicial intervention is necessary to excise social ills that are often shielded under the garb of religious tradition. While the Union government advocates for legislative-led reform to protect denominational autonomy under Article 26, the judiciary is scrutinizing its own role as a guardian against discriminatory practices that may violate the principles of equality and dignity.

- **Revisiting the 2018 Verdict:** The Bench is reviewing the legal questions raised by the 2018 judgment, which initially allowed women of menstruating age into the Sabarimala shrine, sparking a debate on the limits of judicial reach into faith.
- **Doctrine of Essentiality:** Justice B.V. Nagarathna emphasized that "social ills" cannot be granted constitutional protection by merely branding them as essential religious practices, signaling a potential tightening of the ERP test.
- **Legislature vs. Judiciary:** The Union government argued that religious reform should primarily be driven by the legislature rather than the courts, asserting that judicial "intrusion" may infringe upon the free exercise of religious freedoms.
- **Constitutional Morality:** The hearing seeks to balance the "Liberty of Worship" mentioned in the Preamble with Article 14 (Equality) and Article 21 (Dignity), determining if individual rights override a religious denomination's right to manage its affairs.
- **Scope of the Reference:** Unlike a standard appeal, this nine-judge bench is tasked with evolving a broad judicial policy for all constitutional courts to follow when dealing with Articles 25 and 26.

- **Article 25 vs. Article 26:** A key point of contention is whether the individual's right to freedom of religion (Article 25) should be subordinate to or harmonize with the rights of a "religious denomination" (Article 26) to maintain its unique traditions.

Key Definitions & Legal Concepts

- **Essential Religious Practices (ERP) Doctrine:** A judicial test evolved by the SC (starting with the Shirur Mutt case) to determine which aspects of a religion are integral to it and thus protected under the Constitution.
- **Religious Denomination:** A collection of individuals having a common faith, a common organization, and designated by a distinctive name, enjoying autonomy under Article 26.
- **Constitutional Morality:** The principle that the interpretation of the Constitution must be guided by core values like justice, liberty, equality, and fraternity, rather than popular or social morality.
- **Reference Jurisdiction:** A process where a smaller bench refers significant questions of law to a larger bench for a definitive and authoritative pronouncement.

Constitutional & Legal Provisions

- **Article 25:** Guarantees freedom of conscience and the right freely to profess, practice, and propagate religion, subject to public order, morality, and health.
- **Article 25(2)(b):** Specifically empowers the State to make laws providing for social welfare and reform or the throwing open of Hindu religious institutions of a public character to all classes and sections of Hindus.

- **Article 26:** Grants every religious denomination the right to establish and maintain institutions and manage its own affairs in matters of religion.
- **Article 13:** Declares that all laws inconsistent with or in derogation of the fundamental rights shall be void, which the Court uses to test religious customs against Part III of the Constitution.

Additional Key Points for Examination

- **Gender Justice:** The presence of Justice B.V. Nagarathna is significant as the Court addresses whether biological factors like menstruation can be used as a basis for exclusion under the guise of "custom."
- **Judicial Overreach vs. Activism:** This case is a primer on the debate over whether the judiciary is encroaching upon the domain of the legislature (separation of powers) by initiating religious reforms.
- **Universal Impact:** The "judicial policy" evolved here will not only affect Sabarimala but also other pending issues, such as the entry of women into mosques and the practice of female genital mutilation (FGM) in certain communities.

Conclusion The review by the nine-judge bench represents a defining moment for Indian secularism. It moves beyond the specific rituals of a single shrine to address the foundational question: Can a "denomination" claim immunity from the constitutional values of equality and non-discrimination? By distinguishing "social evils" from "genuine faith," the Court seeks to ensure that religious freedom does not become a sanctuary for regressive practices, while simultaneously respecting the pluralistic fabric of Indian society.

UPSC Relevance

- **GS Paper II (Polity & Governance):** Indian Constitution—historical underpinnings, evolution, features, and significant provisions; Separation of powers between various organs; Judiciary's role in social reform.
- **GS Paper I (Social Issues):** Secularism; Communalism; Social empowerment of women and religious barriers.

7. Nari Shakti Vandan Adhiniyam: Accelerating Women's Reservation and Seat Expansion

The implementation of the Constitution (One Hundred and Sixth Amendment) Act, 2023, has entered a critical new phase with reports suggesting a significant shift in government strategy. Originally, the Act's operationalisation was contingent upon a fresh Census and a subsequent delimitation exercise. However, the current discourse indicates a move to decouple the reservation from the upcoming Census (expected to include caste enumeration) by potentially utilizing 2011 Census data. This plan is coupled with a monumental proposal to expand the Lok Sabha's strength by approximately 50%, increasing it from 543 to 816 seats. While aimed at expediting gender justice, these structural changes raise complex questions regarding federal parity, the north-south demographic divide, and the representational accuracy of decade-old data in a rapidly urbanizing India.

- **Expedited Implementation:** The government appears set to bypass the earlier requirement of waiting for the next Census, aiming to implement the 1/3rd women's reservation ahead of the 2029 general elections.
- **Massive Legislative Expansion:** A proposal to increase Lok Sabha seats by nearly 50% (to 816) is being considered to accommodate the reservation without reducing the absolute number of seats available for general candidates.

- **Delimitation Concerns:** Lifting the 1970s-era freeze on seat allocation risks deepening the north-south divide; northern states with higher fertility rates stand to gain more absolute seats than southern states that successfully stabilized their populations.
- **Data Reliability:** Using 2011 Census data for a 2026-27 exercise is contested, as it overlooks massive demographic shifts, migration patterns, and urbanization that have occurred over the last 15 years.

- **Sub-quota Demands:** The move to act before the next Census may temporarily sideline demands for an "OBC sub-quota" within the women's reservation, a point of significant contention among opposition parties.
- **Operational Ambiguity:** Critical details regarding the rotation of reserved constituencies remain unresolved, which is essential for ensuring candidate continuity and legislative accountability.

Key Definitions & Technical Terms

- **Delimitation:** The act of redrawing boundaries of Lok Sabha and Assembly seats to represent changes in population over time, ensuring "one citizen, one vote, one value."
- **First-Past-The-Post (FPTP):** An electoral system where the candidate with the most votes in a constituency wins, regardless of whether they secure an absolute majority.
- **Nari Shakti Vandan Adhiniyam:** The official name for the 106th Constitutional Amendment Act providing 33% reservation for women in legislative bodies.
- **Federal Compact:** The underlying agreement between the Union and States in India to maintain a balance of power and representation, currently strained by demographic asymmetries.

Constitutional & Legal Provisions

- **Article 82:** Provides for the readjustment of seats in the Lok Sabha after each Census; however, the 42nd and 84th Amendments froze this until the first Census after 2026.
- **Article 330A & 332A:** Newly inserted by the 106th Amendment to provide reservation for women in the Lok Sabha and State Legislative Assemblies respectively.
- **Article 170:** Governs the composition of State Legislative Assemblies and the delimitation of their constituencies.
- **The Constitution (106th Amendment) Act, 2023:** Specifically mandates that women's reservation will come into effect after delimitation is undertaken based on the first Census conducted after the Act's commencement.

Additional Key Points for Examination

- **The 2026 Deadline:** The constitutional freeze on delimitation expires in 2026, making the upcoming years a "foundational moment" for India's representative democracy.
- **Economic Divergence:** Southern states contribute disproportionately to India's GDP; a reduction in their political weight via population-based delimitation could lead to "taxation without proportionate representation" concerns.

- **Global Precedents:** Many mature democracies use a "cap" or a "weighted formula" for seat allocation to protect the interests of regions that have achieved demographic stability.

Conclusion The proposed "decoupling" of women's reservation from the new Census marks a significant tactical shift in Indian politics. While it fulfills a long-standing demand for gender parity, the concurrent expansion of the Parliament and the potential use of outdated data create a complex "structural reconfiguration." To ensure that this reform strengthens rather than weakens the democratic fabric, it must be balanced against the principles of federalism and the need for accurate, updated demographic representation.

UPSC Relevance

- **GS Paper II (Polity & Governance):** Constitutional Amendments; Parliament and State Legislatures—structure, functioning, conduct of business, powers & privileges; Federalism and the North-South divide; Issues related to women.
- **GS Paper I (Social Issues):** Population and associated issues; Women's empowerment.

8. India's Updated NDCs (2031-2035): Balancing Growth and Climate Justice

In March 2026, the Union Cabinet approved India's third round of Nationally Determined Contributions (NDCs) for the 2031-2035 period. This update represents an incremental yet strategic advancement of India's climate ambition, rooted in the principle of "Common But Differentiated Responsibilities" (CBDR). While many developed nations face "climate fatigue" or policy reversals, India has opted for a "continuity and confidence" model, raising its targets based on a proven track record of meeting previous goals ahead of schedule. The revised pledges aim to decouple economic growth from greenhouse gas emissions while ensuring that the transition does not compromise India's developmental space as a lower-middle-income nation.

- **Enhanced Emissions Target:** India has committed to reducing the emissions intensity of its GDP by 47% by 2035 (relative to 2005 levels), up from the previous 2030 target of 45%.
- **Shift to Non-Fossil Energy:** The target for non-fossil fuel-based installed electricity capacity has been raised to 60% by 2035, reflecting a significant leap from the 50% target set for 2030.
- **Expanded Carbon Sinks:** India aims to create an additional carbon sink of 3.5–4 billion tonnes of CO_2 equivalent through enhanced forest and tree cover by 2035.
- **Economic Realism:** The NDCs acknowledge structural constraints, such as the continued role of coal as an energy security backstop and the high costs of grid-scale battery storage (estimated at several trillion rupees).
- **Strategic Diversification:** Beyond solar and wind, the update emphasizes "leap-frogging" technologies including Green Hydrogen, Green Steel, and Carbon Capture, Utilization, and Storage (CCUS).
- **Climate Justice Framework:** India maintains that its targets are its "fair share" of global action, refusing to compromise manufacturing growth while per capita emissions remain a third of the global average.

Key Definitions & Technical Terms

- **Nationally Determined Contributions (NDCs):** Climate action plans to cut emissions and adapt to climate impacts, which each party to the Paris Agreement is required to establish and update every five years.
- **Emissions Intensity:** The volume of greenhouse gas emissions emitted per unit of GDP; reducing it means the economy is becoming more energy-efficient.
- **Non-Fossil Fuel Sources:** Energy derived from solar, wind, biomass, hydro, and nuclear power, which do not emit CO_2 during generation.
- **Carbon Sink:** Anything that absorbs more carbon from the atmosphere than it releases—for example, plants, the ocean, and soil.

Constitutional & Legal Provisions

- **Article 48A (DPSP):** Mandates that the State shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country.
- **Article 51A(g) (Fundamental Duties):** States that it shall be the duty of every citizen to protect and improve the natural environment including forests, lakes, rivers, and wildlife.
- **Environment (Protection) Act, 1986:** The umbrella legislation that provides the legal framework for the government to take measures to protect the environment and implement international climate agreements.
- **Energy Conservation (Amendment) Act, 2022:** Provides a legal mandate for a domestic Carbon Credit Trading Scheme and the use of non-fossil energy sources.

Additional Key Points for Examination

- **The "Cicada" Strategy:** Similar to its diplomatic stance, India's climate policy is "dormant" on radical shifts but "pops up" with credible, implementation-focused updates that reflect its national circumstances.
- **Storage Challenges:** Utility-scale RE expansion is currently limited by the lack of cost-effective battery storage and the environmental/regulatory hurdles of pumped hydropower.
- **Global Context:** India's per capita emissions (approx. 2 tonnes) are significantly lower than those of the US (14 tonnes) or China (8 tonnes), justifying its demand for "carbon space" to achieve its *Viksit Bharat @2047* vision.

Conclusion

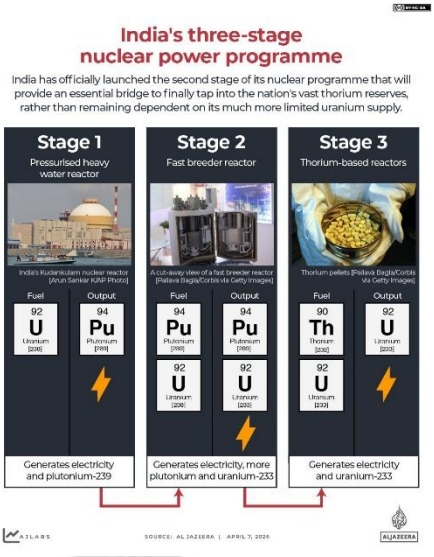
India's updated NDCs for 2035 are a masterclass in "Strategic Circumspection." By refusing to succumb to international pressure for an immediate coal phase-out, yet raising its efficiency and renewable targets, India is hedging its developmental future against climate volatility. The success of these targets will depend heavily on the availability of international climate finance and the domestic scaling of storage technologies.

UPSC Relevance

- **GS Paper III (Environment):** Conservation, environmental pollution and degradation, environmental impact assessment; National Action Plan on Climate Change (NAPCC).
- **GS Paper III (Economy):** Infrastructure: Energy; Growth and development.

9. India's Three-Stage Nuclear Program: Criticality of the Prototype Fast Breeder Reactor (PFBR)

In a landmark achievement for India's civil nuclear journey, the 500 MW Prototype Fast Breeder Reactor (PFBR) at Kalpakkam, Chennai, achieved "criticality" in early 2026. Criticality marks the state where a nuclear chain reaction becomes self-sustaining, a prerequisite for steady power generation. Developed by the Indira Gandhi Centre for Atomic Research (IGCAR) and built by BHAVINI, this reactor signifies the formal commencement of the "Second Stage" of India's indigenous three-stage nuclear power program. By utilizing "spent fuel" from existing reactors to breed more fuel than it consumes, the PFBR acts as a strategic bridge toward unlocking India's vast thorium reserves, ensuring long-term energy security and self-reliance.



- **Second Stage Milestone:** The PFBR is the linchpin of the second stage, transitioning India from Pressurised Heavy Water Reactors (PHWRs) to Fast Breeder technology.
- **Fuel Efficiency:** Unlike conventional reactors that extract less than 1% of energy from uranium, the PFBR can extract 80-100 times more energy by reprocessing depleted uranium and plutonium.
- **Breeder Technology:** The reactor is "fast" because it uses high-energy neutrons and a "breeder" because it produces more fissile material (Plutonium-239) than it consumes (Uranium-238).
- **Indigenous Innovation:** The project is a feat of Indian engineering, utilizing liquid sodium as a coolant—a technologically demanding choice necessitated by the high heat density of fast reactors.
- **Strategic Bridge to Thorium:** By generating a stockpile of Plutonium, the PFBR creates the necessary inventory to eventually trigger the "Third Stage," which will utilize India's world-leading thorium deposits.
- **Energy Vision 2047:** The success at Kalpakkam supports India's goal of reaching 100 GW of nuclear capacity by 2047, complementing the rollout of Bharat Small Modular Reactors (BSMRs).

Key Definitions & Technical Concepts

- **Criticality:** The point at which a nuclear reactor reaches a state where each fission event releases a sufficient number of neutrons to sustain an ongoing series of reactions at a constant power level.
- **Fast Breeder Reactor (FBR):** A type of nuclear reactor that uses fast neutrons to generate more fissile material than it consumes, typically using a mixture of Plutonium and Uranium oxide.
- **Liquid Sodium Coolant:** Used in FBRs due to its excellent heat transfer properties and low neutron absorption; however, it is highly reactive with air and water, requiring extreme precision in engineering.
- **Burn-up:** A measure of how much energy is extracted from a primary nuclear fuel source; PFBR increases this value from approximately 8,000 units in PHWRs to nearly 100,000 units.

Constitutional & Legal Provisions

- **Entry 6, List I (Union List):** The Seventh Schedule of the Constitution grants the Union Parliament exclusive power over "Atomic energy and mineral resources necessary for its production."

- **Atomic Energy Act, 1962:** The primary legal framework for the development, control, and use of atomic energy for welfare and peaceful purposes. It grants the central government a monopoly over nuclear activities.
- **Civil Liability for Nuclear Damage Act, 2010:** Provides a framework for compensation in the event of a nuclear accident, establishing the "no-fault liability" of the operator.
- **Atomic Energy Regulatory Board (AERB):** The statutory body mandated to ensure that the use of ionizing radiation and nuclear energy in India does not cause undue risk to health and the environment.

Additional Key Points for Examination

- **Closing the Fuel Cycle:** The PFBR enables a "closed fuel cycle" where spent fuel is reprocessed rather than treated as waste, significantly reducing the radiological burden of nuclear power.
- **Strategic Autonomy:** Success in breeder technology reduces India's heavy dependence on imported uranium, which is currently subject to strict international "peaceful use" monitoring and supply chain risks.
- **Indira Gandhi Centre for Atomic Research (IGCAR):** The premier R&D wing under the Department of Atomic Energy (DAE) located at Kalpakkam, responsible for the design and development of liquid metal-cooled fast breeder reactors.

Conclusion The criticality of the PFBR at Kalpakkam is not merely a technical success but a geopolitical statement of India's scientific maturity. By mastering the complex physics of fast reactors and liquid sodium cooling, India has secured the "missing link" in its energy strategy. While commercial power operations will follow rigorous safety assessments, the path is now clear for the multi-cycle extraction of energy, turning "spent fuel" into a strategic asset and bringing the "Thorium Dream" within reachable distance.

UPSC Relevance

- **GS Paper III (Science & Technology):** Indigenization of technology and developing new technology; Nuclear technology and its applications.
- **GS Paper III (Energy):** Infrastructure: Energy; Strategy for energy security and self-reliance.

10. UNSC Veto on Strait of Hormuz: Geopolitical Stalemate and Global Implications

The United Nations Security Council (UNSC) recently witnessed a significant diplomatic deadlock as Russia and China exercised their veto power to block a resolution aimed at reopening the Strait of Hormuz. The draft, sponsored by Bahrain, sought international consensus to restore navigation in the world's most critical oil transit chokepoint, which has been obstructed due to escalating regional hostilities. Despite the text being moderated to exclude explicit authorization for the use of military force—a concession made to address the concerns of non-aligned members—the "Big Two" of the East rejected the proposal. This move underscores the deep-seated rift within the P5 (Permanent Five) members, where Western efforts to secure maritime routes are being countered by a Sino-Russian bloc that emphasizes state sovereignty and opposes what they perceive as Western-led interventionism in the Middle East.

- **Diplomatic Deadlock:** The resolution received 11 votes in favor but was defeated by the dual veto of Russia and China, highlighting the paralysis of the UNSC in managing high-stakes maritime crises.

- **Diluted Mandate:** In an attempt to secure a pass, the draft was stripped of provisions that would have granted a "green light" for military intervention, yet it still failed to satisfy the opposing permanent members.
- **Global Energy Security:** The Strait of Hormuz carries approximately 1/5th of the world's total oil consumption; its continued closure poses a direct threat to global energy price stability and supply chains.

- **Sovereignty vs. Intervention:** Russia and China's stance reflects their consistent policy of opposing unilateral or Western-backed "police actions" in the Persian Gulf, favoring instead a regional security architecture.
- **Impact on Gulf Nations:** The failure of the resolution leaves Gulf exporters in a precarious position, as they lack a formal UN-backed security umbrella to protect their primary economic lifeline.
- **Regional Tensions:** The veto is perceived as a strategic win for Tehran, as it prevents a coordinated international legal basis for naval operations within the strait, which Iran considers its territorial waters.

Key Definitions & Concepts

- **Veto Power:** The power of the five permanent members of the UNSC (US, UK, France, Russia, China) to unilaterally block any "substantive" resolution, regardless of the level of international support.
- **Maritime Chokepoint:** A narrow sea route, such as a strait, where high volumes of traffic pass through and which can be easily blocked to disrupt global trade.
- **P5 vs. E10:** The P5 refers to the five permanent members with veto power, while the E10 refers to the ten non-permanent members elected for two-year terms.
- **Freedom of Navigation:** A principle of international law that ships flagged under any state shall not suffer interference from other states, apart from the exceptions provided for in international law.

Constitutional & Legal Provisions

- **UN Charter, Article 27:** Outlines the voting procedure in the Security Council, establishing the requirement for "concurring votes of the permanent members" on all non-procedural matters.
- **UNCLOS (United Nations Convention on the Law of the Sea):** Specifically Part III, which deals with "Straits Used for International Navigation" and the right of "Transit Passage" for all ships and aircraft.
- **Article 51 (UN Charter):** The right of individual or collective self-defense, which states often invoke when UN resolutions fail to provide security.
- **Entry 10, List I (Seventh Schedule):** In the Indian context, the Union government has exclusive jurisdiction over "Foreign affairs; all matters which bring the Union into relation with any foreign country," including stances taken at the UN.

Additional Key Points for Examination

- **Strategic Autonomy:** For India, the UNSC failure necessitates a delicate balancing act—protecting its energy interests in the Gulf while maintaining its "multi-aligned" relationships with both the US and the Sino-Russian bloc.
- **Alternate Routes:** The closure of Hormuz increases the strategic importance of the International North-South Transport Corridor (INSTC) and alternate pipelines bypassing the strait, such as the East-West Pipeline in Saudi Arabia.
- **UNSC Reform:** This incident adds momentum to the global demand for UNSC expansion and reform, as the current veto system is increasingly seen as an impediment to addressing 21st-century security challenges.

Conclusion The dual veto by Russia and China serves as a stark reminder of the "New Cold War" dynamics currently shaping international relations. By blocking the reopening of the Strait of Hormuz via the UN framework, the permanent members have inadvertently shifted the theatre of resolution from the diplomatic halls of New York to the volatile waters of the Persian Gulf. For the global economy, this implies a prolonged period of energy uncertainty and a potential rise in "coalition-based" naval missions outside of UN auspices.

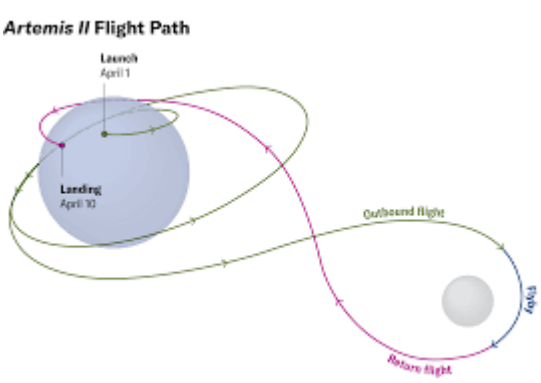
UPSC Relevance

- **GS Paper II (International Relations):** Important International institutions, agencies and fora—their structure, mandate; Effect of policies and politics of developed and developing countries on India's interests.
- **GS Paper III (Internal Security):** Maritime security and the protection of Sea Lines of Communication (SLOCs).

11. Artemis II: Breaking Deep Space Records and the Free-Return Trajectory

On April 6, 2026, NASA's Artemis II mission set a new milestone in human spaceflight by traveling 4,06,771 km away from Earth, surpassing the 1970 record held by Apollo-13. This mission represents the first crewed lunar voyage in over five decades and serves as a critical test for the Orion spacecraft and its life support systems in deep space. Unlike previous lunar missions that aimed for orbit or landing, Artemis II utilized a "free-return trajectory," a highly efficient flight path that uses lunar gravity to slingshot the vehicle back to Earth. This achievement marks a pivotal step toward establishing a long-term human presence on the Moon and eventually Mars, proving that modern spacecraft can safely sustain life at unprecedented distances from our home planet.

- **Record-Breaking Distance:** The Artemis II crew traveled 4,06,771 km from Earth, breaking the previous human spaceflight record of 4,00,171 km set by the Apollo-13 mission in 1970.
- **Free-Return Trajectory:** The mission employs a figure-eight "free-return" path, which uses the Moon's gravity to naturally whip the spacecraft back toward Earth without requiring a massive engine burn for the return journey.
- **High-Earth Orbit (HEO) Phase:** Before heading to the Moon, Orion spent 42 hours in a 74,000 km elliptical Earth orbit to verify environmental control and life support systems while still within reach of an emergency abort.



- **Lunar Slingshot Mechanism:** The spacecraft aimed for a point 10,300 km beyond the lunar far side, allowing gravity to act as a tether to redirect the craft toward Earth's atmosphere for re-entry.
- **Fuel and Mass Efficiency:** By avoiding a circular lunar orbit—which requires fuel-heavy deceleration and acceleration—the mission significantly reduced the required propellant, allowing the Space Launch System (SLS) to lift a lighter overall mass.
- **Safety as Priority:** The looping flight plan serves as an inherent safety mechanism; in the event of an engine failure after leaving Earth's orbit, the spacecraft's momentum and lunar gravity ensure the crew is not stranded in deep space.

Key Definitions & Technical Terms

- **Free-Return Trajectory:** A spacecraft trajectory that uses the gravity of a secondary body (the Moon) to return the craft to its point of origin (Earth) with minimal engine use.
- **Far Side of the Moon:** The hemisphere of the Moon that always faces away from Earth due to synchronous rotation; Artemis II traveled behind this region to achieve its record distance.
- **Orion Spacecraft:** NASA's next-generation crew vehicle designed for deep space missions, capable of carrying four astronauts for up to 21 days.
- **European Service Module (ESM):** The "powerhouse" of the Orion craft, provided by ESA, which supplies electricity, propulsion, thermal control, air, and water to the crew.

Constitutional & Legal Provisions

- **Article 51(h):** Part of the Fundamental Duties in the Indian Constitution, which mandates that citizens "develop the scientific temper, humanism and the spirit of inquiry and reform."
- **Outer Space Treaty, 1967:** The foundational framework of international space law, which declares that space exploration shall be carried out for the benefit of all countries and that the Moon is not subject to national appropriation.
- **Artemis Accords:** A non-binding set of principles led by the US (with India as a signatory since 2023) to guide sustainable and transparent civil space exploration in the 21st century.
- **Space Policy 2023 (India):** While the mission is led by NASA, India’s own space policy encourages international collaboration in deep space exploration and human spaceflight missions (Gaganyaan).

Additional Key Points for Examination

- **Comparison with Apollo:** While Apollo-8 followed a circular orbit at a fixed distance, Artemis II’s elliptical path was designed specifically to test the structural and life-support limits of the new Orion hardware.
- **Radiation Protection:** A major objective of traveling this far is to assess the efficacy of Orion’s radiation shielding against solar particles and cosmic rays outside the protection of Earth’s Van Allen belts.
- **Gateway to Mars:** The Artemis program is viewed as a "Moon to Mars" initiative, where lunar missions serve as a testing ground for the technologies needed for multi-year interplanetary voyages.

Conclusion The Artemis II mission is more than a record-breaking distance feat; it is a masterclass in gravitational physics and mission safety. By mastering the free-return trajectory, space agencies can conduct high-stakes deep space testing while maintaining a "fail-safe" return path. For the global scientific

community, the success of this mission confirms that the return to the Moon is no longer a matter of 'if,' but 'when,' paving the way for the Artemis III landing.

UPSC Relevance

- **GS Paper III (Science & Technology):** Awareness in the fields of Space; Achievements of Indians in science & technology; Indigenization of technology and developing new technology.
- **GS Paper II (IR):** Important International institutions and agreements (Artemis Accords, UNCOPUOS).

12. Space-Based Solar Power (SBSP) and the Lunar Ring: Future of Energy

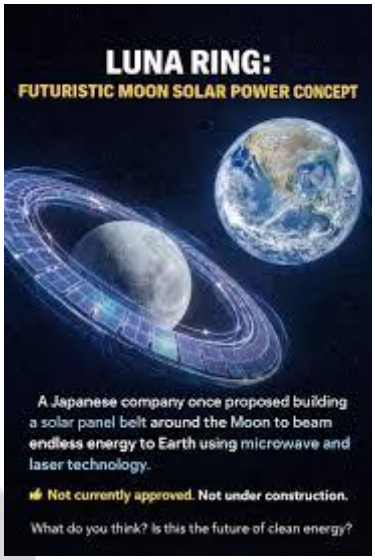
Space-Based Solar Power (SBSP) is an emerging technological concept aimed at capturing solar energy in outer space and transmitting it to Earth. Unlike terrestrial solar plants, which are limited by the diurnal cycle and atmospheric conditions, SBSP facilities—such as Japan's proposed "Lunar Ring"—can collect high-intensity sunlight 24/7. The Lunar Ring concept involves an 11,000 km belt of solar collectors along the Moon's equator, constructed by autonomous robots using lunar regolith. While theoretically revolutionary for achieving "Net Zero" targets, the transition from science fiction to reality faces immense barriers, including the prohibitive cost of launching heavy hardware, energy loss during microwave transmission, and the persistent threat of orbital debris.

- **Constant Energy Harvest:** SBSP operates above the atmosphere, bypassing the 50% energy loss caused by clouds and air, and avoids the "night-time" limitation, providing a true baseload power source.
- **The Lunar Ring Concept:** Proposed by Japan's Shimizu Corporation, this involves building a solar belt on the Moon's equator using lunar soil to generate energy, which is then beamed to Earth via microwaves or lasers.
- **Transmission Mechanisms:** Energy is converted into microwaves or laser beams and transmitted to "rectennas" (rectifying antennas) on Earth, which convert the radiation back into electricity for the grid.
- **Logistical and Economic Hurdles:** The primary challenge is the "Mass-to-Orbit" cost; transporting thousands of tonnes of construction material remains economically unviable compared to cheapening terrestrial solar and battery storage.
- **Orbital Hazards:** Systems in Earth's orbit face significant risks from Space Debris (Kessler Syndrome), where a single collision could trigger a chain reaction, destroying multi-billion dollar energy assets.
- **Efficiency Losses:** While solar collection is higher in space, significant energy is lost as heat during the wireless power transmission (WPT) process through Earth's atmosphere.

Key Definitions & Technical Terms

- **Lunar Regolith:** The layer of loose, fragmented material covering solid rock on the Moon; proposed as a primary building material for lunar structures via 3D printing or robotic assembly.
- **Microwave Beaming:** A method of wireless power transfer where energy is converted into electromagnetic waves in the microwave spectrum for long-distance transmission.
- **Rectenna:** A special type of receiving antenna used for converting electromagnetic energy (microwaves) into direct current (DC) electricity.

- **Kessler Syndrome:** A theoretical scenario where the density of objects in Low Earth Orbit (LEO) is high enough that collisions cause a cascade, rendering space activities and satellites unusable for generations.



Constitutional & Legal Provisions

- **Article 51A(h):** The Fundamental Duty to develop "scientific temper, humanism and the spirit of inquiry" supports the exploration of frontier technologies like SBSP.
- **Outer Space Treaty (1967):** Principles governing the activities of States in the exploration and use of outer space, including the Moon, stipulating that space is the "province of all mankind" and cannot be claimed by any nation.
- **The Moon Agreement (1979):** Establishes that the Moon and its natural resources are the "common heritage of mankind" and that an international regime should govern exploitation—though major space powers like the US, Russia, and China have not ratified it.
- **Space Liability Convention (1972):** Holds a launching state absolutely liable to pay compensation for damage caused by its space objects on the surface of the Earth or to aircraft.

Additional Key Points for Examination

- **Environmental Impact:** While "clean," the long-term effects of high-intensity microwave beams on the ionosphere and migratory birds remain a subject of environmental impact assessment (EIA).
- **Technological Convergence:** Success in SBSP requires breakthroughs in three fields: Low-cost reusable rockets (like SpaceX Starship), Wireless Power Transfer (WPT), and In-situ Resource Utilization (ISRU).
- **Strategic Competence:** Countries like Japan, China, and the UK are currently leading the research, viewing SBSP as a way to achieve energy independence and a technological edge in the "New Space" race.

Conclusion Space-Based Solar Power represents the ultimate frontier of renewable energy, offering an inexhaustible power supply that could solve the global climate crisis. However, its current status is hampered by "poor economics" and the rapid advancement of terrestrial alternatives. Until launch costs drop by an order of magnitude and robotic lunar manufacturing becomes feasible, the Lunar Ring remains a visionary blueprint rather than an immediate solution.

UPSC Relevance

- **GS Paper III (Science & Technology):** Developments and their applications and effects in everyday life; Achievements of Indians in science & technology; Indigenization of technology.
- **GS Paper III (Energy/Environment):** Renewable energy resources; Conservation and environmental pollution.
- **Prelims:** Outer Space Treaty, Types of Orbits (GEO/LEO), Wireless Power Transmission, and Major Global Space Missions (Artemis, Lunar Ring).