7 PM COMPILATION

1st and 2nd week November, 2026

Features of 7 PM compilation

- Comprehensive coverage of a given current topic
- Provide you all the information you need to frame a good answer
- Critical analysis, comparative analysis, legal/constitutional provisions, current issues and challenges and best practices around the world
- Written in lucid language and point format
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India's Steel Sector – SWOT Analysis – Explained Pointwise



The Ministry of Steel has recently released the **Draft National Steel Policy: Vision 2047**, aimed at transforming India into a globally competitive, technologically advanced and environmentally sustainable steel manufacturing hub. It envisages expanding crude steel capacity to 604 MTPA by 2047, while promoting self-reliance, innovation and green steel production.

What is the present status of India's steel sector?

- India's steel sector has emerged as a major pillar of industrial and economic growth, supported by rising domestic demand, infrastructure development and expanding production capacity.
- India has retained its position as the world's **second-largest crude steel producer** since 2018, after China.
- **Key indicators of India's steel sector** (For FY 2025-26):
    - Crude steel production = **170.15 MT**
    - Crude steel capacity = **220.41 MT**
    - Finished steel production = **162.47 MT**
    - Finished steel consumption = **164.36 MT**

What are the significance and key strengths of India's steel sector?

Significance of Steel Sector:

1. **Economic growth**: The steel sector accounts for roughly **2% of India's GDP.** It contributes significantly to industrial output and supports India's ambition of becoming a developed economy by 2047.
2. **Infrastructure development**: It provides essential raw materials for roads, bridges, railways, airports, ports and urban infrastructure.
3. **Employment generation**: The sector creates direct and indirect employment to over 2.5mn people in mining, manufacturing, transportation, construction and allied industries.

4. **Foreign Direct Investment (FDI):** Metallurgical and steel-making industries have attracted over **$19 billion in foreign direct investment**, establishing India as a major destination for global steelmakers (e.g., ArcelorMittal, POSCO) partnering with local conglomerates.
5. **Industrial development**: Steel is a critical input for automobiles, defence, engineering, shipbuilding, machinery and capital goods industries.
6. **Strategic importance**: Domestic steel production reduces dependence on foreign suppliers and strengthens India's economic and national security.
7. **Export potential**: A competitive steel industry can enhance India's export earnings and strengthen its position in global value chains.
8. **Regional development:** Steel plants promote industrial clusters, infrastructure development and economic activities in mineral-rich and relatively underdeveloped regions.
9. **Green transition**: Green steel production can contribute to industrial decarbonisation and India's climate commitments.

Strengths of Steel Sector:

1. **Abundant raw material availability**: India possesses extensive, high-grade **iron ore deposits** (hematite and magnetite) located predominantly in resource-rich states like Odisha, Jharkhand, Chhattisgarh, and Karnataka. This natural endowment provides raw material security and reduces reliance on foreign mining supply chains.
2. **Large domestic market:** Rapid urbanisation, infrastructure expansion and growing manufacturing activities ensure strong domestic demand for steel.
3. **Cost Competitiveness & Labor Advantage:** India benefits from significantly lower conversion and labor costs relative to North American, European, and East Asian producers. The availability of skilled metallurgy talent alongside a large industrial workforce gives domestic plants a structural margin cushion.
4. **Established public-sector enterprises:** Companies such as SAIL and RINL have contributed to developing India's steel manufacturing capabilities.
5. **Growing private-sector participation:** Major private players such as Tata Steel, JSW Steel and AM/NS India have strengthened production capacity, investment and technological capabilities.
6. **Skilled workforce:** Availability of engineers, metallurgists, technicians and industrial labour supports the sector's expansion.
7. **Strategic geographical advantage:** India's proximity to major international shipping routes and access to coastal locations provide opportunities for exports.
8. **Growing technological capabilities:** Modern steel plants increasingly employ advanced technologies, automation and energy-efficient production processes.

What are the major challenges and weaknesses of India's steel sector?

1. **Dependence on imported coking coal**: India has substantial reserves of iron ore but lacks adequate reserves of high-quality coking coal, which is an essential raw material for conventional blast furnace-based steel production. Consequently, the Indian steel industry depends heavily on imports, particularly from countries such as Australia, Russia, the USA and Canada.
2. **High logistics costs**: India's steel industry faces high logistics and transportation costs due to the geographical mismatch between mineral resources, steel production centres and major consumption markets. Inadequate railway connectivity, limited dedicated freight capacity, port congestion and dependence on road transportation increase the cost of moving bulky raw materials such as iron ore

and coking coal, as well as finished steel products. This raises the overall cost of production, reduces export competitiveness and makes Indian steel less competitive in international markets.

3. **Technological limitations**: A significant section of India's steel industry, particularly small and medium-scale secondary steel producers, continues to rely on outdated and relatively inefficient production technologies. Limited adoption of advanced technologies results in lower productivity, higher production costs, inconsistent product quality and greater energy consumption. This reduces the global competitiveness of Indian steel manufacturers and slows the transition towards low-carbon and green steel production.
4. **High energy consumption**: The steel industry is highly energy-intensive, relying heavily on coal and other fossil fuels for ironmaking and steel production. This increases operational costs, carbon emissions and dependence on energy imports, thereby affecting the industry's global competitiveness and environmental sustainability.
5. **Environmental pollution**: The steel industry is one of the major contributors to industrial pollution and greenhouse gas emissions in India. Conventional steelmaking processes are highly energy-intensive and rely heavily on coal, resulting in significant carbon dioxide emissions, particulate matter and other air pollutants. Steel production also generates industrial waste, slag and wastewater, contributing to soil and water pollution.
6. **Import dependence on speciality steel**: India continues to rely on imports for certain high-grade and technologically advanced speciality steel products, particularly those used in defence, aerospace, automobiles, power generation and precision engineering. This dependence reflects gaps in domestic technological capabilities, specialised manufacturing capacity and R&D.
7. **Fragmented industry structure**: India's steel sector comprises numerous small and medium-scale producers, particularly in the secondary steel segment, which often lack economies of scale, adequate financial resources and access to advanced technologies. This fragmentation limits productivity, technological modernisation and global competitiveness while increasing operational costs.
8. **Global competition**: India's steel industry faces intense competition from major steel-producing countries, particularly China, Japan and South Korea. Cheap imports, global overcapacity, aggressive pricing strategies and trade restrictions in international markets put pressure on domestic manufacturers. Moreover, differences in production costs, technological efficiency and economies of scale affect India's export competitiveness.
9. **Carbon border measures**: The introduction of carbon border measures, particularly the European Union's Carbon Border Adjustment Mechanism (CBAM), poses a significant challenge to India's steel exports. Since India's steel industry largely relies on coal-intensive blast furnace technology, it may face higher compliance costs and reduced export competitiveness.

What are the various government initiatives aimed at strengthening India's steel sector?

Draft National Steel Policy 2047	• The Ministry of Steel has introduced the Draft National Steel Policy 2047 to provide a long-term strategic framework for the development of India's steel industry, aligned with the vision of Viksit Bharat 2047. • **Major objectives and targets:** 1. **Capacity expansion:** Increase India's crude steel production capacity to approximately 600 MTPA by 2047, compared with around 220 MTPA in FY 2025-26. 2. **Consumption & Demand Forecast:** Projects finished steel demand to rise to **505 MT** by 2047, elevating per-capita steel consumption from ~90 kg to **302 kg**. 3. **Global Export Target:** Aims for **45 MT** in annual finished steel exports by 2047. 4. **Raw Material Security & Coal Optimization:** Focuses on mitigating the ~92% import dependency on coking coal through AI-driven coal blending, expanding domestic coal washeries, and establishing long-term overseas asset acquisitions. 5. **Green steel transition**: Promote low-carbon steelmaking technologies, renewable energy, green hydrogen and greater utilisation of recycled steel. 6. **Speciality steel production:** Strengthen domestic manufacturing of high-grade and value-added steel to reduce import dependence. 7. **Circular economy:** Promote steel scrap recycling, resource efficiency and sustainable utilisation of industrial by-products.
Production Linked Incentive (PLI) Scheme for Speciality Steel	• Launched in 2021 to promote domestic manufacturing of high-value and speciality steel. • Provides financial incentives to eligible manufacturers based on incremental sales. • Covers speciality steel used in automobiles, defence, electrical equipment and other strategic sectors.
Domestically Manufactured Iron and Steel Products (DMI&SP) Policy	• Provides preference to domestically manufactured iron and steel products in government procurement. • Establishes minimum domestic content requirements for notified steel products. • Aims to promote indigenous manufacturing, strengthen domestic industries and reduce import dependence.

Green Steel Initiative	• The Ministry of Steel has undertaken several measures to promote low-carbon and environmentally sustainable steel production.
	• Major intiatives include:
	  ○ **Green Steel Taxonomy**: Introduced in 2024 to establish a standard definition and certification framework for green steel based on carbon emission intensity.
	  ○ **Green Steel Certification**: Provides star ratings based on the emission intensity of steel production.
	  ○ **Green Hydrogen:** Six pilot projects have been awarded under the National Green Hydrogen Mission to explore hydrogen-based steelmaking.

Steel Scrap Recycling Policy, 2019	• Aims to develop an organised steel scrap collection, dismantling and recycling ecosystem. • Promotes the availability of domestic scrap as an alternative raw material for steel production. • Encourages resource efficiency, reduces dependence on imported scrap and helps lower carbon emissions. • Supports the transition towards a circular economy.

What should be the way forward?

1. **Ensuring Raw Material Security**:
   - Diversify sources of coking coal imports to reduce dependence on a limited number of supplier countries.
   - Promote domestic exploration, mining and beneficiation of iron ore and other critical minerals.
2. **Technological Modernisation**:
   - Upgrade conventional steel plants through automation, artificial intelligence, robotics and digital technologies.
   - Promote advanced steelmaking technologies to improve productivity, product quality and energy efficiency.
3. **Promoting Green Steel**:
   - Accelerate the adoption of hydrogen-based direct reduced iron (DRI) technology and renewable energy.
   - Promote carbon capture, utilisation and storage (CCUS) to reduce emissions from conventional steel plants.
   - Develop a robust green steel certification and carbon accounting framework to meet emerging global environmental standards.
4. **Strengthening Infrastructure and Logistics**:
   - Improve railway connectivity between mining areas, steel plants and consumption centres.
   - Strengthen port infrastructure and develop dedicated freight corridors for efficient transportation.
   - Promote slurry pipelines and multimodal logistics to reduce transportation costs.
5. **Reducing Import Dependence**:

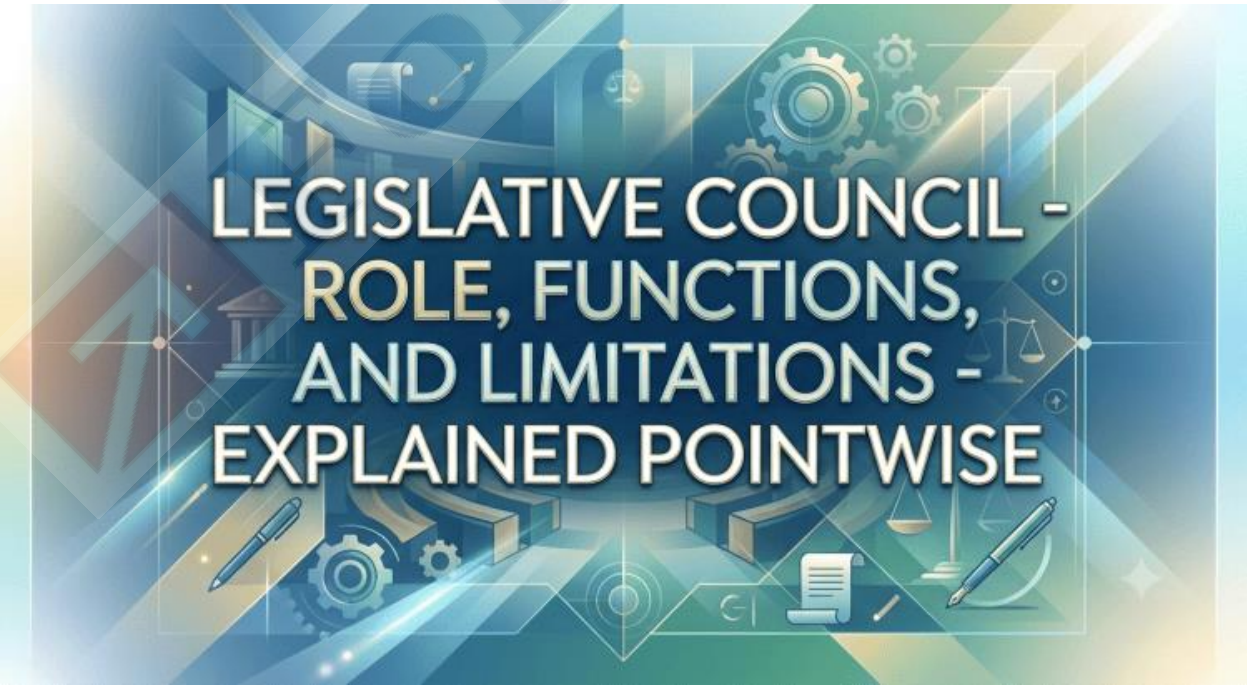
- Strengthen domestic manufacturing of speciality and high-grade steel.
- Encourage technology transfer, indigenous innovation and industry-academia collaboration.
- Implement appropriate quality standards and trade measures to ensure fair competition against substandard and unfairly priced imports.

6. **Promoting Steel Recycling and Circular Economy**:
   - Develop an organised steel scrap collection, segregation and recycling ecosystem.
   - Encourage greater utilisation of scrap as a secondary raw material to reduce energy consumption and carbon emissions.
7. **Supporting MSMEs and Secondary Steel Producers**:
   - Provide easier access to institutional finance, modern technology and affordable energy.
   - Encourage consolidation, economies of scale and technological upgradation in the secondary steel industry.
8. **Effective Implementation of Draft National Steel Policy 2047:**
   - Ensure coordination between the Centre, state governments, steel producers and other stakeholders.
   - Translate the proposed long-term targets into measurable short- and medium-term milestones.
   - Monitor progress on emission reduction, speciality steel production, recycling and raw material security.

Conclusion: India's steel sector needs to move beyond conventional capacity expansion towards a technology-driven, resource-efficient and environmentally sustainable growth model.

UPSC GS-3: Indian Economy
Read More: Indian Express

Legislative Council – Role, Functions, and Limitations – Explained Pointwise



The recent elections to 28 Legislative Council seats across Uttar Pradesh, Bihar, Maharashtra and Karnataka have brought the institution of State Legislative Councils into focus. This provides an opportunity to examine their constitutional role, functions, significance and limitations in India's federal system.

What are Legislative Councils? Explain their composition and constitutional provisions.

- A Legislative Council (Vidhan Parishad) is the upper house of a state's legislature in India.
- It is a permanent and indirectly elected legislative body that functions alongside the Legislative Assembly (Vidhan Sabha) in States having a bicameral legislature.
- Currently, 6 Indian states have a Legislative Council: **Uttar Pradesh, Bihar, Maharashtra, Karnataka, Andhra Pradesh, and Telangana.**

Constitutional Provisions:

- **Article 168:** Provides for the constitution of State legislatures, which may consist of one or two houses.
- **Article 169:** Empowers Parliament to create or abolish a Legislative Council in a State.
- **Article 171:** Deals with the composition of Legislative Councils.
- **Article 172:** Provides that Legislative Councils are permanent bodies and are not subject to dissolution.
- **Article 173:** Specifies the qualifications for membership of State legislatures.
- **Article 182:** Deals with the Chairman and Deputy Chairman of the Legislative Council.

Composition of Legislative Councils (Article 171):

Strength of the Council	• The total membership cannot exceed one-third of the total strength of the State Legislative Assembly. • Its membership cannot be less than 40 members, except where otherwise provided by Parliament by law.
Categories of Members	1. **One-third:** Elected by members of local authorities such as municipalities, district boards and other local bodies. 2. **One-twelfth:** Elected by graduates of at least three years' standing residing in the state. 3. **One-twelfth:** Elected by teachers of at least three years' standing in educational institutions not lower than secondary schools. 4. **One-third:** Elected by members of the State Legislative Assembly from among persons who are not members of the Assembly. 5. **Remaining members:** Nominated by the Governor from persons having special knowledge or practical experience in: ○ Literature ○ Science ○ Art ○ Cooperative movement ○ Social service

Qualifications for Membership	To be eligible for election or nomination as an MLC, a person must: 1. Be a citizen of India. 2. Be at least **30 years of age** (compared to 25 for the Legislative Assembly). 3. Be an elector in the constituency of the State concerned.
Method of Election	• A Legislative Council is a permanent house and cannot be dissolved. • Its members serve a term of six years. • One-third of its members retire every two years. • The minimum age for membership is 30 years. • The Chairman and Deputy Chairman are elected by the members of the Council from among themselves.

Creation and Abolition of Legislative Councils (Article 169):

- Parliament can create or abolish a Legislative Council if the concerned State Legislative Assembly passes a resolution.
- Such a resolution must be passed by:
    - A majority of the total membership of the Assembly; and
    - A majority of not less than two-thirds of the members present and voting.
- Parliament can then pass a law to create or abolish the Council through a simple majority.
- Such a law is not considered a constitutional amendment under Article 368.

What are the role and functions of Legislative Councils in the Indian parliamentary system?

Legislative Functions	The Legislative Council shares legislative duties with the Legislative Assembly, though its legislative authority is strictly advisory and delay-oriented rather than veto-based.
	• **Ordinary Bills:**
	  ○ An ordinary Bill can originate in either house.
	  ○ If a Bill originates in the Legislative Assembly and is passed to the Council, the Council can:
	  1. Pass it as sent by the Assembly.
	  2. Pass it with amendments and send it back to the Assembly.
	  3. Reject the Bill outright.
	  4. Take no action (let it sit).
	  ○ **Delaying Powers:** The Council can delay an ordinary bill for up to **3 months** on its first receipt. If the Assembly passes the bill again and re-sends it, the Council can delay it for **1 additional month**. After a total delay of **4 months**, the bill is deemed passed by both houses in the form desired by the Assembly.
	  ○ **No Joint Sitting:** Unlike Parliament, where a deadlock between the Lok Sabha and Rajya Sabha leads to a joint sitting, state legislatures have no constitutional provision for joint sittings. The Assembly's decision ultimately prevails.
	• **Money Bills:**

	○ Money Bills **cannot** originate in the Legislative Council. ○ Once passed by the Assembly, a Money Bill is transmitted to the Council, which must return it within **14 days** with or without recommendations. ○ The Assembly is free to accept or reject any or all recommendations. If the Council does not return the bill within 14 days, it is deemed passed by both houses.
Financial Functions	1. **Budget Discussion:** The State budget (Annual Financial Statement) is laid before the Legislative Council alongside the Assembly. MLCs have the right to discuss budget provisions and general fiscal policies. 2. **Demands for Grants:** The Council **cannot vote** on Demands for Grants; this power is reserved exclusively for the Legislative Assembly.
Control over the Executive	1. **Scrutiny Techniques:** MLCs can question Ministers, ask supplementary questions, move call-attention motions, and debate government administrative actions and policies. 2. **Ministerial Representation:** Members of the Legislative Council (MLCs) are eligible to be appointed as Chief Minister or Cabinet Ministers. 3. **No-Confidence Motion:** The Council of Ministers is collectively responsible **only** to the Legislative Assembly. The Legislative Council cannot pass a No-Confidence Motion to bring down a government.

What is the significance of having a bicameral legislature at the State level?

1. **Legislative Function**: Legislative Councils examine and review Bills passed by the Legislative Assembly, suggest amendments and provide an opportunity for further deliberation, thereby improving the quality of legislation.
2. **Revisory Function**: Legislative Councils act as revising chambers by critically examining Bills passed by the Legislative Assembly, identifying errors, ambiguities and shortcomings, and suggesting necessary amendments to improve the quality of legislation.
3. **Representation of Diverse Interests**: Legislative Councils provide representation to diverse sections of society, including graduates, teachers, local authorities and individuals with specialised knowledge, ensuring that varied perspectives are incorporated into the legislative process.
4. **Expertise in Lawmaking**: Legislative Councils bring specialised knowledge and practical experience into the legislative process through nominated members from fields such as science, literature, art, social service and cooperative movements, thereby improving the quality of legislation.
5. **Deliberative Function**: Legislative Councils provide an additional platform for detailed discussions and informed debates on important legislative proposals, public policies and issues of public interest, thereby promoting thoughtful decision-making and democratic deliberation.
6. **Executive Accountability**: Legislative Councils promote executive accountability by allowing members to raise questions, participate in debates and discuss government policies and administrative decisions. This helps scrutinise the functioning of the State government and highlight administrative shortcomings.

7. **Protection of Minority and Specialised Views**: Legislative Councils provide a platform for underrepresented groups, professionals and individuals with specialised knowledge to express their views, ensuring that diverse perspectives are considered in the legislative process.

What are the major limitations of State Legislative Councils in India?

1. **Limited Legislative Powers**: Legislative Councils have restricted powers compared to Legislative Assemblies. They can neither permanently reject ordinary Bills nor exercise decisive authority over Money Bills, limiting their influence on the legislative process.
2. **Absence of Joint Sittings:** Unlike Parliament, where a deadlock between the Lok Sabha and Rajya Sabha triggers a joint sitting, state legislatures have no constitutional mechanism for joint sittings. The Assembly's decision automatically prevails.
3. **Lack of Permanent Existence:** Under **Article 169**, a Council's existence depends entirely on the Legislative Assembly. The Assembly can pass a resolution to abolish the Council at any time, making it structurally vulnerable to political changes in the lower house.
4. **No Financial Authority:** Money Bills cannot originate in the Council and can only be delayed for **14 days**. The Assembly is under no obligation to accept any amendments suggested by the Council. Furthermore, the Council cannot vote on Demands for Grants in the state budget.
5. **Inability to Dismiss Government:** While MLCs can question ministers and debate policies, the Council of Ministers is accountable only to the Legislative Assembly. The Council **cannot pass a No-Confidence Motion** to remove a government from power.
6. **Lack of Democratic Accountability**: Unlike Legislative Assemblies, whose members are directly elected by the people, most Legislative Council members are indirectly elected or nominated. This limits their direct accountability to voters and raises concerns about their democratic legitimacy.
7. **Political Rehabilitation**: Legislative Councils are sometimes criticised for being used by political parties to accommodate defeated electoral candidates, party loyalists and political associates by nominating or electing them to the Upper House, thereby raising concerns about political patronage and undermining the institution's intended purpose.
8. **Financial Burden**: Maintaining an additional legislative chamber increases the financial burden on State governments through expenditure on members' salaries, allowances, pensions, staff, infrastructure and administrative facilities, raising concerns about the efficient utilisation of public funds.
9. **Possibility of Legislative Delays**: Legislative Councils may delay the passage of important Bills due to political disagreements and repeated reconsideration, potentially slowing down the legislative process and implementation of government policies.
10. **Duplication of Legislative Work**: The existence of two legislative chambers may lead to repetitive discussions, overlapping deliberations and duplication of legislative efforts, increasing procedural complexity without necessarily improving the quality of lawmaking.

What measures should be adopted to improve the effectiveness and functioning of State Legislative Councils?

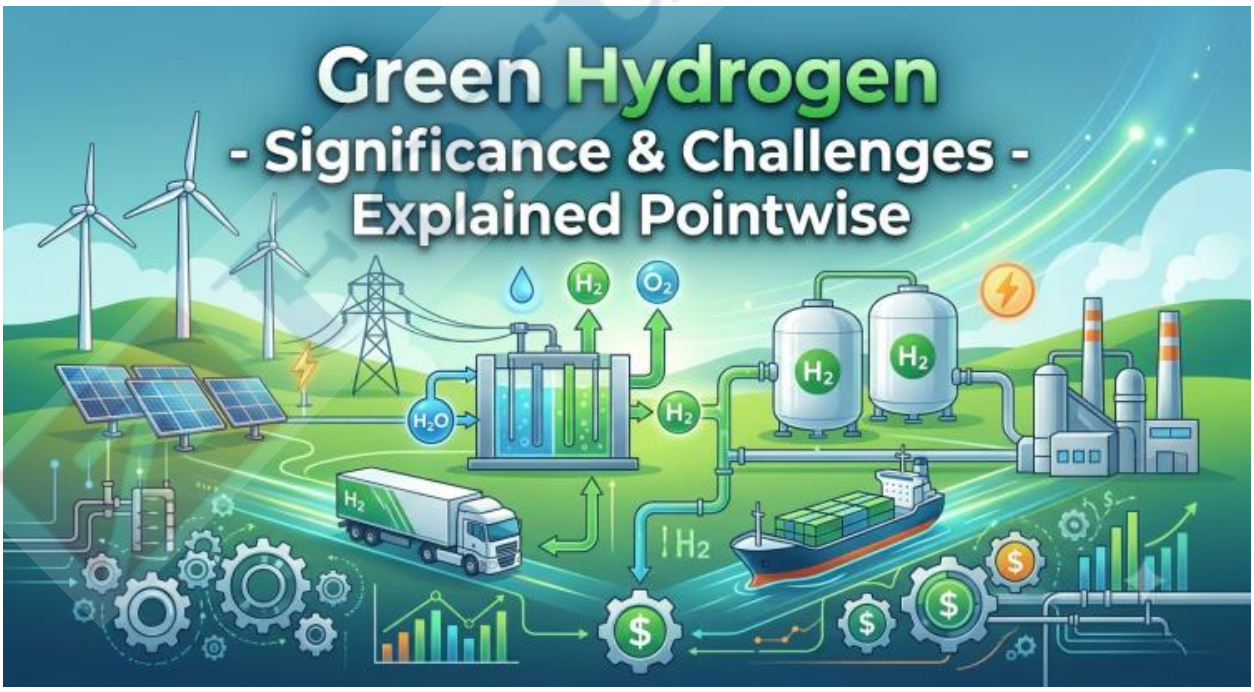
1. **National Policy on Bicameralism:** Establish objective, uniform criteria – based on State population, legislative workload, and administrative complexity – to determine whether a State should have a Legislative Council, ensuring that the process remains free from political interference.
2. **Protection Against Arbitrary Abolition:** Amend **Article 169** to require a Parliamentary vote by a **special majority** (or a constitutional amendment under Article 368) to abolish or create a Council. This would prevent State ruling parties from dissolving the upper house simply when they lose majority in it.

3. **Merit-Based Nominations**: Ensure that the Governor nominates individuals with proven expertise, achievements and practical experience in fields such as literature, science, art, cooperative movement and social service, rather than accommodating political loyalists.
4. **Joint Standing Committees:** Introduce Departmentally Related Standing Committees (DRSCs) at the state level – modeled on Parliament – with equal participation from both Assembly members and MLCs to scrutinize State policies, expenditure, and Bills before enactment.
5. **Pre-Budget Scrutiny:** Grant the Council formal powers to conduct structured pre-budget discussions and submit committee recommendations on departmental allocations before the Legislative Assembly votes on Demands for Grants.
6. **Restricting "Backdoor" Executive Entry:** Implement a rule or convention prohibiting individuals who have lost a direct Legislative Assembly election from being appointed as Cabinet Ministers via Legislative Council nominations within a specified period (e.g. 1 to 2 years).
7. **Ensuring Regular Functioning**: Legislative Councils should meet regularly with adequate session duration to facilitate meaningful debates, legislative scrutiny and discussions on important public issues, thereby strengthening their role in State governance.

Conclusion: State Legislative Councils should function as effective institutions of legislative review rather than merely additional political chambers. Strengthening their independence, expertise, transparency and accountability can help realise the constitutional vision of deliberative and participatory democracy.

UPSC GS-2: Indian Polity
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Green Hydrogen – Significance & Challenges – Explained Pointwise

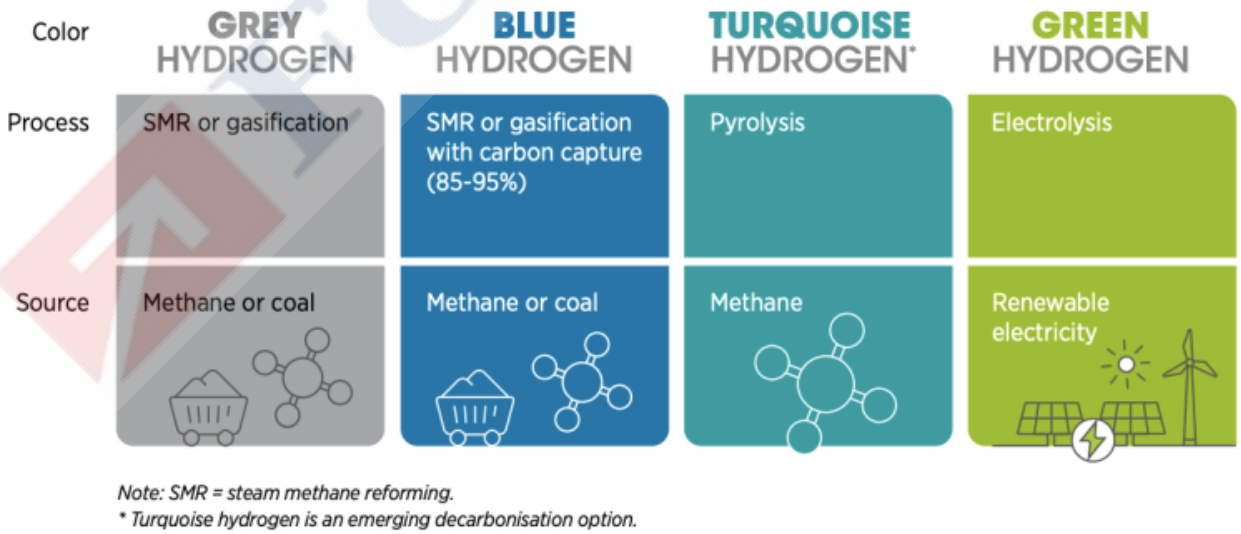


Green Hydrogen is being considered as one of the vital avenue for energy transition away from fossil fuels, for both the mobility (transportation) and industrial sectors. It is emerging as a pillar of India's clean energy

transition. Many breakthroughs have been made in the Green Hydrogen Technology, yet many challenges remain for scaling-up the utilization and adoption of Green Hydrogen technologies.

What is Green Hydrogen?

- Hydrogen is the **lightest element** found in nature. In standard conditions it **exists as a gas** of diatomic molecules (H_2). Hydrogen is the **most abundant chemical substance in the universe**, constituting roughly 75% of all normal matter. Stars including the Sun, are mainly composed of hydrogen. (though in the plasma state instead of gaseous state). The hydrogen gas can act as a useful fuel. Its **combustion with oxygen releases a lot of energy** and **produces water as byproduct**. Hence, it is more environment-friendly as it does not produce carbon-dioxide (produced by combustion of fossil fuels) and thus does not contribute to climate change.
- There are several ways to produce Hydrogen on industrial scale (large-scale). These include **steam reforming of natural gas**, **oil reforming**, or **coal gasification**. A small percentage is also produced using more energy-intensive methods such as the **electrolysis of water**. The hydrogen produced via these methods have been given various different names in order to distinguish them in terms of their carbon footprints.
- **Grey Hydrogen** is traditionally produced from methane (CH_4), split with steam into carbon-dioxide (CO_2, Green House Gas) and hydrogen. Grey hydrogen is increasingly being produced from coal, with **significantly higher CO_2 emissions per unit of hydrogen produced**. It is produced at industrial scale today. It has no energy transition value.
- **Blue hydrogen** follows the **same process as grey**, with the **additional technologies necessary to capture the CO_2 produced** (when hydrogen is split from methane (or from coal)) and **store it for long term**. It is not possible to capture 100% of the CO_2 produced and not all means of storing it are equally effective in the long term.
- **Green hydrogen** is produced mainly through **water (H_2O) electrolysis**. Electrolysis uses electricity to split a compound into simpler substances. Here, **renewable electricity** splits water into hydrogen (H_2) and oxygen (O_2), with minimal emissions.
  $2H_2O$ (Liquid) + Renewable Electricity→ $2H_2$ (Gas) + O_2 (Gas)



Source: WEF, IRENA

Read More: Green Hydrogen: Potential, Issues and Solutions – Explained, pointwise

What are the various applications of green hydrogen across different sectors of the economy?

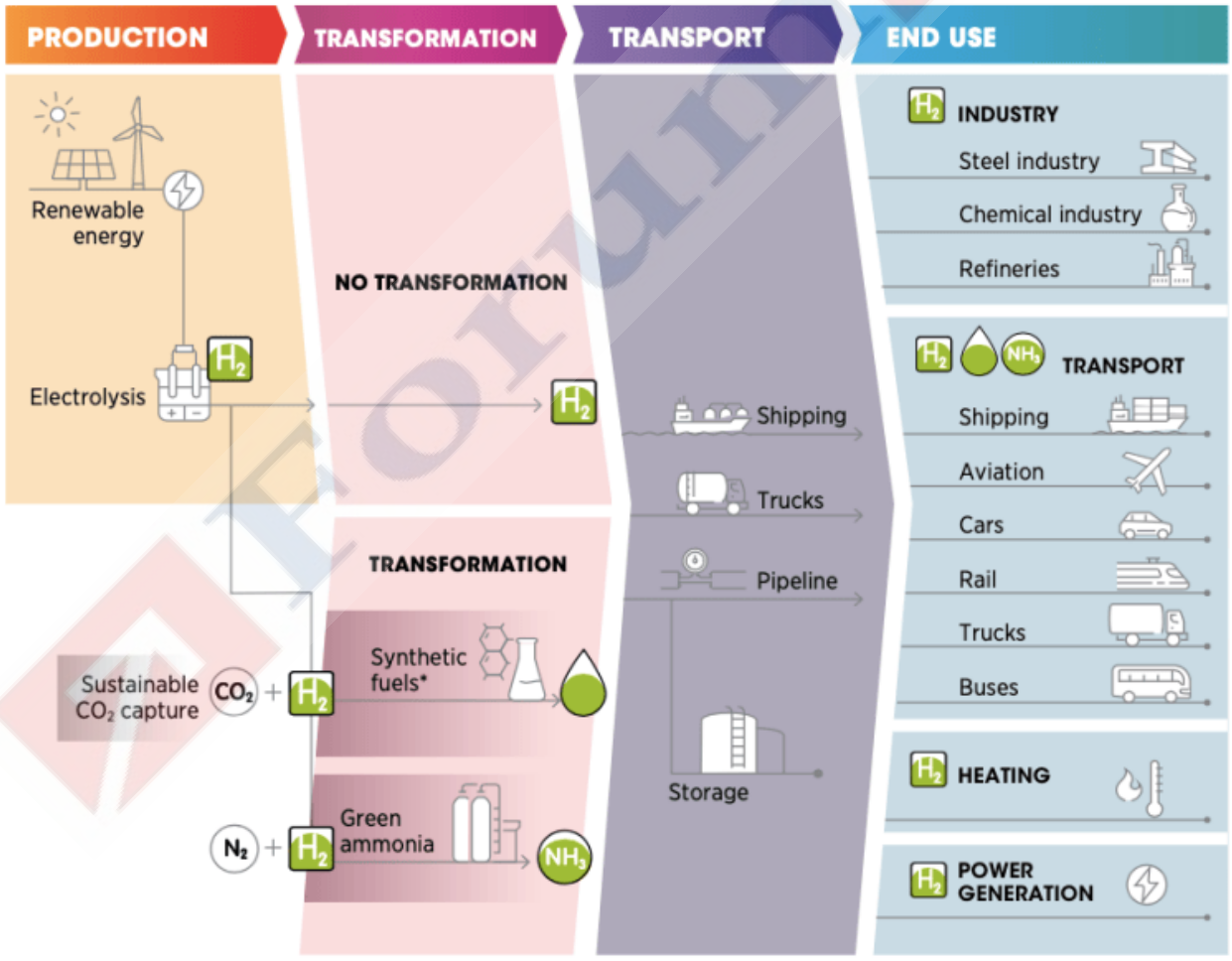
1. **Fertilisers:** Ammonia, made from hydrogen and nitrogen, is the base for nitrogen fertilisers such as urea. Most of this hydrogen now comes from natural gas. Green hydrogen can replace it and yield green ammonia with far lower emissions.
2. **Petroleum refineries:** Refineries use hydrogen to remove sulphur from petrol and diesel, so the fuels burn cleaner. They also use it to upgrade heavy oil into lighter fuels such as diesel, aviation turbine fuel and naphtha. These fuels serve road transport, aviation and industry. Most refinery hydrogen comes from fossil fuels, so a green supply can cut refining emissions.
3. **Steel:** Conventional steelmaking uses coal to strip oxygen from iron ore, releasing carbon dioxide. In direct reduced iron routes, green hydrogen can do this job instead. The reduction stage then releases water vapour in place of carbon dioxide.
4. **City gas networks:** Green hydrogen can be blended with natural gas in limited proportions, subject to safety standards and infrastructure compatibility. This allows existing gas networks to supply a hydrogen-natural gas blend to homes, businesses and industries. Such blending can reduce fossil fuel consumption and associated emissions while utilising existing distribution infrastructure.
5. **Road and rail transport:** Fuel-cell vehicles convert hydrogen into electricity on board, which drives electric motors. Their only emission at the point of use is water vapour. This suits buses, trucks and trains that need long range and quick refuelling.
6. **Shipping:** Green hydrogen can be converted into green ammonia and green methanol, which can fuel ships. These can replace conventional marine fuels on long voyages. Adoption depends on engine compatibility, safety requirements and port infrastructure.

What are the benefits of Green Hydrogen?

1. **Net Zero Transition**: The use of hydrogen in combustion has zero GHG emissions. Since, renewable energy is used in producing the Green Hydrogen, the entire chain (production to consumption) has very low GHG emissions (in contrast to Grey Hydrogen). Thus Green Hydrogen is vital to Net Zero transition. It can be utilized to decarbonize the heavy industry, long haul freight, shipping, and aviation sectors. Governments and industry have both acknowledged **Green Hydrogen as an important pillar of a Net Zero economy**.
2. **Energy Security**: Green hydrogen can enhance India's energy security by reducing dependence on imported fossil fuels such as oil, natural gas and coal. It promotes diversification of the energy mix and enables efficient storage of surplus renewable energy. This can reduce vulnerability to global energy price fluctuations, strengthen strategic autonomy and ensure a reliable, sustainable energy supply.
3. **Industrial Benefits**: Green hydrogen promotes industrial decarbonisation by reducing dependence on fossil fuels in hard-to-abate sectors such as steel, cement, fertilisers and refineries. It can facilitate green steel production, provide clean feedstock for chemical industries and reduce the carbon footprint of industrial processes. This enhances industrial sustainability and competitiveness while supporting India's transition towards a low-carbon economy.
4. **Export potential**: Green hydrogen offers India an opportunity to emerge as a major global exporter of clean energy. With abundant solar and wind energy resources, India can produce green hydrogen and its derivatives, such as green ammonia, for export to countries seeking to decarbonise their economies. This can generate foreign exchange, attract investments and strengthen India's position in the global clean energy market.

5. **Energy transition**: Green hydrogen facilitates the transition from fossil fuels to clean and renewable energy sources. It helps reduce dependence on coal, oil and natural gas while enabling the integration and storage of renewable energy. It can also decarbonise energy-intensive industries, transportation and power generation, thereby promoting a sustainable, low-carbon economy.
6. **Clean transportation**: Green hydrogen can promote clean transportation by powering hydrogen fuel-cell vehicles, particularly heavy-duty trucks, buses, trains and ships. Unlike conventional fossil-fuel-based vehicles, hydrogen fuel-cell vehicles emit only water vapour at the point of use, thereby reducing air pollution and carbon emissions. For e.g. India has initiated trials of hydrogen-powered trains and buses to promote sustainable public transportation.
7. **Energy Storage Solution**: Hydrogen is emerging as one of the leading options for **storing energy from renewables**. Hydrogen-based fuels can potentially transport energy from renewables over long distances; from regions with abundant energy resources, to energy-intensive areas thousands of kilometers away;
8. **Versatility**: Green Hydrogen can be transformed into electricity or synthetic gas and used for commercial, industrial or mobility purposes.

FIGURE 1.1 Green hydrogen production, conversion and end uses across the energy system



Source: WEF, IRENA

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What are the challenges in scaling up adoption of Green Hydrogen?

1. **High Production Cost**: The process of production of hydrogen using electrolysis consumes a lot of energy. The process uses **high end-technological electrolysers**. Electrolysers are devices that use electricity to split water into hydrogen and oxygen and **are expensive**. Hence, the cost of production of Green Hydrogen is high.
2. **High Energy Consumption**: Green hydrogen production through electrolysis is an energy-intensive process, requiring large amounts of electricity to split water into hydrogen and oxygen. Since renewable energy sources such as solar and wind are intermittent, ensuring a continuous and reliable electricity supply becomes challenging.
3. **Technological dependence**: India faces dependence on imported technologies, critical components and specialised materials required for manufacturing electrolysers. Limited domestic manufacturing capabilities increase production costs and create vulnerabilities in global supply chains.
4. **Storage difficulties**: Hydrogen has very low volumetric energy density, meaning it occupies a large volume even at relatively low weight. Therefore, it requires high-pressure compression, liquefaction at extremely low temperatures (around −253°C) or specialised storage materials. These processes are energy-intensive, expensive and require specialised infrastructure, making large-scale storage, transportation and distribution of green hydrogen challenging.
5. **Inadequate infrastructure**: Large-scale adoption of green hydrogen is constrained by the limited availability of dedicated infrastructure for its production, storage, transportation and distribution. The absence of hydrogen pipelines, specialised storage facilities, refuelling stations and port infrastructure increases logistical costs and limits its commercial utilisation.
6. **Water availability**: Green hydrogen production through electrolysis requires a continuous supply of purified water. Large-scale production may put additional pressure on freshwater resources, particularly in water-stressed regions of India.
7. **Uncertain demand**: High production costs and the availability of cheaper conventional alternatives, such as grey hydrogen and fossil fuels, discourage industries from switching to green hydrogen. Moreover, the absence of long-term purchase agreements and limited demand from end-user industries create uncertainty regarding future returns on investment, thereby discouraging large-scale production and private investment.
8. **Safety Issues**: Hydrogen is a **highly volatile** and **flammable element**, making it susceptible to fire and explosions in case of leakage. Its colourless and odourless nature makes leak detection difficult. Moreover, its storage under high pressure or at extremely low temperatures requires specialised infrastructure, advanced monitoring systems and stringent safety standards.
9. **Skill shortages**: The green hydrogen industry requires specialised skills in electrolysis, renewable energy systems, hydrogen storage, transportation and safety management. However, the shortage of trained professionals and technical expertise can hinder large-scale production, infrastructure development and commercial adoption.
10. **Global competition**: Several countries, including China, the USA, Germany, Japan and Australia, are making substantial investments in green hydrogen production, technology and infrastructure. This creates competition for investment, global markets, critical minerals and technological leadership. For e.g. China's dominance in electrolyser manufacturing and renewable energy equipment could create competitive pressure on India's emerging green hydrogen industry.

What steps have been taken to promote Green Hydrogen?

National Green Hydrogen Mission (2023)	• The intent of the Mission is to **incentivise the commercial production of green hydrogen** and make India a **net exporter of Green Hydrogen by creating opportunities for exports**. • The Mission is also aimed at **decarbonisation of the energy sector** and use in **mobility applications** in a bid to **lower the dependence on imported fossil fuels**; and to develop **indigenous manufacturing capacities**. • It will also help in creating employment opportunities; and developing new technologies such as efficient fuel cells. • The mission has laid out a target to develop Green Hydrogen production capacity of at least **5 MMT (Million Metric Tonne) per annum**. This is alongside adding renewable energy capacity of about 125 GW (gigawatt) in the country. • The Government hopes that by 2030, the Mission will help bring in investments worth INR 8 trillion and create over six lakh jobs. • With implicit subsidy support and a **Government-backed R&D push**, the plan is to target lower costs of renewable power generation and to **bring down the costs of electrolysers** to make the production of Green Hydrogen **cost-competitive.** • There are two umbrella sub-missions under the Green Hydrogen Mission: 1. **Strategic Interventions for Green Hydrogen Transition Programme** (SIGHT) will fund the domestic manufacturing of electrolysers and produce Green Hydrogen. 2. **Green Hydrogen Hubs:** To **support pilot projects** in emerging end-use sectors and production pathways, States and regions capable of supporting large scale production and/or utilisation of hydrogen will be identified and developed as Green Hydrogen Hubs**.**
Green Hydrogen Policy (2022)	• The Government had launched the Green Hydrogen Policy in February 2022 that envisages to build a prominent role for clean fuels in the country's fossil fuel-dominated energy mix.
Green Hydrogen Standards	• The government notified the Green Hydrogen Standard for India in August 2023. • It defines green hydrogen based on a well-to-gate greenhouse gas emission threshold of not more than 2 kg CO_2 equivalent per kg of hydrogen, averaged over 12 months. • Establishes a common framework for identifying and certifying green hydrogen.
Green Hydrogen Purchase Obligations (GHPO)	• Introduced under the National Green Hydrogen Mission to create assured demand for green hydrogen and its derivatives. • Encourages industries to gradually increase the consumption of green hydrogen and green ammonia.

State-Level Green Hydrogen Policies	• Gujarat, Maharashtra, Rajasthan, Uttar Pradesh, Andhra Pradesh and West Bengal have notified dedicated policies. • Kerala has set up a high-level working group for its own **Hydrogen Economy Mission** to devise a strategic roadmap, policy formulations, and implementation plans for facilitating investments in green hydrogen and making the State "a green hydrogen hub".

Read More: Green Hydrogen Policy – Explained, pointwise

What more steps can be taken to scale-up production/adoption of Green Hydrogen?

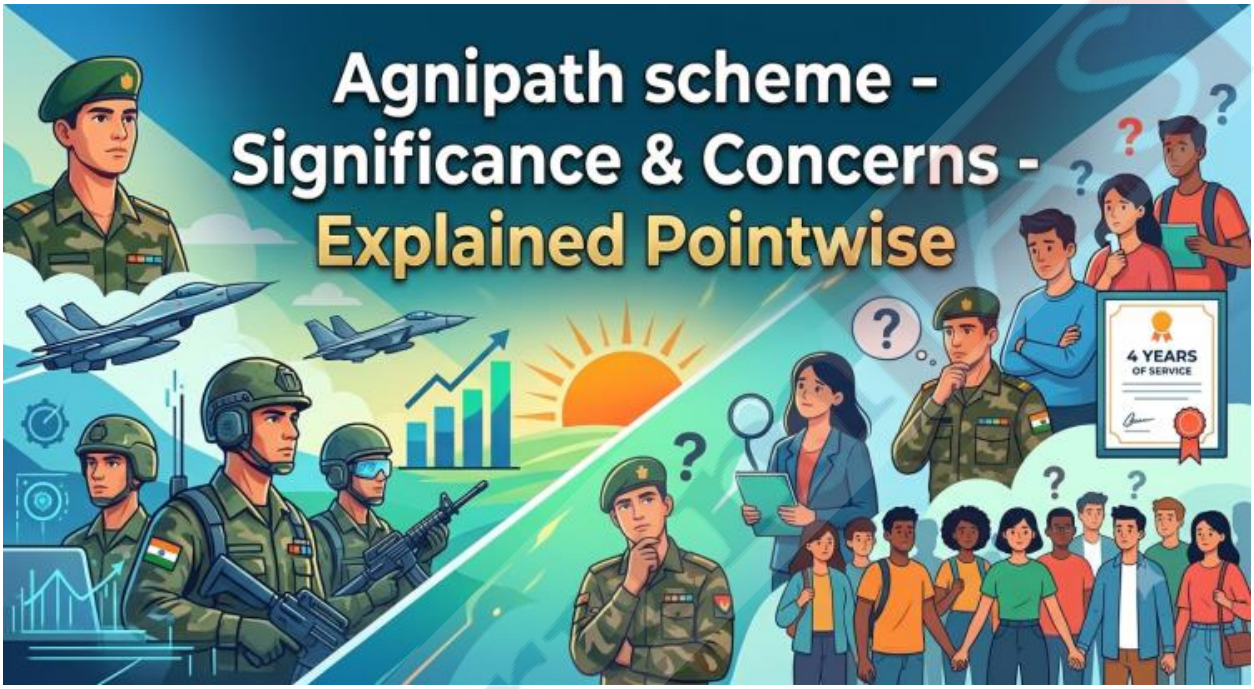
1. **Reducing Production Costs**: The government should focus on reducing the cost of green hydrogen production by expanding affordable renewable energy capacity, promoting large-scale domestic manufacturing of electrolysers and achieving economies of scale. Providing targeted subsidies, tax incentives and low-interest loans can encourage private investment and make green hydrogen commercially competitive with conventional fossil fuel-based hydrogen.
2. **Strengthening Domestic Manufacturing**: India should promote indigenous manufacturing of electrolysers, fuel cells, storage systems and other critical components to reduce dependence on imported technologies and strengthen supply-chain resilience.
3. **Infrastructure Development**: Developing dedicated infrastructure for the production, storage, transportation and distribution of green hydrogen is essential for its large-scale adoption. This includes establishing hydrogen pipelines, storage facilities, refuelling stations and integrated hydrogen hubs near industrial clusters and ports.
4. **Creating Assured Market Demand**: The government should create a stable and predictable market for green hydrogen by gradually introducing mandatory consumption targets in hard-to-abate sectors such as steel, fertilisers, petroleum refining and cement.
5. **Promoting Public-Private Partnerships**: Encourage collaboration between government agencies, private companies, research institutions and startups to mobilise investment, promote technological innovation and accelerate large-scale green hydrogen projects. The government can provide financial incentives, policy support and risk-sharing mechanisms to attract private investment.
6. **Ensuring Water and Resource Security**: Green hydrogen production through electrolysis requires significant quantities of purified water and critical minerals for manufacturing electrolysers. Therefore, promoting the use of treated wastewater and desalinated seawater can reduce pressure on freshwater resources, particularly in water-stressed regions.
7. **Skill Development and Capacity Building**: Promote specialised training programmes in green hydrogen technologies. Collaboration between industries, technical institutions and universities can help develop a skilled workforce, strengthen research capabilities and address the shortage of trained professionals required for large-scale adoption of green hydrogen.
8. **International Cooperation**: Strengthen international partnerships for technology transfer, joint research and development, and investment in green hydrogen projects. India should collaborate with countries possessing advanced hydrogen technologies to develop efficient electrolysers, storage systems and transportation infrastructure.

Conclusion: Shift to Green Hydrogen based economy requires a mission mode approach to ensure quick transition without any disruption. The Green Hydrogen Mission is a foresighted initiative in this regard. The

focus should be on effective implementation with the target oriented approach. The Green Hydrogen Mission may be single biggest initiative in transition of the economy to Net Zero.

UPSC: GS III, Infrastructure: Energy; GS III, Conservation
Read More: PIB

Agnipath Scheme – Significance & Concerns – Explained Pointwise



The Union Cabinet has approved significant changes to the Agnipath Scheme, aimed at expanding retention opportunities and providing greater career continuity to Agniveers as the first batch approaches the completion of its initial four-year service tenure. In this context, let us examine the significance, concerns and possible way forward for the scheme.

What is Agnipath scheme?

- Agnipath Scheme is a short-term recruitment scheme launched by the Government of India on 14 June 2022 to recruit young personnel into the three branches of the Indian Armed Forces – Indian Army, Indian Navy & Indian Air Force.
- Under this scheme, selected candidates are known as **Agniveers** and are initially recruited for a period of **four years**.
- At the end of 4 years, up to **25%** of each batch are selected for retention in the regular cadre of the armed forces based on merit and organizational requirements. The remaining 75% exit active service.

Core Features of Agnipath Scheme:

- **Age Limit:** Open to candidates aged **17.5 to 21 years** (relaxed up to 23 years during initial recruitment cycles).
- **Four-Year Initial Tenure:** Recruits serve an initial 4-year period, which includes 6 months of basic military training followed by 3.5 years of active deployment.

- **Merit-Based Retention:** Upon completing the initial 4-year period, up to **25%** of each batch are selected for permanent enrolment into the regular cadre based on merit, performance, and operational needs.
- **Customized Monthly Salary:** Starts at ₹30,000/month in Year 1 and increases annually to ₹40,000/month in Year 4.
- **Seva Nidhi Corpus Fund:** 30% of an Agniveer's monthly salary is deducted and deposited into the Agniveer Corpus Fund, matched equally by the Government.
- **Exit Corpus:** Non-retained Agniveers exiting after their service period receive a tax-free **Seva Nidhi package** of approximately **₹11.71 lakh** (including accumulated interest).
- **Life Insurance Cover:** Non-contributory life insurance cover of **₹48 lakh** for the duration of the engagement period.
- **Disability Compensation:** Ex-gratia lump-sum payment up to ₹44 lakh (depending on the degree of disability), alongside full pay for the unserved tenure and Seva Nidhi package benefits.
- **Death Benefits:** In the event of death on duty, the family receives an ex-gratia of ₹44 lakh, full pay for the unserved portion of the 4-year tenure, and the complete Seva Nidhi package.
- **No Lifelong Pension:** Recruits who exit after their engagement period do not receive regular pensions, gratuity, or lifelong post-retirement medical coverage (ECHS).
- **Skill Certification:** Exiting Agniveers receive an official **Agniveer Skill Certificate** detailing the technical proficiencies, trade capabilities, and operational experience acquired during service.

Broad objectives of Agnipath scheme:

- To enhance youthful profile of the Armed Forces so that they are at their best fighting abilities, and increased risk taking ability, at all times.
- Trim long-term military pension and salary liabilities to reallocate defence budgets toward capital acquisition, equipment modernization, and tech adoption.
- To bring in young talent from society who can effectively use new technologies and have higher technical skills, using the country's technical institutions.
- To provide an opportunity to the youth who may be keen to serve the Nation in uniform albeit for a short period of time.
- To imbibe the Armed Forces ethos, camaraderie, commitment and teamwork in the youth.
- To provide abilities and qualities such as discipline, dynamism, motivation and work-skills so that the youth remains an asset.

Post Demobilisation Employment Opportunities:

Central / State Government	Incentive
Ministry of Home Affairs	10% reservations in vacancies of the Central Armed Police Forces (CAPF) and Assam Rifles (AR) Relaxation of the upper age limit by three years (five years for the first batch of Agniveers) in recruitments to the CAPF and AR
Ministry of Defence	10% reservation in jobs in the Indian Coast Guard, defence civilian posts, and 16 Defence Public Sector Undertakings (DPSUs)
Ministry of Ports, Shipping and Waterways	Job opportunities for Agniveers in six sectors of the merchant navy
Ministry of Education	Special educational programme to enable Agniveers who finished 10th Class to obtain 12th Class pass certificate
Government of Assam	Assam Police to absorb Agniveers who are permanent residents of the State
Governments of Uttar Pradesh, Haryana and Madhya Pradesh	Priority in recruitment in state police forces

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Source-PIB

What recent changes has the government introduced in the Agnipath Scheme?

1. **Optional 2-Year Service Extension (4+2 Model)**: The original rules required the 75% non-retained Agniveers to exit service after 4 years. Under the revised framework, outgoing Agniveers are granted the option of an **additional 2-year engagement.** After completing this extended 6-year total tenure, willing recruits will be considered again for enrolment into the regular cadre based on objective selection criteria.
2. **Higher Pay During Extension:** Personnel opting for the 2-year extension receive an upgraded monthly salary scale (scaling from ₹43,500 to ₹47,500/month) alongside higher operational allowances.
3. **Boosted Government Contribution to *Seva Nidhi*:** For the extended 2-year period, the government increased its matching contribution to the *Seva Nidhi* corpus from **30% up to 70%** of the member's individual share, resulting in a larger tax-free payout upon final exit.
4. **Service Seniority:** Agniveers who serve the extended 2 years and subsequently get absorbed into the regular cadre will receive partial credit for their extended service period toward overall seniority.
5. **Changes in Recruitment Process**: The written examination will now be conducted before the physical fitness test, reversing the earlier sequence. This is intended to streamline the recruitment process.

What is the significance of Agnipath scheme?

1. **Leaner and Younger Armed Force:** The Agnipath Scheme aims to reduce the average age profile of India's Armed Forces from approximately 32 years to 26 years, resulting in a younger, fitter and more agile military. It is also expected to reduce the size of the permanent workforce by limiting long-term recruitment and retention, thereby creating a leaner force.
2. **Reduction in Pension Burden:** The Agnipath Scheme seeks to reduce the long-term pensionary and retirement liabilities of the Defence Ministry by recruiting personnel for a fixed four-year tenure without regular pension benefits. For e.g. according to PRS Legislative Research, defence pension

expenditure is estimated at ₹1.71 lakh crore in 2026-27, accounting for approximately 22% of the total defence budget.

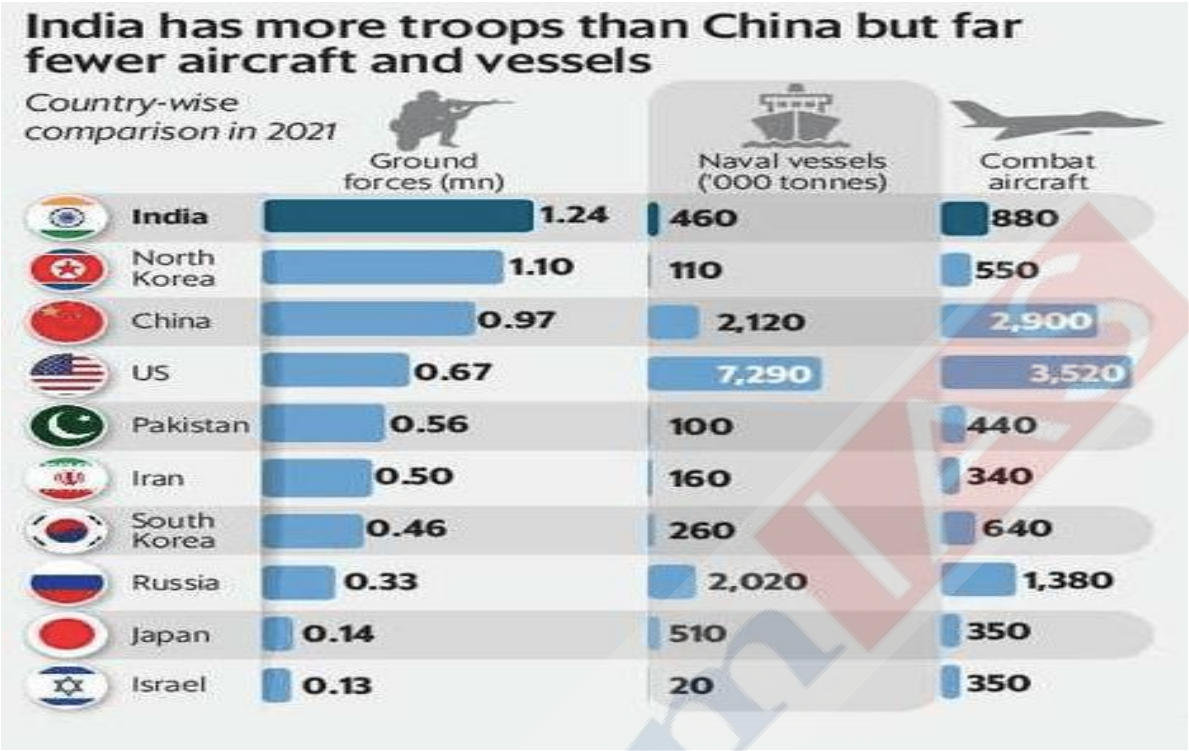
3. **Defence Budget Optimisation**: A leaner military and reduced benefits will significantly lower the defense budget, which has been a major concern for governments for many years. According to the PRS analysis of Union Budget 2026-27, salaries and pensions account for approximately 44% of India's total defence expenditure, while capital outlay accounts for only 29%. According to MP-IDSA, the share of pay and allowances in the Army's revenue budget declined from 61.3% in 2022-23 to 52.9% in 2026-27 (BE) following the introduction of the Agnipath scheme.



Broad Distribution of the MoD's Expenditure, 2013/14-2022/23

Modernisation of Armed Forces: The Agnipath Scheme facilitates the induction of young and technologically skilled personnel who can adapt to emerging technologies, modern warfare and evolving security challenges, including drone warfare, artificial intelligence and cyber operations. This can enhance

the technological adaptability and operational preparedness of the Armed Forces.



4. **Gender Parity:** Agnipath formalizes short-service induction for women into non-officer ranks in the Navy and Air Force, expanding women's participation in the armed forces.
5. **All-India, All-Class Intake:** The scheme breaks away from legacy recruitments tied to specific region- or caste-based regiments, transitioning recruitment to a uniform, merit-based model across all states and Union Territories.
6. **Enhanced Operational Efficiency:** The scheme aims to create a younger, physically fitter and more agile military workforce, thereby improving operational readiness, responsiveness and the ability to adapt to evolving battlefield requirements.
7. **Skill Development**: The Agnipath Scheme provides Agniveers with structured military training in technical operations, leadership, teamwork, discipline and crisis management. These transferable skills enhance their employability and enable them to pursue diverse career opportunities in the defence sector, government services and private industries after completing their military engagement.
8. **Employment Opportunities**: The Agnipath Scheme provides young people with an opportunity to serve in the Armed Forces for four years, offering them stable income, professional training and valuable work experience. Additionally, up to 25% of each batch may be selected for permanent enrolment, while the remaining Agniveers can explore employment opportunities in CAPFs, police forces and the private sector after completing their service.
9. **Financial Launchpad (*Seva Nidhi*):** Exiting Agniveers receive a tax-free corpus of approximately **₹11.71 lakh**, providing capital to pursue higher education, vocational training, or entrepreneurship.
10. **National Integration**: The scheme promotes national integration by providing opportunities to youth from diverse regions, religions, castes and socio-economic backgrounds to serve together in the Armed Forces. It fosters a sense of patriotism, unity, discipline and national identity, thereby strengthening India's social cohesion.

What are the concerns associated with Agnipath scheme?

1. **Job Insecurity**: The four-year service tenure creates uncertainty about long-term career prospects, as only up to 25% of each batch is eligible for permanent enrolment under the original scheme. The remaining Agniveers must seek alternative employment after completing their engagement, raising concerns about livelihood security and career stability.
2. **Lack of Social Security**: Agniveers who are not retained in the regular cadre after four years are not entitled to regular pension, gratuity or other long-term retirement benefits. This creates concerns regarding their financial security and livelihood, particularly in the absence of guaranteed post-service employment.
3. **Military Experience**: The short four-year tenure may limit the time available for Agniveers to acquire specialised military skills, operational experience and institutional knowledge. This could affect the availability of experienced personnel, particularly in technically demanding roles that require prolonged training and practical exposure.
4. **Militarized Youth in Civilian Society:** A recurring concern among social analysts is the influx of thousands of military-trained individuals returning to civilian life every year without guaranteed employment, which could pose security challenges if exploited by unlawful groups.
5. **Training Constraints**: The short four-year service tenure may put pressure on the Armed Forces to compress training schedules, leaving limited time for developing specialised military skills, operational experience and technical expertise. This may affect the preparedness and effectiveness of personnel, particularly in technologically advanced and complex combat roles.
6. **Rehabilitation and Employment**: The short-term nature of the scheme raises concerns about the reintegration of released Agniveers into civilian life. Absorbing a large number of trained personnel into government services and the private sector may be challenging due to limited job opportunities, lack of assured employment and possible mismatch between military skills and civilian job requirements.
7. **Impact on Regimental Ethos**: The short tenure of Agniveers may affect the traditional regimental system of the Indian Army, which is built on long-term bonding, shared experiences, loyalty and a strong sense of belonging. Frequent turnover of personnel may weaken unit cohesion, camaraderie and the regimental spirit developed through years of service.
8. **Impact on Rural Economies:** In many traditional recruitment belts (such as parts of Haryana, Rajasthan, Punjab, and Uttarakhand), military service was seen as a primary route to socio-economic mobility and financial security for rural families.

What should be the way forward?

1. **Differentiate Tech vs. General Infantry:** Rather than applying a blanket 25% retention cap across all arms, retention should be tailored by trade. Technical branches – such as Signals, Electronics & Mechanical Engineers (EME), aviation maintenance, and cyber/radar units – require 50% to 75% retention to prevent the loss of highly specialized skills.
2. **Strengthening Post-Service Rehabilitation**: The government should develop a comprehensive rehabilitation framework to facilitate the smooth transition of released Agniveers into civilian life. This may include employment reservations in CAPFs, state police forces and PSUs, industry-linked skill development, vocational training and career counselling to ensure better employment opportunities and financial security after military service.
3. **Skill Development and Certification**: Agniveers should be provided with industry-recognised skill certificates and vocational training aligned with civilian employment requirements. Collaboration with NSDC, ITIs and private industries can help translate their military training into recognised qualifications, improving their employability in sectors such as security, logistics, aviation, engineering and technology.

4. **Enhancing Social Security**: The government should explore additional social security measures, including health insurance, accident coverage, pension-linked savings and financial assistance for former Agniveers. This would provide greater financial stability, reduce post-service uncertainty and ensure their long-term welfare and dignified transition into civilian life.
5. **Periodic Review**: The government should undertake regular assessments of the Agnipath Scheme to evaluate its impact on military preparedness, operational efficiency, recruitment quality and personnel morale. Feedback from serving personnel, defence experts and former Agniveers should be incorporated to address emerging challenges and make necessary policy adjustments.
6. **Strengthening Training Infrastructure**: The government should invest in modern training facilities, advanced simulation technologies, qualified instructors and specialised skill-development programmes to ensure comprehensive military training within the limited service period. This would enhance the operational readiness, technical proficiency and combat effectiveness of Agniveers.
7. **Industry Collaboration**: The government should establish partnerships with private industries, sector skill councils and corporate organisations to facilitate the employment of former Agniveers. Their military training and technical skills can be aligned with industry requirements in sectors such as security, logistics, aviation, manufacturing and information technology, ensuring smoother transition into civilian employment.
8. **Balanced Manpower Policy**: The government should maintain an appropriate balance between young recruits and experienced personnel in the Armed Forces. While younger personnel bring physical fitness and technological adaptability, experienced soldiers provide operational expertise, leadership and institutional knowledge. This balance is essential for maintaining military effectiveness, unit cohesion and long-term combat readiness.

Conclusion: The success of the Agnipath Scheme depends on balancing military modernisation with personnel welfare. A robust rehabilitation framework, adequate social security and preservation of military traditions are essential to achieving its long-term objectives.

UPSC GS-3: Internal Security
Read More: Indian Express

Nuclear Fusion – Significance & Challenges – Explained Pointwise

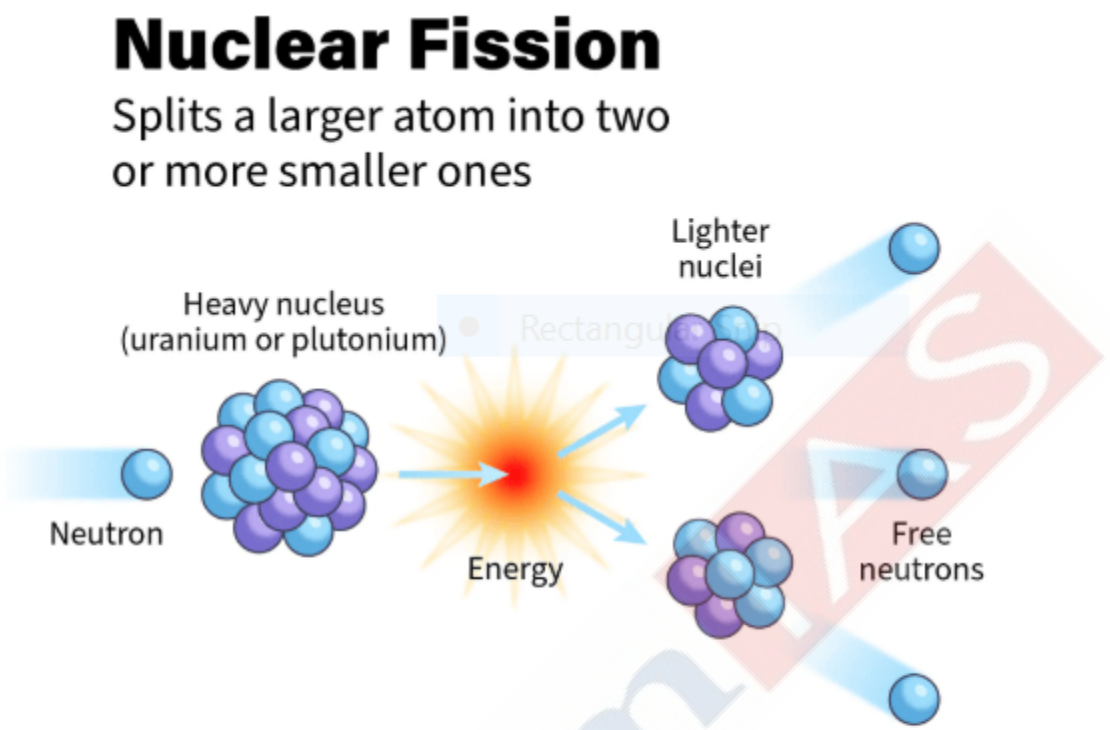


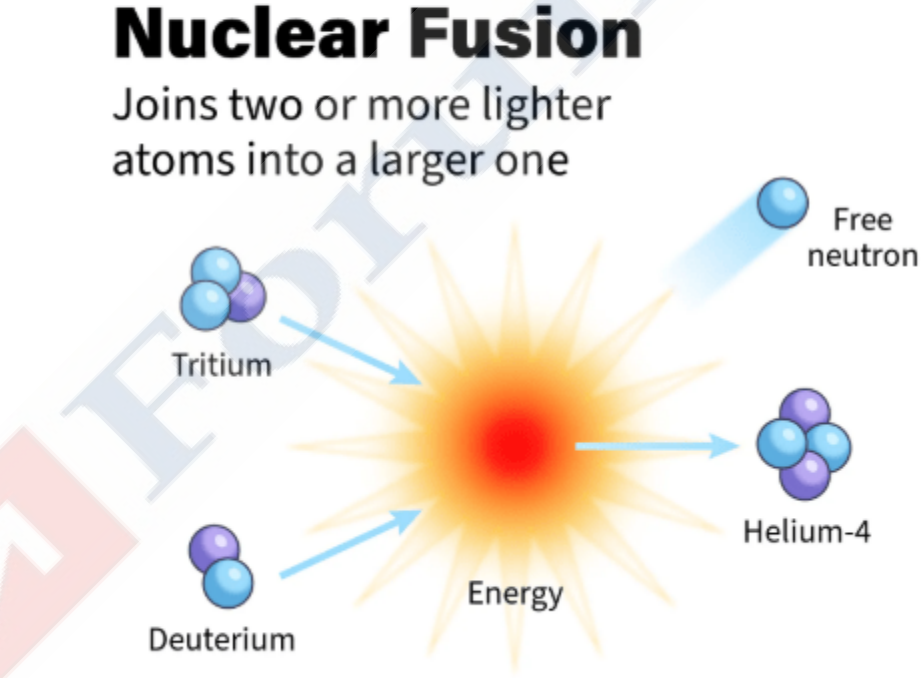
Recent technological breakthroughs and growing global investments have renewed interest in **nuclear fusion** as a potential source of clean and sustainable energy. In November 2026, the US Department of Energy announced $8.5 million in funding for 28 collaborative research projects to accelerate commercial fusion energy. This reflects the growing global efforts to overcome technological challenges and make nuclear fusion a viable energy source.

What is nuclear fusion? How does it differ from nuclear fission?

- Nuclear fusion is a nuclear reaction in which two or more light atomic nuclei combine to form a heavier nucleus, releasing a large amount of energy.
- It is the fundamental reaction that powers the Sun and other stars, where hydrogen isotopes fuse under extreme temperature and gravitational pressure to form helium.

NUCLEAR FUSION	NUCLEAR FISSION
Combines two light nuclei into a heavier nucleus.	Splits a heavy nucleus into lighter nuclei.
Hydrogen isotopes, such as deuterium and tritium.	Uranium-235 or Plutonium-239.
Requires extremely high temperatures and pressure.	Can be initiated by neutron bombardment.
Releases enormous energy per unit mass of fuel.	Releases substantial energy through nuclear splitting,
Produces comparatively less long-lived radioactive waste.	Produces significant radioactive waste.
No self-sustaining chain reaction; comparatively lower risk of runaway reactions.	Risk of uncontrolled chain reactions and nuclear accidents.
e.g. Sun, stars and experimental fusion reactors.	e.g. Nuclear power plants and atomic bombs.





Why is nuclear fusion considered a promising source of clean energy?

1. **Abundant Fuel:** Fusion relies on deuterium (extracted from seawater) and tritium (bred from lithium, an abundant crustal element). The deuterium found in just one liter of seawater could provide as much energy as 300 liters of oil.

2. **Extreme Energy Density:** Recombining light atomic nuclei releases roughly 4 million times more energy per kilogram than burning fossil fuels (coal, oil, or natural gas) and nearly 4 times more energy per unit mass than nuclear fission.
3. **Zero Greenhouse Gas Emissions:** Fusion power generation emits no carbon dioxide, methane, or air pollutants. Its primary direct byproduct is non-toxic helium gas.
4. **Reduced Radioactive Waste:** It produces comparatively less long-lived radioactive waste than conventional nuclear fission.
5. **Inherent Safety (Zero Meltdown Risk):** Fusion requires precise, extreme conditions to sustain. It does not rely on a self-sustaining chain reaction. If power, fuel flow, or magnetic confinement fails, the plasma instantly expands, cools, and safely terminates the reaction in milliseconds.
6. **Energy Security:** It can reduce dependence on fossil fuels and imported energy resources.
7. **Reliable Power Supply:** Unlike solar and wind energy, fusion could provide continuous electricity irrespective of weather conditions.
8. **Reliable Baseload Power:** Unlike solar and wind, which fluctuate with weather conditions and time of day, fusion can generate continuous, dispatchable power on demand without requiring large-scale battery storage networks.

What are the major scientific and technological challenges associated with nuclear fusion?

1. **Extremely High Temperature:** Fusion requires temperatures exceeding 100 million°C to overcome the repulsive forces between atomic nuclei. Achieving and maintaining such temperatures is difficult.
2. **Plasma Confinement:** The extremely hot plasma must be confined for sufficient time without touching reactor walls. Maintaining stable plasma using magnetic fields remains a major challenge.
3. **Precision Magnetic Control:** Machines like tokamaks and stellarators rely on massive superconducting magnets to suspend the plasma away from the reactor walls. Keeping this turbulent, swirling ring of plasma stable requires advanced control algorithms and magnetic field tolerances near perfection.
4. **Energy Breakeven:** Producing more usable energy than the total energy consumed by the fusion power plant remains a major challenge for commercial viability.
5. **Material Limitations:** Reactor walls and components must withstand extreme heat, high-energy neutron bombardment and radiation damage without frequent replacement.
6. **Tritium Fuel Availability**: Tritium is scarce and radioactive. Developing technologies to produce and recycle sufficient tritium within fusion reactors is essential.
7. **Heat Extraction and Electricity Generation**: Developing efficient systems to capture fusion energy and convert it into electricity on a continuous basis remains challenging.
8. **High Costs and Infrastructure**: Constructing reactors with high-temperature superconductors, massive vacuum vessels, and precise optics requires immense upfront capital, making economic viability a central challenge.
9. **Maintenance Difficulties**: High radiation levels inside reactors make direct human maintenance difficult, necessitating advanced robotic systems.

How is international cooperation playing an important role in the development of commercial nuclear fusion energy?

1. **ITER Project**: The **ITER** (**International Thermonuclear Experimental Reactor**) is the world's largest magnetic confinement plasma physics experiment. Located in Saint-Paul-lez-Durance in southern France, ITER is an intergovernmental megaproject supported by 35 nations—including

seven main signatories: the European Union, the United States, China, Russia, India, Japan, and South Korea.

2. **Component Specialization:** In the ITER consortium, different countries manufacture distinct core components based on their industrial expertise. For e.g. Japan and the US supply massive high-field superconducting magnets, European entities produce the vacuum vessel sectors, and Russia supplies specialized electrical systems.
3. **Shared Experimental Results:** Insights gained from major public research devices—such as EAST in China, JET in the UK, KSTAR in South Korea, and JT-60SA in Japan—are routinely shared across global research networks.
4. **Joint Ventures:** Strategic alliances between national laboratories (such as the UK Atomic Energy Authority or US Department of Energy labs) and private firms in North America, Europe, and Asia accelerate the commercialization of compact tokamak and stellarator designs.
5. **Regulatory Alignment:** Organizations like the **International Atomic Energy Agency (IAEA)** bring international regulators together to establish safety protocols distinct from conventional nuclear fission.

What is the significance of the ITER project in advancing nuclear fusion technology?

1. **Demonstrating Fusion Feasibility**: ITER aims to demonstrate that controlled nuclear fusion can generate substantial energy for sustained periods.
2. **Achieving Energy Gain:** It aims to produce 500 MW of fusion power using 50 MW of external heating power, achieving a fusion energy gain factor (Q) of 10.
3. **Advancing Scientific Research**: It will improve understanding of plasma behaviour, stability and sustained fusion reactions.
4. **Developing Advanced Technologies**: ITER will test superconducting magnets, plasma heating systems, cryogenic technologies and remote maintenance systems.
5. **Preparing for Commercial Fusion**: It will provide scientific and technological knowledge for future demonstration fusion power plants.
6. **Promoting International Cooperation:** It brings together scientific expertise, financial resources and technological capabilities from seven international partners.
7. **Strengthening India's Capabilities:** India's participation through ITER-India provides opportunities for indigenous engineering, advanced manufacturing and nuclear research.

Conclusion: Nuclear fusion holds immense potential to revolutionise the global energy sector by providing abundant, reliable and low-carbon energy. However, overcoming technological and economic challenges through sustained research, innovation and international cooperation is essential to realise its potential as a future energy source.

UPSC GS-3: S&T
Read More: The Hindu

Health Costs of Cash Shortages – Explained Pointwise



Cash shortages, particularly in developing countries, impose significant yet often overlooked costs on healthcare systems by affecting the affordability and accessibility of medical services. With the growing expansion of Digital Public Infrastructure (DPI), it becomes increasingly important to examine the hidden health costs of cash shortages and their implications for public health.

What are the health costs associated with cash shortages?

1. **Delayed Medical Treatment:** Patients may postpone consultations, diagnostic tests and surgeries due to a lack of money, worsening their health conditions.
2. **Reduced Access to Medicines**: Cash shortages may prevent people from purchasing essential medicines, particularly those suffering from chronic diseases.
3. **Increased Out-of-Pocket Expenditure**: Limited access to affordable healthcare may force patients to seek expensive private medical services, increasing financial hardship.
4. **Malnutrition and Food Insecurity**: Reduced purchasing power can limit access to nutritious food, particularly among vulnerable households, leading to nutritional deficiencies.
5. **Mental Health Problems**: Financial insecurity and difficulties in meeting medical expenses can increase stress, anxiety and psychological distress.
6. **Disproportionate Impact on Vulnerable Groups**: Poor households, women, children, elderly people and persons with disabilities are more likely to suffer from inadequate healthcare due to financial constraints.
7. **Higher Healthcare Costs in the Long Run**: Delayed treatment can aggravate illnesses, requiring more expensive medical interventions and hospitalisation.
8. **Increased Health Inequalities**: Cash shortages can widen disparities in healthcare access and health outcomes between affluent and economically weaker sections.

How do cash shortages affect healthcare delivery in developing countries?

1. **Inadequate Healthcare Infrastructure**: Financial constraints limit investments in hospitals, medical equipment, laboratories and healthcare facilities, particularly in rural areas.

2. **Shortage of Medical Supplies**: Cash shortages can disrupt the procurement of essential medicines, vaccines, diagnostic equipment and other medical supplies.
3. **Reduced Healthcare Workforce**: Limited financial resources may delay salary payments, recruitment and training of healthcare professionals, leading to staff shortages.
4. **Disruption of Public Health Programmes**: Insufficient funding can affect immunisation, maternal healthcare, disease prevention and other public health initiatives.
5. **Increased Out-of-Pocket Expenditure**: Weak public healthcare systems force people to depend on expensive private healthcare, increasing financial hardship.
6. **Widening Regional Inequalities**: Rural and remote areas often face greater healthcare challenges due to inadequate financial resources and limited infrastructure.
7. **Poor Health Outcomes**: Delayed treatment, inadequate medical facilities and limited preventive healthcare contribute to higher morbidity and mortality rates.
8. **Reduced Emergency Preparedness**: Financial constraints weaken the capacity of healthcare systems to respond effectively to epidemics, pandemics and natural disasters.

How do cash shortages affect the affordability and accessibility of healthcare?

Impact on Affordability:

1. **Higher Financial Burden**: Limited cash availability makes it difficult for households to afford consultations, medicines, diagnostic tests and hospitalisation.
2. **Increased Out-of-Pocket Expenditure**: Inadequate public healthcare services may force patients to depend on expensive private healthcare.
3. **Delayed Treatment**: Financial constraints may compel patients to postpone treatment, resulting in more complicated and expensive medical conditions.
4. **Risk of Indebtedness**: Families may borrow money or sell assets to meet medical expenses, pushing vulnerable households into poverty.

Impact on Accessibility:

1. **Reduced Access to Medical Services**: Cash shortages may prevent people from travelling to hospitals, purchasing medicines or accessing diagnostic facilities.
2. **Disproportionate Impact on Rural Areas**: Rural and remote populations face greater difficulties due to limited healthcare infrastructure and transportation facilities.
3. **Exclusion of Vulnerable Groups**: Poor households, elderly people, women and persons with disabilities are disproportionately affected.
4. **Disruption of Healthcare Services**: Financial constraints can affect the availability of medicines, medical equipment and healthcare professionals in public hospitals.

What measures should be adopted to minimise the health costs associated with cash shortages?

1. **Strengthening Public Healthcare**: Increase investment in public hospitals, primary healthcare centres and essential medical infrastructure to ensure affordable healthcare.
2. **Expanding Health Insurance Coverage**: Strengthen schemes such as Ayushman Bharat PM-JAY to reduce out-of-pocket expenditure and protect vulnerable households from medical expenses.
3. **Ensuring Essential Medicine Availability**: Strengthen initiatives such as the Pradhan Mantri Bhartiya Janaushadhi Pariyojana to provide affordable medicines, particularly to economically weaker sections.
4. **Promoting Digital Health Services**: Expand telemedicine, digital health consultations and online healthcare services to reduce transportation and consultation costs.

5. **Strengthening Social Protection**: Provide targeted financial assistance, healthcare subsidies and emergency medical support to vulnerable households.
6. **Improving Public Healthcare Financing**: Ensure adequate and timely funding for healthcare institutions to prevent disruptions in medicines, equipment and essential services.
7. **Promoting Preventive Healthcare**: Strengthen immunisation, health awareness, nutritional programmes and early disease detection to reduce long-term healthcare expenditure.
8. **Enhancing Emergency Healthcare Facilities**: Establish emergency medical funds and strengthen ambulance services to ensure timely treatment during financial crises.

Conclusion: A combination of affordable healthcare, adequate public financing and effective social protection can minimise the health costs associated with cash shortages and promote inclusive healthcare delivery.

UPSC GS-2: Social Justice – Health
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Cracker Conundrum – Reasons & Measures – Explained Pointwise



The sharp deterioration in air quality across several North Indian cities following the festive season has once again brought the issue of firecracker-induced pollution into focus. The recurring spike in pollution levels raises the '**Cracker Conundrum**' – the challenge of balancing cultural and religious celebrations with public health concerns and environmental sustainability.

What are the major reasons behind the recurring cracker conundrum in Delhi?

1. **Cultural and religious significance**: Firecrackers are traditionally associated with Diwali celebrations, making restrictions a sensitive socio-cultural issue.
2. **Public health vs. individual freedom**: Conflicting concerns over the right to celebrate festivals and the collective right to a clean and healthy environment complicate the issue.

3. **Weak enforcement of regulations**: Ineffective monitoring, inadequate policing and widespread violations undermine firecracker restrictions.
4. **Limited public awareness**: Lack of awareness about the harmful effects of firecrackers on human health and the environment contributes to their continued use.
5. **Economic interests**: Livelihoods associated with firecracker manufacturing, distribution and retail trade create resistance to strict restrictions.
6. **Availability of illegal firecrackers**: Illegal manufacturing, storage and sale of banned firecrackers make regulatory enforcement difficult.
7. **Ineffectiveness of green crackers**: Limited availability, affordability concerns and questions about compliance and actual emission reductions affect their adoption.
8. **Seasonal meteorological conditions**: Low temperatures, reduced wind speed and temperature inversion during winter trap pollutants close to the ground, aggravating the impact of firecracker emissions.
9. **Multiple sources of pollution**: Vehicular emissions, construction dust, industrial activities and stubble burning contribute to Delhi's pollution crisis, making it difficult to isolate the contribution of firecrackers.
10. **Lack of inter-state coordination**: Pollution control requires coordinated action among Delhi and neighbouring NCR states, particularly to regulate the manufacture, transportation and sale of firecrackers.

What have been the major judicial interventions to regulate the use of firecrackers and tackle air pollution in Delhi?

The Supreme Court of India and the National Green Tribunal (NGT) have played an important role in regulating firecracker use in Delhi and the National Capital Region (NCR), primarily by balancing environmental protection, public health and religious practices.

1. **Supreme Court's intervention (2016)**: In Arjun Gopal v. Union of India, the Supreme Court suspended existing licences for the sale of firecrackers in Delhi-NCR and prohibited the issuance of fresh licences.

Arjun Gopal & Ors. v. Union of India is a landmark Supreme Court of India case that addressed severe air pollution in the Delhi-National Capital Region (NCR) and across the country caused by the burning of firecrackers.

2. **Restrictions on harmful chemicals (2017)**: The Court directed authorities to examine the chemical composition of firecrackers and restrict the use of harmful substances such as lithium, mercury, arsenic and lead.
3. **Green crackers (2018)**: The Supreme Court permitted the manufacture and sale of only reduced-emission and green crackers, while prohibiting conventional firecrackers that did not meet prescribed standards.
4. **Restrictions on bursting timings (2018)**: The Court restricted firecracker use to specific time windows, including 8 PM to 10 PM on Diwali, and encouraged community-based celebrations.
5. **NGT's intervention (2020)**: The NGT imposed a temporary ban on the sale and use of all types of firecrackers in NCR and other cities experiencing poor or worse air quality during the festive period.

6. **Ban on harmful chemicals (2023)**: The Supreme Court clarified that the prohibition on barium-based firecrackers and other banned chemicals applied across the country, and not merely to Delhi-NCR.
7. **Complete ban in Delhi-NCR (2024–25)**: Following the Court's directions, Delhi imposed a year-round ban on the manufacture, storage, sale and use of all firecrackers from January 2025. The Court also directed neighbouring NCR states, including Haryana and Uttar Pradesh, to impose similar restrictions.
8. **Judicial intervention in 2024**: In November 2024, the Supreme Court questioned the poor implementation of Delhi's firecracker ban and sought affidavits from the Delhi Government and Police Commissioner regarding enforcement measures.
9. **Supreme Court's latest intervention (October 2026)**: In Arjun Gopal v. Union of India (29 October 2026), the Court permitted certified green crackers for two days (7–8 November 2026), subject to strict conditions, including:
    - Mandatory CSIR-NEERI certification and QR codes.
    - Sale only through licensed traders at designated locations.
    - Restrictions on bursting timings (6–7 AM and 8–10 PM).
    - Prohibition within 300 metres of hospitals, schools and other sensitive locations.
    - AQI monitoring and public awareness campaigns.

What measures should be adopted to comprehensively address the problem of firecracker-induced pollution in Delhi?

1. **Effective enforcement of regulations**: Strict implementation of firecracker-related restrictions, regular inspections and penalties for violations.
2. **Promotion of green crackers**: Encourage the development, certification and adoption of scientifically tested green crackers with reduced emissions.
3. **Strengthening monitoring mechanisms**: Use CCTV cameras, dedicated enforcement teams and digital platforms to monitor the illegal sale and use of firecrackers.
4. **Public awareness campaigns**: Educate citizens about the harmful effects of firecrackers on respiratory health, air quality and the environment.
5. **Community-based celebrations**: Promote collective Diwali celebrations through community events to reduce the overall number of firecrackers used.
6. **Inter-state coordination**: Strengthen coordination between Delhi, Haryana, Uttar Pradesh and other NCR authorities to regulate the manufacture, transportation and sale of prohibited firecrackers.
7. **Stakeholder participation**: Involve RWAs, educational institutions, NGOs, religious organisations and local communities in promoting environmentally responsible celebrations.
8. **Strengthening institutional accountability**: Clearly define the responsibilities of pollution control boards, police departments, municipal authorities and district administrations.
9. **Regional air pollution management**: Address other major sources of pollution, including vehicular emissions, construction dust, industrial pollution and stubble burning, alongside firecracker-related restrictions.
10. **Judicial and regulatory oversight**: Ensure timely implementation of judicial directions and strengthen compliance with environmental regulations.

Conclusion: The firecracker conundrum requires a shift from a purely restrictive approach towards a comprehensive strategy based on scientific innovation, behavioural change, effective governance and public participation. The objective should be to ensure that cultural celebrations do not come at the cost of public health and environmental sustainability.

UPSC GS-3: Environment
Read More: The Hindu

OBC Reservation – SC ruling on Creamy Layer – Explained Pointwise



The Supreme Court's landmark judgment in **Union of India v. Rohith Nathan** has brought the criteria for determining the creamy layer among Other Backward Classes (OBCs) into sharp focus. The ruling raises important questions concerning substantive equality, non-discrimination and equitable distribution of reservation benefits, necessitating a comprehensive understanding of its constitutional foundations, judicial interpretation, policy implications and implementation challenges.

What is the concept of the creamy layer in the context of OBC reservation?

- The concept of the creamy layer refers to the relatively socially and economically advanced sections within the Other Backward Classes (OBCs) who are excluded from the benefits of reservation to ensure that such benefits reach the genuinely disadvantaged sections of society.
- **Origin:** The concept was introduced through the Supreme Court's landmark **Indra Sawhney v. Union of India (1992)** judgment, which upheld OBC reservations while directing the exclusion of the socially advanced sections.
- **Objective:** To prevent the concentration of reservation benefits among relatively advanced sections within the OBC communities and promote equitable distribution of affirmative action benefits.
- **Identification criteria:** The creamy layer is identified through criteria prescribed by the government, including:
    1. Parental income.
    2. Constitutional and high-level government positions held by parents.
    3. Occupational status and equivalence of parental posts.
    4. Other prescribed indicators of social advancement.

- **Income ceiling:** The present income ceiling for OBC creamy layer exclusion is ₹8 lakh per annum, subject to the applicable rules and exemptions. The income test is not a simple test of total family income; the source and nature of income also matter.
- **Exclusion from reservation:** OBC candidates falling within the creamy layer are not eligible for OBC reservation in central government employment and educational institutions, although they continue to belong to their respective OBC communities.
- **Constitutional basis:** The principle is rooted in Articles 14, 15(4) and 16(4) of the Constitution, which provide the framework for equality and affirmative action.

What has been the Supreme Court's recent ruling on the determination of creamy layer status among OBCs?

- The Supreme Court, in its landmark judgment of 11 March 2026 in **Union of India v. Rohith Nathan**, clarified that the creamy layer status of OBC candidates cannot be determined solely on the basis of their parents' salary income, particularly in cases involving employment in Public Sector Undertakings (PSUs) and private-sector organisations.
- The judgment emphasised the need to consider the status and category of the parents' posts while determining eligibility for OBC reservation.
- **Key observations of the Supreme Court:**
    1. **Salary alone is insufficient**: Parental salary income cannot be the sole criterion for determining the creamy layer status of OBC candidates.
    2. **Importance of occupational status**: The status and category of the post held by parents must also be considered, including its equivalence with corresponding government positions.
    3. **Equality and non-discrimination**: Treating similarly placed employees differently merely because one works in government and another in a PSU or private organisation can amount to hostile discrimination under Articles 14 and 16.
    4. **Primacy of the 1993 OM**: An executive clarification issued in 2004 cannot override or substantially alter the original framework established through the 1993 Office Memorandum.
    5. **Correct application of income criteria**: The exclusion of salary and agricultural income under the prescribed income/wealth test must be respected while determining creamy layer status, alongside the applicable status-based criteria.

What are the constitutional and policy implications of the Supreme Court's recent ruling on the criteria for determining the creamy layer among OBCs?

Constitutional implications:

1. **Strengthening substantive equality**: Reinforces the principle that equality requires fair and non-arbitrary treatment of similarly situated individuals, rather than merely identical treatment in form.
2. **Preventing hostile discrimination**: Recognises that differentiating between children of government employees and PSU/private-sector employees, without establishing a rational basis, may violate Article 14.
3. **Reinforcing equality of opportunity**: Protects eligible OBC candidates from arbitrary exclusion from reservation benefits under Article 16(4).
4. **Upholding affirmative action**: Reaffirms that creamy layer exclusion should serve the constitutional objective of ensuring that reservation benefits reach genuinely disadvantaged sections within OBC communities.

5. **Maintaining constitutional supremacy:** Clarifies that executive instructions cannot override or substantially modify the substantive framework established through an earlier government Office Memorandum.

Policy implications:

1. **Revision of creamy layer criteria**: Necessitates reviewing the existing framework to ensure that salary income is not mechanically used as the sole basis for exclusion.
2. **Uniformity in eligibility assessment**: Calls for consistent treatment of similarly placed employees across government departments, PSUs, banks and private-sector organisations.
3. **Determination of post equivalence**: Highlights the need to establish equivalence between posts in government services and those in PSUs and other organisations.
4. **Administrative reforms**: Requires clearer guidelines and transparent procedures for issuing OBC Non-Creamy Layer certificates.
5. **Protection of eligible beneficiaries**: Can help candidates who were previously denied reservation benefits solely on the basis of parental salary seek appropriate relief.
6. **Balancing competing interests:** The November 2026 clarification protects completed selections and appointments from being reopened while allowing the judgment to govern subsequent selections and appointments.

What are the challenges in implementation of the SC's ruling?

1. **Complexity of post equivalence:** Establishing equivalence between government and PSU/private-sector positions may involve considerable administrative and technical difficulties.
2. **Potential litigation**: Differences in interpreting occupational status and eligibility criteria may generate further legal disputes.
3. **Identification of beneficiaries**: Ensuring that relatively advanced sections do not disproportionately capture reservation benefits remains an important policy concern.
4. **Administrative delays**: Revising eligibility guidelines and verification procedures may affect recruitment and service-allocation processes.

What should be the way forward?

1. **Comprehensive review:** Update the 1993 Office Memorandum in accordance with constitutional principles and contemporary employment structures.
2. **Objective parameters:** Develop transparent criteria incorporating parental occupational status, equivalence of posts and applicable income/wealth tests.
3. **Periodic revision:** Regularly review creamy layer criteria to account for inflation and changing socio-economic conditions.
4. **Data-driven policymaking:** Strengthen socio-economic data collection to assess the distribution of reservation benefits among different OBC communities.
5. **Stakeholder consultation**: Involve the Centre, states, OBC commissions and other relevant stakeholders in framing revised guidelines.

Conclusion: The Supreme Court's ruling reinforces the principle that affirmative action must be governed by fairness, substantive equality and rational classification. Going forward, a transparent and uniform creamy layer framework is essential to ensure that reservation benefits reach genuinely disadvantaged OBC sections while preventing arbitrary exclusion and unequal treatment.

UPSC GS-2: Indian Polity

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Circular Battery Economy – Significance & Challenges – Explained Pointwise



Amid rising global demand for critical minerals such as lithium, nickel and cobalt, driven by the growing electrification of various sectors, the demand for lithium-ion batteries and electrical conductors is witnessing a significant surge. However, the limited availability and geographical concentration of these mineral reserves make their supply chains vulnerable to geopolitical tensions, resource nationalism, trade restrictions and other disruptions. For India, which remains heavily dependent on imports to meet its critical mineral requirements, securing reliable and sustainable supplies has become a strategic priority. In this context, developing a **circular battery economy** assumes particular significance.

What is a Circular Battery Economy? How does it differ from the traditional linear battery economy?

- A Circular Battery Economy refers to an economic system that promotes the sustainable production, use, reuse, refurbishment and recycling of batteries to minimise waste and maximise the recovery and utilisation of valuable materials such as lithium, cobalt, nickel and manganese.
- It follows the principles of Reduce, Reuse, Repurpose and Recycle (4Rs), ensuring that batteries and their constituent materials remain within the economic value chain for as long as possible.

Linear Battery Economy	Circular Battery Economy
Follows a take–make–dispose model.	Follows a reduce–reuse–repurpose–recycle model.
Relies heavily on fresh extraction of raw materials.	Promotes recovery and reuse of existing materials.
Batteries are generally discarded after their useful life.	Batteries are reused, refurbished, repurposed and recycled.
Generates considerable battery waste.	Minimises waste through material recovery and recycling.
Increases resource depletion and environmental pollution.	Reduces mining pressure, pollution and carbon footprint.
Creates greater dependence on virgin raw materials.	Promotes resource efficiency and creates opportunities in recycling and secondary markets.

What are the economic and environmental significance of developing a circular battery economy in India?

Economic Significance:

1. **Reduces Import Dependence:** Battery recycling enables the recovery of critical minerals such as lithium, cobalt, nickel and manganese, reducing India's dependence on imports and strengthening its resource security.
2. **Ensures Critical Mineral Security:** Recovered minerals can serve as an alternative source of raw materials for domestic battery manufacturing, reducing vulnerabilities arising from global supply-chain disruptions.
3. **Promotes Domestic Manufacturing:** Availability of recycled raw materials can strengthen India's domestic battery manufacturing ecosystem and support the development of indigenous battery technologies.
4. **Generates Employment Opportunities:** The expansion of battery collection, dismantling, refurbishment and recycling industries can generate green jobs and promote entrepreneurship, particularly in the waste management sector.
5. **Reduces Production Costs:** Recovering valuable materials from used batteries can reduce the need for fresh mineral extraction, potentially lowering raw material procurement costs for battery manufacturers.
6. **Promotes Investment and Innovation:** A circular battery ecosystem can attract investments in advanced recycling technologies, battery refurbishment, material recovery and sustainable manufacturing.

7. **Supports Electric Mobility:** Affordable availability of recovered battery materials can strengthen India's EV ecosystem by improving the long-term sustainability of battery supply chains.

Environmental Significance:

1. **Reduces Pressure on Natural Resources:** Recycling batteries reduces the need for fresh mining of critical minerals, thereby limiting land degradation, deforestation and habitat destruction associated with mineral extraction.
2. **Minimises Hazardous Waste:** Scientific collection, treatment and recycling of used batteries prevent the improper disposal of toxic and hazardous substances, reducing soil and groundwater contamination.
3. **Reduces Carbon Footprint:** Recovering and reusing battery materials can reduce the energy-intensive processes associated with mining, refining and processing virgin raw materials, thereby lowering greenhouse gas emissions.
4. **Promotes Resource Efficiency:** The reuse, refurbishment and recycling of batteries ensure optimal utilisation of valuable materials and minimise resource wastage throughout their lifecycle.
5. **Reduces Water Consumption:** Battery recycling can reduce the water-intensive mining and mineral processing activities associated with the extraction of virgin raw materials.
6. **Promotes Sustainable Waste Management:** A circular battery economy encourages scientific collection, segregation, transportation and recycling of end-of-life batteries, reducing the burden on landfills.
7. **Supports India's Climate Commitments:** By reducing emissions from mineral extraction and battery manufacturing, battery circularity can complement India's net-zero target of 2070 and its broader clean energy transition.

What are the major challenges in developing a robust circular battery economy in India?

Technological Challenges:

1. **Limited Recycling Technologies:** Advanced battery recycling technologies, particularly for lithium-ion batteries, require sophisticated processes and specialised expertise. Limited domestic technological capabilities constrain efficient recovery of valuable minerals.
2. **Low Material Recovery Efficiency:** Recovering high-purity lithium, cobalt, nickel and other valuable materials from complex battery chemistries remains technically challenging. Inefficient recovery can reduce the economic viability of recycling.
3. **Changing Battery Chemistries:** Rapid technological advancements and the emergence of different battery chemistries, such as LFP (Lithium Iron Phosphate) and NMC (Nickel Manganese Cobalt), make standardisation and recycling processes more complex.

Infrastructural Challenges:

1. **Inadequate Collection Mechanism:** India lacks a sufficiently organised collection and reverse-logistics network to ensure the systematic collection and transportation of end-of-life batteries from consumers to authorised recycling facilities.
2. **Limited Recycling Infrastructure:** The availability of advanced battery recycling facilities remains inadequate in relation to the expected growth of EV and battery waste, restricting large-scale recycling operations.
3. **Lack of Standardisation:** The absence of uniform standards for battery design, labelling, dismantling and material composition makes battery sorting, refurbishment and recycling difficult.

Economic Challenges:

1. **High Initial Investment:** Establishing advanced battery recycling facilities requires substantial capital investment in specialised machinery, technology, skilled manpower and safety infrastructure, creating entry barriers for smaller enterprises.
2. **Economic Viability:** Fluctuations in the prices of critical minerals, coupled with high collection and processing costs, can make recycling less economically attractive than using virgin raw materials.
3. **Uncertain Availability of Waste Batteries:** India's EV ecosystem is still evolving, and the availability of end-of-life EV batteries may remain limited in the initial years, making it difficult for recycling facilities to achieve economies of scale.

Regulatory and Institutional Challenges:

1. **Weak Enforcement of EPR**: Despite the Battery Waste Management Rules, 2022, effective implementation and monitoring of Extended Producer Responsibility (EPR) obligations remain challenging, particularly in ensuring compliance across the battery value chain.
2. **Informal Recycling Sector:** A significant portion of waste batteries may enter informal recycling channels, where unsafe dismantling and primitive extraction methods can cause environmental pollution and health hazards.
3. **Lack of Traceability:** Inadequate digital tracking mechanisms make it difficult to monitor batteries throughout their lifecycle, identify their composition and ensure their proper collection and recycling.

Safety and Environmental Challenges:

1. **Fire and Safety Risks:** Improper handling, storage, transportation and dismantling of lithium-ion batteries can cause thermal runaway, fires and explosions, posing risks to workers and infrastructure.
2. **Environmental Pollution:** Improper recycling and disposal can release hazardous chemicals and toxic substances, contaminating soil and water and undermining the environmental benefits of battery circularity.

What are the various government initiatives undertaken to promote a circular battery economy in India?

Battery Waste Management Rules, 2022	• Notified by the Ministry of Environment, Forest and Climate Change (MoEFCC) under the Environment (Protection) Act, 1986. • Cover all types of batteries, including EV, portable, automotive and industrial batteries. • Introduce Extended Producer Responsibility (EPR), making battery producers and importers responsible for the collection, recycling and refurbishment of waste batteries. • Mandate the use of minimum prescribed quantities of domestically recycled materials in new batteries from FY 2027–28 onwards.
Centralised EPR Portal	• The Central Pollution Control Board (CPCB) has established an online portal for the registration of battery producers, recyclers and refurbishers. • Facilitates the generation and exchange of EPR certificates and submission of compliance returns.

	• Promotes transparency, accountability and traceability in battery waste management.
Critical Mineral Recycling Incentive Scheme, 2025	• The Union Cabinet approved a ₹1,500 crore incentive scheme in September 2025 to promote domestic recycling of critical minerals from secondary sources. • Covers the recovery of valuable minerals from spent lithium-ion batteries, e-waste and other scrap. • Aims to develop domestic recycling capacity, attract private investment and strengthen India's critical mineral supply chains. • The scheme forms part of the National Critical Mineral Mission (NCMM) and has a six-year implementation period (FY 2025–26 to FY 2030–31)
National Critical Mineral Mission (NCMM)	• Approved in 2025 to strengthen India's entire critical mineral value chain, including exploration, mining, processing, recycling and recovery. • Promotes the recovery of critical minerals from secondary sources, including used batteries and electronic waste. • Seeks to reduce import dependence and enhance resilience against global supply-chain disruptions.
Production Linked Incentive (PLI) Scheme for Advanced Chemistry Cell (ACC) Battery Storage	• Approved in May 2021 with a financial outlay of ₹18,100 crore. • Aims to establish 50 GWh of domestic Advanced Chemistry Cell manufacturing capacity. • Encourages domestic value addition and investment in battery manufacturing. • Although not exclusively a recycling initiative, it supports the development of a domestic battery ecosystem, which is essential for establishing an integrated circular battery value chain.

What measures should India adopt to develop a sustainable circular battery economy?

1. **Strengthening Recycling Infrastructure**:
    - **Establishment of Advanced Recycling Facilities**: Invest in modern recycling facilities equipped with advanced technologies to recover valuable minerals such as lithium, cobalt, nickel and manganese.
    - **Decentralised Collection Centres**: Establish collection and aggregation centres across urban and rural areas to facilitate the systematic collection of end-of-life batteries.
    - **Scientific Waste Management**: Ensure environmentally sound storage, transportation, dismantling and disposal of battery waste.
2. **Promoting Research and Technological Innovation**:
    - **Indigenous Recycling Technologies**: Encourage R&D to develop cost-effective technologies for recovering high-purity critical minerals from different battery chemistries.
    - **Public-Private Partnerships**: Promote collaboration between government research institutions, universities and private industries to accelerate technological innovation.

- **Technology Transfer**: Facilitate international technology transfer and cooperation to adopt globally established battery recycling practices.

3. **Strengthening Regulatory Framework**:
   - **Effective Implementation of EPR:** Ensure strict enforcement of Extended Producer Responsibility (EPR) provisions under the Battery Waste Management Rules, 2022, to make producers accountable for end-of-life battery management.
   - **Strict Monitoring and Compliance**: Strengthen CPCB and State Pollution Control Boards' monitoring mechanisms to prevent illegal disposal and unsafe recycling practices.
   - **Uniform Standards**: Develop standardised guidelines for battery design, labelling, dismantling, refurbishment and recycling to improve material recovery.
4. **International Cooperation:**
   - **Technology Collaboration**: Collaborate with countries possessing advanced battery recycling technologies to facilitate knowledge-sharing and technology transfer.
   - **Global Supply Chains**: Participate in international initiatives to establish sustainable and transparent critical mineral supply chains.
   - **Best Practice Adoption**: Learn from successful battery recycling frameworks and circular economy practices adopted by the European Union, Japan and South Korea.

Conclusion: India must adopt a lifecycle-based approach to battery management, moving beyond recycling alone towards reducing resource consumption, extending battery life and recovering valuable materials. An integrated ecosystem involving government, industry, research institutions and consumers can transform battery waste into an economic resource while advancing India's clean energy transition.

UPSC GS-3: Indian Economy
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Siang Upper Multipurpose Project – Significance & Concerns – Explained Pointwise

The proposed **Siang Upper Multipurpose Project (SUMP)** in Arunachal Pradesh has recently triggered protests by sections of the indigenous Adi community over concerns surrounding displacement, loss of ancestral land, livelihoods and ecological degradation. While the project holds strategic significance for India's energy and water security amid China's upstream hydropower ambitions, it also raises important questions about environmental sustainability and indigenous rights. Understanding its significance and associated concerns is therefore essential.

What is the Siang Upper Multipurpose Project (SUMP)?

- The Siang Upper Multipurpose Project (SUMP) is a proposed mega hydropower and water-storage project on the Siang River in Arunachal Pradesh, aimed at generating electricity, regulating river flows, moderating floods and strengthening India's strategic water security in the eastern Himalayan region.
- **Location:** Near Geku village in Upper Siang district, Arunachal Pradesh.
- **Proposed capacity:** Approximately 11,000–11,200 MW.
- **Strategic status:** Declared a National Project by the Government of India in 2008.

What are its major objectives?

Energy Security	• Generate approximately 11,200 MW of hydropower, strengthening India's renewable energy capacity. • Reduce dependence on fossil fuels and support India's clean energy transition. • Meet the growing electricity demand of the Northeast and other regions.
Water security and storage	• Create a large water reservoir to improve India's capacity to store and regulate river water. • Strengthen preparedness against possible sudden changes in upstream water releases from China. • Improve long-term water resource management in the Brahmaputra basin.
Flood moderation	• Regulate river flows to help mitigate downstream flood risks. • Improve preparedness against potential sudden water releases from upstream areas. • Support more effective management of seasonal variations in river discharge.
Strategic and geopolitical security	• Strengthen India's strategic preparedness in response to China's proposed mega-dam project on the Yarlung Tsangpo. • Reduce India's vulnerability to potential upstream interventions affecting downstream water flows. • Enhance India's strategic leverage and preparedness in transboundary water management.
Regional economic development	• Generate employment opportunities and promote infrastructure development in Arunachal Pradesh. • Improve road connectivity and other supporting infrastructure in remote border regions. • Promote industrial development through reliable electricity availability.
Climate resilience	• Improve the capacity to manage extreme hydrological events through regulated water storage. • Support adaptation to changing rainfall patterns and increasing flood variability. • Contribute to a more resilient water and energy infrastructure in the Himalayan region.

What are its geographical, economic and geopolitical significance?

Geographical significance:

1. **Strategic river location:** The Siang is the principal headstream of the Brahmaputra in India, making the project important for managing water resources across the river basin.
2. **Transboundary river system:** The Siang originates in Tibet as the Yarlung Tsangpo, flows through Arunachal Pradesh and joins the Dibang and Lohit rivers to form the Brahmaputra in Assam.

3. **Water resource management:** The proposed reservoir can facilitate regulated water storage and river-flow management, subject to its final design and operating arrangements.
4. **Flood management:** Regulated releases may help moderate downstream flood peaks, although actual benefits would depend on reservoir capacity, operating rules and flood conditions.

Economic significance:

1. **Hydropower generation:** Its proposed capacity of approximately 11,200 MW can significantly enhance India's renewable electricity generation capacity.
2. **Energy security:** It can reduce dependence on fossil fuels and support India's transition towards a low-carbon economy.
3. **Regional development**: Construction and associated infrastructure can generate employment and stimulate economic activities in Arunachal Pradesh.
4. **Infrastructure development**: Development of roads, bridges and transmission infrastructure can improve connectivity in remote border areas.
5. **Revenue generation**: Electricity generation and associated economic activities can provide additional revenue to the State Government.
6. **Industrial development:** Reliable electricity supply can encourage investment in energy-intensive industries and improve economic opportunities in the Northeast.

Geopolitical significance:

1. **Strategic response to China**: The project is viewed as a strategic response to China's proposed mega hydropower project on the lower reaches of the Yarlung Tsangpo in Tibet.
2. **Downstream water security**: It seeks to strengthen India's capacity to store and regulate water amid uncertainties surrounding China's upstream water-management activities.
3. **Strategic leverage:** Enhances India's position as a significant downstream user of the Brahmaputra river system and strengthens its preparedness in transboundary water management.
4. **Border security**: Development of strategic infrastructure in Arunachal Pradesh can strengthen India's presence and connectivity in a sensitive border region.
5. **Regional stability**: Highlights the need for greater transparency, hydrological data sharing and cooperation between India and China on transboundary rivers.

What are the major environmental concerns and concerns of indigenous communities associated with the SUMP?

Major environmental concerns:

1. **Biodiversity loss**: Large-scale submergence of forests and natural habitats may threaten rare, endangered and endemic species in the biodiversity-rich Eastern Himalayas.
2. **Deforestation and habitat fragmentation**: Construction of dams, roads, tunnels and other infrastructure may result in forest degradation and fragmentation of wildlife habitats.
3. **Seismic vulnerability**: The Siang Valley lies in a highly earthquake-prone Himalayan region (Seismic Zone V), raising concerns about dam safety and the consequences of reservoir-induced seismicity.
4. **Landslides and geological instability**: Large-scale excavation, tunnelling and construction may destabilise fragile mountain slopes, increasing landslide risks.
5. **Alteration of river ecology**: Changes in natural river flows, sediment transport and water temperature may affect aquatic biodiversity, fish migration and downstream ecosystems.
6. **Downstream impacts:** Altered sediment flows and river discharge may affect floodplains, wetlands, agriculture and river-dependent communities downstream.

7. **Climate-related risks**: Glacial lake outburst floods (GLOFs), extreme rainfall and changing Himalayan hydrology may pose additional risks to dam infrastructure and reservoir management.

Concerns of indigenous communities:

1. **Displacement and rehabilitation**: The proposed reservoir may submerge villages and displace indigenous populations, creating concerns regarding inadequate rehabilitation and resettlement.
2. **Loss of ancestral land:** The Adi community fears losing ancestral territories, customary land rights and traditional settlements that have been inhabited for generations.
3. **Threat to cultural identity**: The Siang River, locally revered as Ane Siang (Mother Siang), holds deep cultural and spiritual significance for the Adi community. Its alteration may disrupt traditional beliefs and practices.
4. **Livelihood insecurity**: Submergence of agricultural land, forests and fishing areas may threaten traditional livelihoods based on agriculture, fishing and forest resources.
5. **Marginalisation of indigenous voices**: Local communities have raised concerns about inadequate consultation and lack of Free, Prior and Informed Consent (FPIC) in project-related decisions.
6. **Disruption of traditional institutions**: The project may affect customary governance systems, community institutions and traditional land-management practices.
7. **Militarisation of project areas**: Deployment of security personnel during survey activities has raised concerns among sections of local communities regarding freedom of protest and meaningful democratic participation.

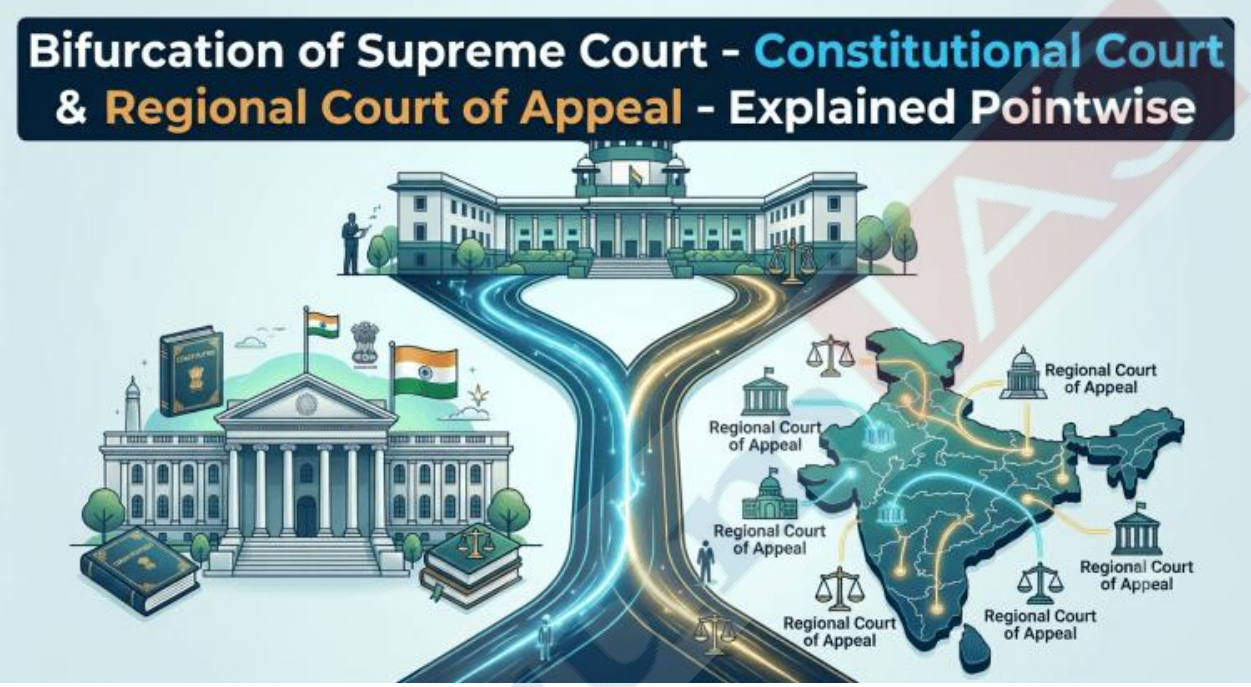
What measures should be adopted to ensure environmental sustainability and social acceptability of the SUMP?

1. **Comprehensive Environmental Impact Assessment (EIA)**: Conduct independent and scientifically rigorous EIA, covering biodiversity, forests, river ecology and downstream impacts before approving construction.
2. **Disaster risk management**: Develop robust early-warning systems, emergency action plans and disaster preparedness mechanisms to address dam failures, GLOFs, landslides and extreme rainfall events.
3. **Environmental flow maintenance:** Ensure adequate ecological flows to preserve aquatic biodiversity, sediment transport and the natural functioning of downstream river ecosystems.
4. **Meaningful community consultation**: Engage affected villages, Gram Sabhas and traditional institutions such as the Adi Bane Kebang from the initial planning stage.
5. **Free, Prior and Informed Consent (FPIC)**: Follow the principles of FPIC by ensuring that indigenous communities receive complete information and can participate meaningfully in decisions affecting their ancestral territories.
6. **Comprehensive Social Impact Assessment (SIA):** Identify the likely impact on settlements, livelihoods, cultural heritage and vulnerable households before taking any construction decision.
7. **Recognition of tribal rights:** Strictly implement applicable safeguards under the Forest Rights Act, 2006, and other relevant legal provisions protecting customary land and forest rights.
8. **Protection of cultural heritage**: Identify and preserve sacred sites, traditional landscapes, burial grounds and other places of cultural and spiritual significance.

Conclusion: The successful implementation of SUMP requires moving beyond a conventional infrastructure-centric approach towards inclusive and sustainable development. India's strategic and energy interests must be balanced with ecological integrity, indigenous rights and meaningful community participation.

UPSC GS-1: Geography, GS-3: Infrastructure, Disaster Management
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Bifurcation of Supreme Court – Constitutional Court & Regional Court of Appeal – Explained Pointwise



The Supreme Court of India performs both constitutional and appellate functions, resulting in an increasing workload and growing judicial pendency. The proposal to bifurcate it into a Constitutional Court and a Court of Appeal has therefore gained significance, necessitating an examination of its rationale, potential benefits and associated challenges.

What is the concept of bifurcating the Supreme Court into a Constitutional Court and a Court of Appeal?

- The **splitting of the Supreme Court into a Constitutional Court and a Court of Appeal** refers to a proposed judicial reform aimed at separating constitutional matters from ordinary appellate cases to improve judicial efficiency and reduce the workload of the Supreme Court.
- Under this proposal, the Supreme Court's existing functions would be divided between two separate judicial bodies:

Constitutional Court	Would primarily deal with constitutional interpretation, constitutional validity of laws, federal disputes and matters involving fundamental rights. Would focus on important questions of constitutional significance and ensure the protection of constitutional principles.
Court of Appeal	Would primarily hear appeals against judgments delivered by High Courts and other subordinate judicial bodies.

	Would deal with ordinary civil, criminal and other appellate matters, thereby reducing the burden on the Constitutional Court.

- **Objective of splitting of SC:** To enable the highest constitutional judicial authority to focus on significant constitutional questions while ensuring faster disposal of routine appeals and reducing judicial pendency.
- Bifurcation of SC has been recommended by:
  - **10th Law Commission – 95th Report (1984):** Recommended dividing the Supreme Court into:
  - Constitutional Division – to handle constitutional matters.
  - Legal Division – to handle non-constitutional matters.
  - **11th Law Commission – 125th Report (1988):** Proposed:
  - Constitutional Court at Delhi.
  - Courts of Appeal/Federal Courts in the Northern, Southern, Eastern, Western and Central regions.
  - **18th Law Commission – 229th Report (2009):** Recommended:
  - One Constitution Bench at Delhi for constitutional and allied matters.
  - Four regional Cassation Benches:
    1. Northern: Delhi
    2. Southern: Chennai/Hyderabad
    3. Eastern: Kolkata
    4. Western: Mumbai
  - **133rd Report of the Parliamentary Standing Committee on Personnel, Public Grievances, Law and Justice:** Recommended that the Supreme Court consider invoking Article 130 to establish regional benches at four or five locations.

What are the major reasons necessitating the bifurcation of the Supreme Court into a Constitutional Court and a Court of Appeal?

1. **Increasing Judicial Pendency:** The Supreme Court faces a substantial backlog of cases, with routine appeals consuming considerable judicial time and delaying justice.
2. **Overburdened Constitutional Court:** The Supreme Court's extensive appellate workload limits the time available for examining important constitutional questions and interpreting constitutional provisions.
3. **Delayed Constitutional Adjudication:** Important constitutional matters involving fundamental rights, federalism and constitutional validity often remain pending for years.
4. **Increasing Diversity of Litigation:** The growing volume and complexity of civil, criminal, commercial and constitutional disputes have increased pressure on the Supreme Court's limited judicial capacity.
5. **Need for Specialisation:** Separation would enable judges to develop greater expertise in constitutional interpretation and appellate adjudication, improving the quality of judicial decisions.
6. **Strengthening Constitutional Governance:** A dedicated Constitutional Court could provide timely clarity on constitutional questions, strengthen constitutional morality and uphold the basic structure of the Constitution.
7. **Improving Judicial Efficiency:** Dividing responsibilities would facilitate better allocation of judicial resources, streamlined procedures and faster disposal of cases.
8. **Reducing the Burden on High Courts:** A separate appellate mechanism could help rationalise the Supreme Court's appellate jurisdiction and encourage greater finality in High Court decisions.
9. **Ensuring Timely Justice:** Faster disposal of appeals would strengthen access to justice and reduce prolonged litigation, particularly for ordinary litigants.
10. **Aligning with International Practices:** Several countries, including Germany and South Africa, have separate constitutional courts, demonstrating alternative institutional arrangements for constitutional adjudication.

What are the major constitutional, institutional and administrative challenges associated with splitting the Supreme Court?

Constitutional Challenges:

1. **Constitutional Amendments:** The restructuring may require substantial amendments to provisions governing the Supreme Court, particularly Articles 124, 130 and 131–140, raising questions about the appropriate constitutional framework.
2. **Basic Structure Doctrine:** Any restructuring must preserve judicial independence, separation of powers and the essential features of the constitutional judicial system.
3. **Judicial Independence:** Creating separate judicial institutions may raise concerns regarding appointment procedures, executive influence and institutional autonomy.
4. **Jurisdictional Overlaps:** Clearly demarcating constitutional and appellate jurisdiction may be difficult, particularly in cases involving both constitutional interpretation and individual legal disputes.
5. **Federal Concerns:** Changes in the Supreme Court's jurisdiction may affect the resolution of Centre-State disputes and the protection of constitutional rights.

Institutional Challenges:

1. **Fragmentation of Judicial Authority:** Dividing the Supreme Court's functions may weaken its institutional unity and create uncertainty regarding the hierarchy of judicial authority.
2. **Conflicting Judgments:** Separate courts may develop divergent interpretations of constitutional and statutory provisions, affecting consistency in judicial precedents.
3. **Appointment of Judges:** Establishing two separate institutions would require an appropriate mechanism for judicial appointments, transfers and allocation of responsibilities.
4. **Access to Justice:** A separate appellate structure may create additional procedural layers, increasing litigation costs and making justice less accessible to economically weaker sections.
5. **Weakening of Judicial Oversight:** There may be concerns regarding the effectiveness of constitutional scrutiny if the appellate and constitutional functions are not adequately coordinated.

Administrative and Operational Challenges:

1. **Infrastructure Requirements:** Establishing separate courts would require additional courtrooms, registries, judicial infrastructure and technological facilities.
2. **Financial Implications:** The creation and maintenance of two judicial institutions would increase expenditure on salaries, administration, infrastructure and support staff.
3. **Case Allocation and Transfer:** Transferring pending cases and determining the jurisdiction of existing matters could create procedural complexities and temporary delays.
4. **Human Resource Constraints:** Recruiting and allocating sufficient judges, judicial officers, legal researchers and administrative personnel may pose significant challenges.
5. **Transition Management:** Ensuring continuity of proceedings, preserving precedents and avoiding disruption during institutional restructuring would require careful planning.

What measures should be adopted to ensure that the proposed bifurcation improves judicial efficiency without compromising access to justice?

1. **Clear Jurisdictional Demarcation:** Establish well-defined constitutional and appellate jurisdictions to avoid overlapping powers, jurisdictional conflicts and unnecessary litigation.
2. **Constitutional Safeguards:** Ensure that restructuring preserves judicial independence, separation of powers and the basic structure of the Constitution.
3. **Regional Accessibility:** Establish regional appellate benches to reduce geographical barriers, travel costs and litigation expenses for litigants from distant regions.
4. **Strengthening Legal Aid:** Expand the role of the National Legal Services Authority (NALSA) and State Legal Services Authorities to ensure representation for economically weaker sections.

5. **Effective Case Transfer Mechanism:** Introduce clear guidelines for transferring pending cases to prevent procedural confusion, duplication and delays during the transition.
6. **Consistent Judicial Precedents:** Establish mechanisms for coordination between the two courts to maintain consistency in constitutional interpretation and avoid conflicting judgments.
7. **Technology-driven Adjudication:** Expand e-filing, virtual hearings, digital case management and multilingual judicial services to improve accessibility and efficiency.
8. **Strengthening High Courts:** Improve the infrastructure and judicial capacity of High Courts to ensure that the new appellate structure does not encourage unnecessary multiple layers of litigation.

Conclusion: The proposed bifurcation should be viewed as an opportunity to strengthen India's judicial architecture rather than merely redistribute judicial workload. Its success must be measured not only by faster case disposal but also by affordable, accessible, independent and equitable justice, consistent with the constitutional vision of Article 39A.

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