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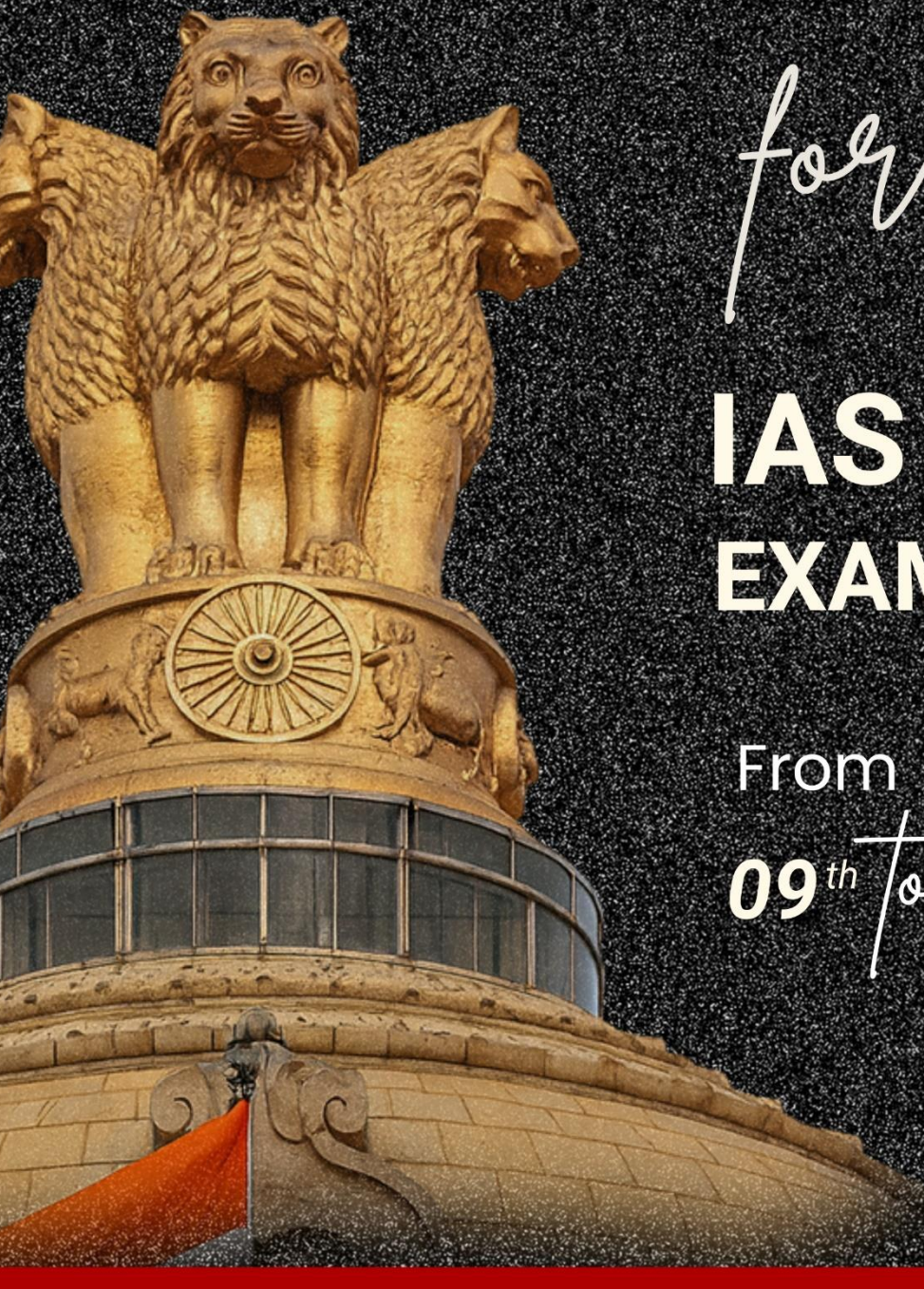

for

IAS MAINS EXAMINATION

From

09th to 14th Mar 2026

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GENERAL STUDIES 1

1.1. GEOGRAPHY

1.1.1. EARTHQUAKES

Context:

An **earthquake** is the sudden shaking of the Earth's surface caused by the **release of energy in the Earth's crust**, producing seismic waves. It usually occurs along **fault lines or tectonic plate boundaries**.

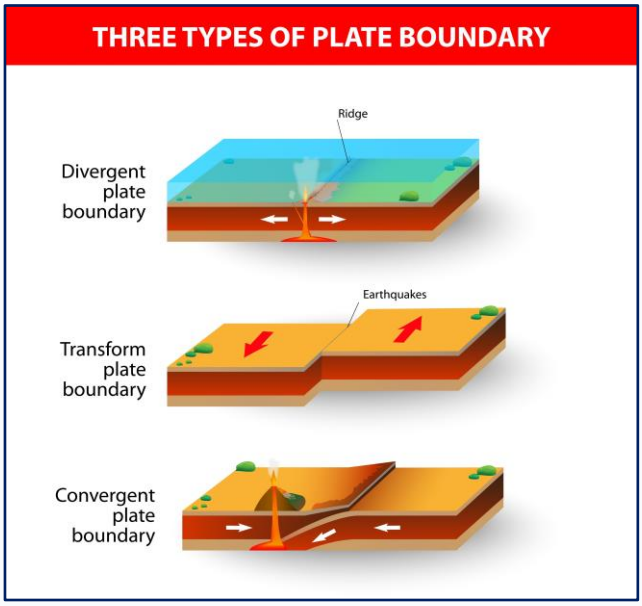
- Measured using **Richter Scale (magnitude)** and **Modified Mercalli Intensity (MMI) scale**.
- Most earthquakes occur along **plate boundaries** such as the Pacific Ring of Fire.
- India is highly vulnerable due to its location near the **collision zone of the Indian and Eurasian plates**.

Causes of Earthquakes

1. **Natural Causes**

   The Earth's lithosphere is broken into several tectonic plates that are constantly in motion due to convection currents in the mantle.

   - **Tectonic Movements:**
     - **Convergent Boundaries:** Plates collide (e.g., Indian Plate hitting the Eurasian Plate), creating the Himalayas and causing high-magnitude quakes.
     - **Divergent Boundaries:** Plates pull apart (e.g., Mid-Atlantic Ridge), allowing magma to rise and causing tremors.
     - **Transform Boundaries:** Plates slide past each other horizontally (e.g., San Andreas Fault), leading to a buildup and sudden release of friction.



   - **Volcanic Eruptions:** The violent movement of magma or the explosion of gases can trigger localized but intense seismic activity.
   - **Faulting and Folding:** Rocks under immense stress eventually fracture (faulting) or bend (folding). When the elastic limit is exceeded, the "Elastic Rebound Theory" explains the sudden snap that releases seismic energy.

2. Anthropogenic (Human-Induced) Causes

Human activities can alter the stress distribution in the Earth's crust:

- **Reservoir-Induced Seismicity (RIS):** The weight of water in massive reservoirs (like the **Koyna Dam** in Maharashtra) puts pressure on underlying rock layers and can lubricate existing faults.
- **Mining and Quarrying:** Deep underground mining can cause "rock bursts" or the collapse of mine roofs, triggering tremors.
- **Nuclear Explosions:** Underground testing of nuclear devices releases a massive amount of energy that mimics a natural earthquake.

Types of Earthquakes

(1) Based on Origin

1. **Tectonic Earthquakes** – caused by plate movements (most common).
2. **Volcanic Earthquakes** – associated with volcanic eruptions.
3. **Collapse Earthquakes** – due to underground mine collapse.
4. **Explosion-induced Earthquakes** – due to nuclear or chemical blasts.

(2) Based on Depth

Type	Depth	Characteristics
Shallow Focus	0 – 70 km	**Most Destructive.** Energy has less distance to travel, hitting the surface with high intensity.
Intermediate Focus	70 – 300 km	Moderate impact; often occur at subduction zones.
Deep Focus	300 – 700 km	Also called **Plutonic** earthquakes. Usually felt over wide areas but cause less surface damage.

Impact of Earthquakes

1. Physical & Structural Impacts

- **Building Collapse:** The primary cause of fatalities.
  - Example: **2023 Turkey-Syria Earthquake** where "pancake collapses" of thousands of buildings led to over 50,000 deaths.
- **Infrastructure Destruction:** Damage to "lifeline" infrastructure like bridges, dams, and power grids.
  - Example: **1993 Latur Earthquake**, which decimated stone-masonry houses in rural Maharashtra.

2. Geological & Environmental Impacts

- **Surface Faulting:** Visible tearing of the Earth's crust.
- **Liquefaction:** Soft soil behaving like liquid, causing buildings to tilt.
  - Example: **2011 Niigata (Japan) Earthquake**, where entire apartment complexes tilted perfectly intact into the saturated soil.
- **Landslides/Avalanches:**
  - Example: **2015 Nepal Earthquake**, which triggered a massive avalanche at the Everest Base Camp and buried the village of Langtang.

3. **Secondary Hazards (The "Follow-on" Disasters)**
    - **Tsunamis:** Displacement of the ocean floor.
    - Example: **2004 Indian Ocean Tsunami** (triggered by a Sumatra quake), affecting 14 countries including India's Andaman & Nicobar Islands.
    - **Flash Floods:** Landslides blocking rivers to create "artificial lakes" that eventually burst.
    - Example: Frequent risks in the **Sikkim-Himalayan belt** following tremors.
    - **Urban Fires:** Ruptured gas lines and electrical short circuits.
        - Example: **1923 Great Kanto Earthquake (Japan)**, where fire caused more deaths than the actual shaking.
4. **Socio-Economic Impacts**
    - **Economic Loss:** Massive drain on the national exchequer for reconstruction.
        - Example: The **2001 Bhuj Earthquake** caused an estimated loss of **$5 billion** and crippled the local handicraft and industrial sectors.
    - **Public Health Crisis:** Outbreak of waterborne diseases in relief camps and long-term PTSD.
    - **Digital/Communication Blackout:** Modern dependency on undersea cables and satellites makes communication fragile.

Earthquake Vulnerability in India

- India lies at the **convergent boundary of Indian and Eurasian plates**, making the Himalayan belt highly active.
- About **59% of India's landmass is prone to earthquakes of varying intensity**.
- **Population at Risk:** About **75% of India's population** lives in seismically active regions.
- **The "Seismic Gap":** Scientists are particularly concerned about the "Central Himalayan Gap"—a section of the Himalayas that hasn't seen a major earthquake in over 200 years, making it overdue for a "Great Earthquake" (M > 8.0).

Bureau of Indian Standards (BIS) divides India into **four seismic zones (II–V)** based on risk.

Approximate distribution:

- Zone V (Very High Risk): Himalayan region, Northeast India, Andaman & Nicobar
- Zone IV (High Risk): Delhi, Kashmir, Himachal Pradesh, Uttarakhand
- Zone III (Moderate Risk): parts of central India
- Zone II (Low Risk): stable peninsular regions

Mitigation Strategies

1. **Structural Mitigation (The "Engineering" Fix)**
    - **Seismic Retrofitting:** Strengthening older, vulnerable buildings (especially hospitals and schools) using steel bracing, base isolation, or jacketed columns.
    - **Base Isolation & Dampers:** Using flexible bearings or "shock absorbers" at the foundation to decouple the building from ground motion.
        - Example: The **Bhuj District Hospital** was rebuilt with base isolation after the 2001 quake.
    - **Strict Enforcement of Building Codes:** Ensuring all new constructions adhere to **IS 1893: 2016** (Seismic Design) and **IS 13920** (Ductile Detailing).

- **Use of Lightweight Materials:** Promoting the use of hollow bricks or Bamboo-based reinforced structures in high-risk hilly terrains (Zone V).

2. **Non-Structural Mitigation (The "Policy" Fix)**
   - **Seismic Microzonation:** Dividing a city into small "micro-zones" based on soil type to determine which areas will shake more (e.g., Delhi and Bengaluru have completed this).
   - **Land Use Planning:** Prohibiting high-rise construction on "fault lines" or liquefaction-prone riverbeds through strict zoning laws.
   - **Early Warning Systems (EWS):** Installing sensors that detect **P-waves** (faster, less destructive) to provide a 10–60 second warning before **S-waves** (destructive) arrive.
     - Example: Uttarakhand's Earthquake Early Warning (EEW) app.
   - **Capacity Building:** Training "Aapda Mitras" (community volunteers) and conducting regular **Mega Mock Drills** (e.g., Annual 'Exercise Sahayta').
3. **Institutional & Global Frameworks**
   - **NDMA Guidelines:** A shift toward "Safe Construction Practices" and "Mandatory Technical Audits" for high-rise buildings.
   - **CDRI (Coalition for Disaster Resilient Infrastructure):** An Indian-led global initiative to ensure that new infrastructure (power, telecommunications) can withstand seismic shocks.
   - **Insurance Penetration:** Promoting "Catastrophe Insurance" to reduce the fiscal burden on the government post-disaster.

India's Preparedness on Earthquakes

1. **Institutional Framework**
   - **Disaster Management Act, 2005:** The bedrock of India's preparedness, establishing a three-tier structure: **NDMA** (National), **SDMAs** (State), and **DDMAs** (District).
   - **NDMA Guidelines (2026 Update):** The latest guidelines emphasize **"Building Back Better"** and shifting from generic risk assessment to **Probabilistic Seismic Hazard Assessment (PSHA)**.
   - **NDRF (National Disaster Response Force):** A specialized force with 16 battalions trained in collapsed structure search and rescue (CSSR).
2. **Technological & Monitoring Systems**
   - **National Seismological Network (NSN):** As of early 2026, the network has expanded to **169 stations** (up from 80 in 2014), providing real-time data to the National Center for Seismology.
   - **Earthquake Early Warning (EEW) Systems:** Operational in **Uttarakhand** (first of its kind in India).
     - Research is underway to expand this across the **Himalayan Arc** to provide a 10–60 second lead time before destructive S-waves hit densely populated plains.
   - **Sachet Portal (NDMA):** A pan-India integrated alert system that uses geo-intelligence to send real-time alerts to mobile phones in local languages.

3. **Structural Preparedness (Building Resilience)**
    - **Seismic Microzonation:** High-risk cities like **Delhi, Bengaluru, Kolkata, and Guwahati** have completed microzonation. This allows planners to identify which specific neighborhoods have soil that amplifies shaking (e.g., Yamuna floodplains in Delhi).
    - **National Building Code (NBC) 2016 & IS Codes:** Mandatory standards for seismic-resistant design.
    - **Retrofitting:** Government initiatives to strengthen "lifeline structures" (hospitals, schools, and bridges) in Zone IV and V.
4. **Community & Capacity Building**
    - **Aapda Mitra Scheme:** A central project that has trained over **1 lakh community volunteers** to be "first responders" before professional help arrives.
    - **School Safety Programs:** Conducted by NIDM (National Institute of Disaster Management) to ensure schools in high-risk zones have evacuation plans.
    - **Traditional Knowledge:** Integration of resilient traditional architecture like **Kath-Kuni** (Himachal) and **Dhajji-Dewari** (Kashmir) into modern building protocols.

Challenges in Earthquake Management

1. **Structural and Engineering Challenges**
    - **Enforcement Deficit:** ~80% of buildings in cities like Delhi/Guwahati violate **IS 1893** norms; prevalence of "non-engineered" structures built without expert supervision.
    - **Retrofitting Dilemma:** Over 12 crore buildings need strengthening. High costs, technical complexity, and **"occupancy disruption"** (e.g., inability to vacate hospitals/schools) hinder progress.
    - **Skill Shortage:** Acute lack of licensed structural engineers and masons skilled in **ductile detailing** and seismic-resistant masonry.
2. **Institutional and Policy Challenges**
    - **The 2026 "Seismic Rollback":** The recent withdrawal of the **IS 1893: 2025** code (which proposed 'Zone VI') due to industry pushback.
        - **Reason:** Concerns over 20–50% spike in construction costs and the risk of **"stranded assets"** in infrastructure.
    - **Top-Down Governance:** Over-centralization persists; **DDMAs** (Districts) lack independent budgets and technical staff to implement microzonation data.
    - **Connectivity Gaps:** Despite 169 monitoring stations, India lacks **"last-mile connectivity"** for real-time Early Warning Systems (EWS) in the Indo-Gangetic plains.
3. **Geographical and Socio-Economic Challenges**
    - **Himalayan Fragility:** Tectonic stress in the **"Central Himalayan Gap"** makes the region overdue for an M > 8.0 quake; compounded by unplanned hill urbanization.
    - **Soil Amplification & Liquefaction:** Soft alluvial soil in the North Indian plains amplifies tremors and causes ground failure (liquefaction) far from the epicenter.
    - **Rural-Urban Divide:** Rural reliance on **"Kutcha" masonry** leads to "pancake collapses," while urban density increases the risk of secondary hazards like fires.

Way Forward

- **Risk-Informed Governance:** Transition from the **2026 Seismic Rollback** to a phased implementation of **IS 1893:2025** standards, mandating "Seismic Compliance Certificates" for all lifeline infrastructure (Metros, Nuclear Plants, Hospitals) first.
- **National Retrofitting Mission:** Address the vulnerability of 12 crore existing structures through a dedicated mission providing **"Resilience Loans,"** tax rebates, and **Parametric Insurance** to ensure immediate liquidity post-event.
- **Technological Last-Mile Connectivity:** Scale the Himalayan **Early Warning System (EEW)** to enable automated triggers for shutting down gas grids and rail networks, while integrating **Seismic Microzonation** into Smart City Master Plans.
- **Decentralized Capacity Building:** Expand the **Aapda Mitra** program to every district and bridge the technical "Skill Gap" by certifying local masons in **ductile detailing** and resilient traditional styles like **Kath-Kuni**.
- **Mainstreaming DRI:** Utilize the **Coalition for Disaster Resilient Infrastructure (CDRI)** to "disaster-proof" the **National Infrastructure Pipeline (NIP)**, shifting the paradigm from "Reactive Relief" to **"Proactive Risk-Informed Development."**

Conclusion

Moving from a "Reactive Relief" to a **"Risk-Informed Development"** paradigm is vital. Integrating the **Sendai Framework** with cutting-edge **Early Warning Systems** and **CDRI** leadership will ensure India's $5 trillion economic vision remains resilient against seismic uncertainties.

Q. *The frequency of earthquakes appears to have increased in the Indian subcontinent. However, India's preparedness for mitigating their impact has significant gaps. Discuss various aspects.*

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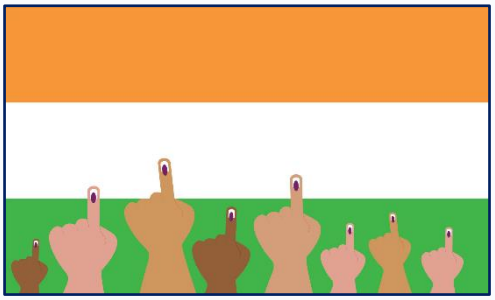
GENERAL STUDIES 2

2.1. POLITY & GOVERNANCE

2.1.1. ONE NATION ONE ELECTION

Context:



The concept of **One Nation One Election** refers to a system where elections to the **Lok Sabha**, **State Legislative Assemblies**, and **Local Bodies** (Panchayats and Municipalities) are held simultaneously within a synchronized timeframe.

Historical Background of One Nation One Election (ONOE)

- **The Norm (1951–1967):** Simultaneous elections were the standard practice in India for the first two decades post-independence (1951-52, 1957, 1962, and 1967).
- **The Disruption:** The cycle was broken in **1968 and 1969** due to the premature dissolution of several State Legislative Assemblies (e.g., Haryana, UP) and the Lok Sabha itself in 1970.
- **Institutional Support: Law Commission (170th Report, 1999):** Recommended returning to simultaneous elections to ensure stability.
    - **Election Commission (1983):** First mooted the idea after the cycle was disrupted.
    - **NITI Aayog (2017):** Published a working paper advocating for a two-phase synchronization.

Significance of One Nation One Election (ONOE)

1. **Enhancing Governance and Policy Continuity**
    - **Ending "Policy Paralysis":** Frequent Model Code of Conduct (MCC) impositions halt new welfare schemes and infrastructure projects. ONOE ensures uninterrupted governance and long-term structural reforms.
    - **Focus on Delivery:** Shifts leadership focus from "permanent campaign mode" to administrative execution, providing a stable four-to-five-year window for performance over populist optics.
2. **Economic and Fiscal Significance**
    - **Massive Cost Savings:** Reduces duplicated logistical and security expenditures. Synchronized polls curb the massive public and private capital drained by frequent election cycles.
    - **Boosting GDP Growth:** Minimizes economic uncertainty and supply-chain disruptions caused by rallies. The HLC suggests a potential **1.5 percentage point** boost to real GDP growth.
    - **Controlling Inflation:** Limits the periodic surges in money supply triggered by massive, decentralized election spending, aiding macro-economic stability.
3. **Administrative and Security Efficiency**
    - **Optimal Resource Deployment:** Prevents the repetitive diversion of CAPF and civil staff (like teachers) from their primary duties, ensuring better internal security and consistent public services.

- **Single Electoral Roll:** Streamlines the process through a common voter list and **Single EPIC**, eliminating data duplication and reducing the administrative burden on the ECI and State Election Commissions.

4. **Impact on the Democratic Fabric**
   - **Checking Populism:** Encourages fiscally responsible "hard" decisions over short-term "freebies" typically announced to influence immediate state-level outcomes.
   - **Curbing Corruption:** Fewer elections lower the constant pressure for political fundraising, potentially reducing the role of "black money" in the electoral process.
   - **Increasing Voter Turnout:** Combats "voter fatigue" and facilitates participation for migrant workers who can vote for multiple levels of government in a single trip.

Challenges of One Nation One Election (ONOE)

1. **Constitutional and Legal Hurdles**
   - **Major Amendments:** Requires amending **Articles 83, 85, 172, 174, and 356**. These govern the duration and dissolution of the Lok Sabha and State Assemblies.
   - **Ratification by States:** Amendments related to the "Union-State" balance and local bodies (73rd/74th Amendments) require ratification by at least **half of the State Legislatures** under Article 368.
   - **Mid-term Collapse:** A major dilemma arises if a government falls mid-tenure. The current proposal for "unexpired terms" (only serving the remaining period) may lead to frequent "interim" elections, defeating the purpose of ONOE.

2. **Threat to Federalism**
   - **Erosion of State Autonomy:** Forcing states to align their terms with the Center is seen as an encroachment on their independent constitutional existence (**S.R. Bommai case**).
   - **Marginalization of Regional Parties:** National issues often overshadow local concerns in synchronized polls. A study by the IDFC Institute suggests a **77% probability** of voters choosing the same party for both Center and State when elections are simultaneous.

3. **Logistical and Operational Complexity**
   - **EVM/VVPAT Shortage:** The ECI would need nearly **double the current number** of voting machines. This involves massive manufacturing costs and significant storage/warehousing challenges.
   - **Security Deployment:** Providing adequate security (CAPF) for a nationwide synchronized poll is a daunting task, potentially stretching the country's internal security apparatus thin.

4. **Impact on Democratic Accountability**
   - **Reduced Frequency of Feedback:** Staggered elections act as a "mid-term review," keeping governments accountable. ONOE might lead to "accountability only once in five years."
   - **Voter Confusion:** Voters may struggle to distinguish between national-level mandates (e.g., Foreign Policy) and state-level issues (e.g., Water/Roads) when casting multiple votes on the same day.

5. **Political Resistance**
    - **Lack of Consensus:** Many regional and opposition parties view ONOE as a move toward a "Unitary State" or a "Presidential" style of governance, leading to significant political pushback and lack of a unified national vision on the reform.

Recommendations of the High-Level (Kovind) Committee

The High-Level Committee (HLC) chaired by **Ram Nath Kovind** (2024) recommended a **Phased Approach**:

- **Step 1:** Synchronize Lok Sabha and State Assembly elections. This would not require ratification by the states.
- **Step 2:** Synchronize local body elections (Panchayats/Municipalities) within **100 days** of the general elections. This would require ratification by at least half of the states.
- **Single Electoral Roll:** Preparation of a common electoral roll and single ID card (EPIC) for all three tiers.
- **Unexpired Term:** In case of a hung house or no-confidence motion, the new house would only serve for the remaining ("unexpired") period of the 5-year cycle.

Global Practices

- **South Africa:** National and provincial elections are held simultaneously every five years.
- **Sweden:** Elections for the national legislature (Riksdag), regional councils, and local councils are held on the same day (second Sunday of September).
- **Germany:** Follows a **"Constructive Vote of No-Confidence,"** where a government cannot be toppled unless an alternative government is already in place. This ensures the term is completed and prevents premature elections.
- **Indonesia:** Indonesia demonstrates that high-volume simultaneous voting is logistically possible but extremely taxing on administrative staff (leading to health concerns for polling workers in past cycles).

Way Forward

1. **Phased Implementation (Two-Step Approach)**
    - **Phase I:** Synchronize elections for the **Lok Sabha** and all **State Legislative Assemblies**. This step focuses on the top two tiers of governance.
    - **Phase II:** Synchronize **Local Body elections** (Panchayats and Municipalities) with the first phase, ensuring they are conducted within **100 days** of the general elections.
2. **Constitutional and Legal Framework**
    - **Appointed Date:** The President should notify an "Appointed Date" (e.g., in 2029) to trigger the synchronization. Terms of assemblies ending after this date would be adjusted to align with the Lok Sabha.
    - **Minimum Amendments:** Focus on essential changes to **Articles 83 and 172** to define "unexpired terms," ensuring the cycle is not broken by mid-term dissolutions.
3. **Institutional Mechanisms for Stability**
    - **Handling Hung Houses:** In the event of a No-Confidence Motion or a hung house, fresh elections should be held only for the **remainder of the five-year cycle** (the "unexpired term"), rather than a full new five-year term.

- **Constructive Vote of No-Confidence:** Explore the German model where a government cannot be removed unless an alternative government is ready, ensuring the legislature completes its synchronized tenure.

4. **Logistical Preparedness**
   - **Vast Scale-up:** The Election Commission must proactively plan for the massive procurement of **EVMs and VVPATs** (nearly double current levels) and develop specialized storage and security protocols for a nationwide single-window election.
5. **Building Political and Social Consensus**
   - **Bipartisan Dialogue:** Since ONOE impacts the federal structure, a **Joint Parliamentary Committee (JPC)** or a similar body should facilitate open deliberations with regional parties to address fears of "national issues overshadowing local ones."
   - **Public Awareness:** Conduct voter education programs to explain the benefits (reduced costs, governance continuity) and the process of casting multiple ballots, ensuring high democratic participation.

Conclusion

While **One Nation One Election** offers a blueprint for administrative and financial efficiency, its success depends on balancing the need for stability with the foundational principles of **Federalism** and **Democratic Accountability**.

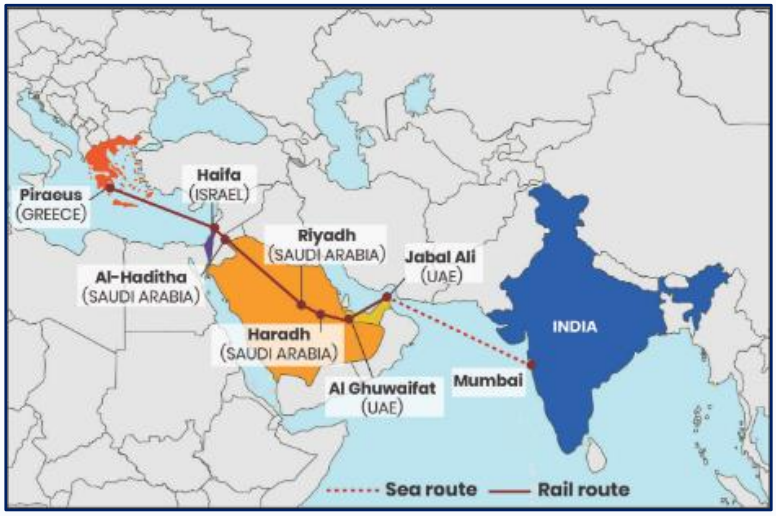
Q. *Examine the need for electoral reforms as suggested by various committees with particular reference to "one nation-one election" principle.*

2.2. INTERNATIONAL RELATIONS

2.2.1. INDIA'S WEST ASIA POLICY

Context:

West Asia (Middle East) is one of the **most strategically important regions for India's foreign policy** due to its significance for energy security, trade, diaspora, and geopolitical stability. India considers West Asia as its **"extended neighbourhood"** and has gradually shifted from a passive diplomatic approach to **active strategic engagement** in the region.



About West Asia

West Asia refers to the region located between **Europe, Africa, and South Asia**, often overlapping with what is called the **Middle East**. It includes countries of the **Arab world, Israel, Iran, and Turkey**.

Key Elements of India's West Asia Policy

1. **The "De-Hyphenation" Strategy**

   India has successfully separated its bilateral ties with traditional rivals. It maintains a **"Special Strategic Partnership"** with **Israel** (focusing on defense and high-tech) while simultaneously engaging with the **Iranian Interim Leadership Council** for strategic connectivity. This allows India to pursue national interests without being forced to choose sides in regional sectarian or political conflicts.

2. **Energy Security 2.0: Transition & Buffering**

   While the Gulf still provides ~55% of India's crude, the agenda has shifted toward:

   - **Strategic Reserves:** Speeding up the expansion of **Strategic Petroleum Reserves (SPR)** to create a 90-day supply buffer against shocks like the current Strait of Hormuz instability.
   - **Green Energy:** Investing in **Green Hydrogen** and solar projects with the UAE and Saudi Arabia to ensure long-term energy synergy beyond fossil fuels.

3. **"Net Security Provider" in Maritime Lanes**

   With the 2026 conflict threatening the Strait of Hormuz and the Red Sea, India has institutionalized **Operation Sankalp**. The Indian Navy now acts as a stabilizer, providing permanent maritime escorts for merchant vessels to protect trade routes and counter piracy or kinetic threats from non-state actors.

4. **Connectivity: The "Two-Gateway" Approach**

   India is aggressively pursuing two distinct corridors to reduce dependency on traditional routes:

   - **IMEC (India-Middle East-Europe Economic Corridor):** Using the Gulf (UAE/Saudi) and Israel as a bridge to Europe.
   - **INSTC & Chabahar:** Developing Iran's **Chabahar Port** as a vital gateway to Central Asia and Russia, ensuring India's land-link despite the blockade of overland routes through Pakistan.

5. **Diaspora Welfare & "Remittance Diplomacy"**

   Protecting the **9 million+ Indians** in the Gulf is a top-tier security priority. The agenda includes:

   - **Crisis Response:** Maintaining active evacuation protocols (like the 2026 Ministerial Committee led by the Home Minister).
   - **Economic Protection:** Signing **Migration and Mobility Partnerships** to ensure job security and social protection for Indian workers during regional economic shifts.

6. **Multilateralism & "Minilateralism"**

   India leverages new, flexible groupings to embed itself into the regional architecture:

   - **I2U2 (India, Israel, UAE, USA):** Focusing on joint projects in food security, water, and space.
   - **BRICS+ Engagement:** Utilizing the inclusion of Saudi Arabia, Iran, and the UAE into BRICS to coordinate on global financial architectures and "Rupee-Trade" settlements.

Advantages of India's West Asia Policy

1. **Energy Resilience & Price Stability**

   By cultivating deep ties with major producers like Saudi Arabia and the UAE, India secures **preferential energy access**. These partnerships also facilitate the development of **Strategic Petroleum Reserves (SPR)** within India, funded partly by Gulf investments.

2. **Strategic "Bridging" Capability**

   India is one of the very few nations that can talk to **Israel, Iran, and the Arab states** simultaneously. This "strategic autonomy" allows India to:

   - Act as a neutral mediator in regional crises.
   - Protect its interests without being dragged into sectarian conflicts.
   - Maintain defense ties with Israel while securing connectivity via Iran's **Chabahar Port**.

3. **Economic Windfall: Remittances & Investment**

   - **Remittances:** The 9 million-strong diaspora sends back over **$120 billion** annually (2025-26 estimates), providing a massive cushion for India's Current Account Deficit (CAD).
   - **Sovereign Wealth Funds:** India has become a primary destination for massive investments from the UAE's ADIA and Saudi Arabia's PIF in infrastructure, green energy, and digital startups.

4. **Countering China's "String of Pearls"**

   A proactive West Asia policy prevents the region from becoming a Chinese lake. By leading initiatives like the **IMEC (India-Middle East-Europe Economic Corridor)**, India offers a transparent, debt-free alternative to China's Belt and Road Initiative (BRI), ensuring the western flank of the Indian Ocean remains open and balanced.

5. **Enhanced Maritime Security**

   Through **Operation Sankalp** and joint naval drills, India has gained "docking rights" and logistical access in places like **Duqm (Oman)**. This extends the Indian Navy's reach, allowing it to protect vital sea lanes of communication (SLOCs) from piracy and drone threats in the North Arabian Sea.

6. **Food and Tech Security (Minilateralism)**

   Through the **I2U2 Group**, India leverages:

   - **Israeli Technology:** For arid-land farming and water recycling.
   - **UAE Capital:** To build "Food Parks" in India.
   - **Result:** This ensures a steady food supply chain for the Middle East while boosting Indian farmers' income and technological prowess.

Challenges of India's West Asia Policy

1. **The "Chokepoint" Paralysis:** Over **40-50% of India's crude oil** and nearly **90% of its LPG** imports pass through the **Strait of Hormuz**. With the current naval blockade and Iranian threats to close the waterway, India faces an existential energy threat.
2. **Connectivity Under Fire (IMEC vs. Reality):** The **India-Middle East-Europe Economic Corridor (IMEC)** is currently inoperable due to active conflict in Israel and the UAE. Failure of IMEC forces reliance on the **Suez Canal** (Houthi threat) or the costly **Cape of Good Hope** route.

3. **The Diaspora Dilemma**

   With nearly **10 million Indians** living in the Gulf, any major regional war is a logistical nightmare.

   - **Evacuation:** While over 52,000 Indians were evacuated in early March, a total regional war would require a rescue operation exceeding the scale of *Operation Rahat*.
   - **Economic Shock:** A decline in production in the Gulf directly hits the **$120 billion+** annual remittance flow, threatening India's foreign exchange stability.

4. **Imported Inflation and Fiscal Strain:** The spike in Brent crude (hitting **$100-$120/barrel**) is driving "cost-push inflation" in India.

   - **Fertilizer Crisis:** India imports 40% of its Urea and NPK inputs from the Gulf. Disruptions are currently inflating the government's subsidy burden and threatening domestic food security.
   - **Currency Pressure:** Increased import bills are putting the Rupee under depreciation pressure (forecasted to hit **₹92-95/$** if tensions persist).

5. **China's "Mediation" Diplomacy:** China is increasingly positioning itself as the regional "peacebroker" (e.g., the Saudi-Iran deal). As Beijing expands its **Belt and Road Initiative (BRI)** into Gulf ports like Gwadar and Jebel Ali.

6. **De-hyphenation Stress:** Balancing a defense pact with **Israel** while engaging **Iran's Interim Council** (for Chabahar) is increasingly difficult. India faces rising domestic criticism and friction with the US-led axis over its strategic autonomy.

Way Forward

1. **Strengthening Strategic Petroleum Reserves (SPR):** India must accelerate the Phase II expansion of its SPR (Strategic Petroleum Reserves) to build a **90-day buffer**. Inviting investments from Saudi Aramco and UAE's ADNOC into these reserves will tie their commercial interests to India's energy security, ensuring supply even during regional volatility.

2. **Operationalizing the "Trans-Continental" Backup:** Given the current paralysis of IMEC, India should prioritize the **International North-South Transport Corridor (INSTC)** via **Chabahar Port**. Strengthening this "middle corridor" provides a vital hedge against chokepoints in the Red Sea and ensures uninterrupted trade with Russia and Central Asia.

3. **Institutionalizing "Rupee-Trade" Hubs:** To counter currency pressure (₹92-95/$) and potential sanctions, India must institutionalize **Local Currency Settlement (LCS)** systems.

4. **Transitioning to Energy 2.0 (Green Hydrogen):** India should pivot from being a "buyer" of oil to a **"partner" in Green Hydrogen**. By co-developing renewable energy infrastructure in the Gulf, India can leverage West Asia's low-cost solar energy to meet its "Net-Zero" goals while reducing the fiscal strain of fossil fuel imports.

5. **Multi-Lateral "Security Architecture":** Utilizing the **I2U2** and **BRICS+** platforms, India can advocate for a "Code of Conduct" in the North Arabian Sea, positioning itself as a net security provider and a stabilizing force between the US-Israel axis and Iran.

Conclusion

India must transition from a "buyer-seller" to a **"strategic stakeholder,"** leveraging **IMEC** and **Green Hydrogen** to anchor its extended neighborhood, ensuring regional stability while securing long-term **energy and maritime sovereignty.**

Q. *The question of India's Energy Security constitutes the most important part of India's economic progress. Analyze India's energy policy cooperation with West Asian Countries.*

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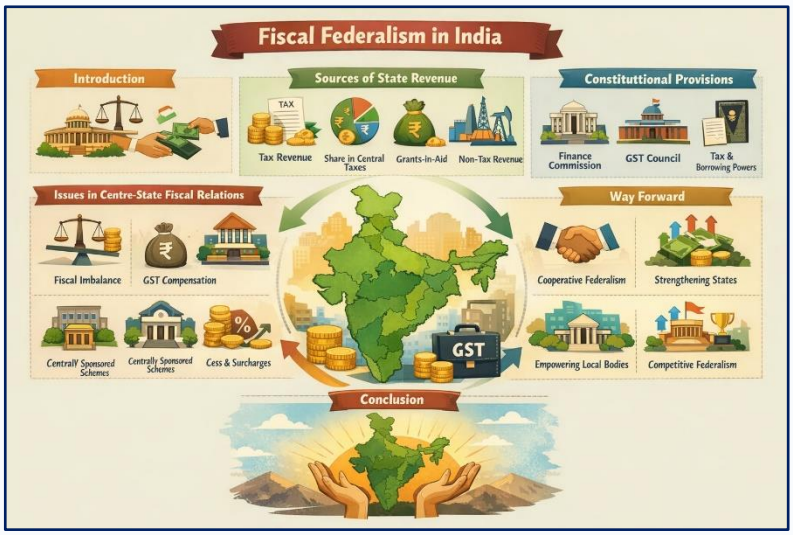
GENERAL STUDIES 3

3.1. ECONOMY

3.1.1. FISCAL FEDERALISM IN INDIA

Context:



- **Definition:** Fiscal Federalism is the study of how revenues and expenditures are allocated across different layers of the government.
- **Nature:** India follows a **Quasi-Federal** fiscal structure. While the Centre has more elastic revenue sources (Income Tax, Corp Tax), the States bear the majority of "ground-level" expenditures (Health, Education, Agriculture).
- **Musgrave's Three Functions:** It aims to achieve **Allocation** (public goods), **Distribution** (equity), and **Stabilization** (macroeconomic health).

Constitutional Provisions on Fiscal Federalism

The legal framework is primarily contained in **Part XII** (Articles 268-293).

1. **Division of Taxing Powers (The Foundation)**
   - **Article 246 (Seventh Schedule): Union List (List I):** Centre has exclusive power over Income Tax (except agriculture), Customs, Corporate Tax, and Central Excise (on tobacco, petroleum, etc.).
     - **State List (List II):** States have exclusive power over Land Revenue, State Excise (on alcohol), Stamp Duty, and Agricultural Income Tax.
     - **Concurrent List (List III):** Minimal taxation powers; mostly regulatory.
   - **Article 246A (101st Amendment):** The "Special Provision" that bypasses the Seventh Schedule to allow both Centre and States to levy **GST** on the same transaction.
2. **Revenue Distribution (The Mechanism)**
   - **Article 268:** Duties levied by the Union but **collected and appropriated by the States** (e.g., Stamp duties).
   - **Article 269:** Taxes levied and collected by the Union but **assigned to the States** (e.g., taxes on inter-state trade, though largely subsumed by IGST).
   - **Article 270 (The Divisible Pool):** Mandatory sharing of "Net Proceeds" of all Union taxes (except cesses and surcharges) between the Centre and States.
     - *Current Status:* The **16th Finance Commission** has maintained the vertical devolution at **41%** for 2026-31.

- **Article 271:** Power of the Union to levy **Cesses and Surcharges**. These are **not part of the divisible pool**, meaning the Centre keeps 100% of this revenue. This remains a major point of friction.

3. **Grants-in-Aid (The Gap Filler)**
   - **Article 275 (Statutory Grants):** Mandatory grants given to specific states based on the Finance Commission's recommendations. Charged on the **Consolidated Fund of India**.
   - **Article 282 (Discretionary Grants):** Allows the Centre or States to make grants for any "public purpose." Most **Centrally Sponsored Schemes (CSS)** are funded under this article.
     - **N.B**: The 16th FC has signaled a shift toward **performance-linked grants** (e.g., 20% of local body grants are now performance-tied).
4. **Institutional Pillars**
   - **Article 280 (Finance Commission):** A quasi-judicial body appointed every 5 years to recommend the formula for horizontal and vertical tax devolution.
   - **Article 279A (GST Council):** A constitutional body for joint decision-making. Decisions require a **75% majority**, where the Centre has **1/3rd voting power** and States have **2/3rd**.
5. **Financial Management & Borrowing**
   - **Article 292:** Union's power to borrow upon the security of the Consolidated Fund of India (within limits set by Parliament).
   - **Article 293:** States' power to borrow.
     - **Constraint:** A State **cannot** borrow without the Centre's consent if it has any outstanding loan due to the Union (Art. 293(3)).
     - *Recent Conflict:* The Centre has used this to include **Off-Budget Borrowings** in the state's debt ceiling, a move challenged by states like Kerala.

Sources of State Revenue

1. **State's Own Tax Revenue (SOTR)**

   This is the most critical component for a state's fiscal autonomy.
   - **State GST (SGST):** The single largest source. It is the state's share of the Goods and Services Tax levied on intra-state supply.
   - **State Excise Duty:** Primarily levied on the manufacture of **alcohol for human consumption** and narcotics. (A major "sin tax" revenue source).
   - **VAT on Petroleum:** Since petrol, diesel, and aviation turbine fuel are outside GST, states levy a Value Added Tax (VAT) on them.
   - **Stamp Duty & Registration Fees:** Levied on the transfer of property and legal documents.
   - **Taxes on Vehicles:** One-time or annual life taxes on motor vehicles.
   - **Land Revenue:** Tax on agricultural land (historically significant, now a smaller share).
   - **Electricity Duty:** Tax on the consumption or sale of electricity.
2. **State's Own Non-Tax Revenue (SONTR)**

   Often underutilized, this includes:
   - **User Charges:** Fees for social and economic services (e.g., irrigation charges, tuition fees in govt colleges, health hospital fees).

- **Interest Receipts:** Interest earned on loans provided by the State to PSUs or local bodies.
- **Dividends & Profits:** Income from State Public Sector Undertakings (SPSUs).
- **Mining Royalty:** Fees paid by mining companies for extracting minerals (crucial for states like Odisha, Jharkhand, and Chhattisgarh).
- **Lottery Proceeds:** Significant for states like Kerala and Sikkim.

3. **Transfers from the Centre**
   - **Tax Devolution (Art. 270):** States receive **41%** of the "Divisible Pool" of central taxes (Income Tax, Corp Tax, CGST, etc.).
   - **Grants-in-Aid (Art. 275): Revenue Deficit Grants:** Given to states facing a fiscal gap after devolution.
     - **Local Body Grants:** For Panchayats and Urban Local Bodies (RLBs/ULBs).
   - **Centrally Sponsored Schemes (CSS):** Funds transferred for specific schemes (e.g., Jal Jeevan Mission, PM-Kisan) under **Article 282**.

Issues In Center-state Fiscal Relations

I. **Vertical Fiscal Imbalance:** The Centre collects roughly **60%** of total revenue but the States perform **60%** of total public expenditure. This creates a dependency of States on the Union.

II. **Growth of Cesses and Surcharges:** Under Article 271, the Centre levies cesses (e.g., Health & Education Cess) which are **not shared** with states. This has effectively reduced the "divisible pool."

Note: The **16th FC** recently proposed a **"Grand Bargain"** where States might accept a lower devolution percentage if Cesses are merged into the shared pool.

III. **Erosion of Autonomy (GST):** The "One Nation, One Tax" regime has taken away the States' power to vary tax rates on most goods, making them "pensioners of the Centre."

IV. **Borrowing Constraints (Article 293):** The Centre imposes a **Net Borrowing Ceiling (NBC)**. States like Kerala have challenged this in the Supreme Court, arguing it infringes on their constitutional right to manage their own finances.

V. **Centrally Sponsored Schemes (CSS):** States argue that CSS (like MGNREGA or Ayushman Bharat) are "one-size-fits-all" and force states to spend their limited resources on Central priorities, often with a 60:40 or 90:10 funding pattern.

Way Forward: Strengthening Fiscal Federalism

1. **Cess Neutralization:** Implement a **"Grand Bargain"** by merging major cesses into the divisible pool. This ensures transparency and prevents the "shrinking" of the states' share of Gross Tax Revenue.
2. **GST 2.0 Reform:** Move toward a **simplified two-slab structure** (e.g., 5% and 18%) and establish a clear roadmap for including **Petroleum and Electricity** under GST to reduce cascading costs and broaden the revenue base.
3. **Revenue Floor Guarantee:** To mitigate the "North-South" divide created by efficiency-linked criteria (like GDP contribution), the Centre should guarantee that no state's absolute revenue falls below its previous levels during the transition.

4. **Local Body Empowerment:** Shift focus from "Grant-Dependency" to **"Fiscal Autonomy"** for Panchayats and ULBs. States must mandate the implementation of **State Finance Commission (SFC)** reports to improve local property tax collection.
5. **Flexi-CSS Model:** Replace rigid **Centrally Sponsored Schemes** with "Outcome-based Tied Grants." This allows states the flexibility to customize scheme implementation based on local geographical and demographic needs.
6. **Institutional Consensus:** Revitalize the **Inter-State Council (Art. 263)** to resolve disputes over **Net Borrowing Ceilings (NBC)** and off-budget liabilities, shifting the resolution of fiscal friction from the Judiciary to collaborative Executive dialogue.

Conclusion

India's fiscal architecture must evolve from "Centralized Coordination" to **"Equitable Partnership."** Leveraging the 16th Finance Commission's efficiency-linked criteria while absorbing cesses into the divisible pool will ensure a fiscally resilient, **Viksit Bharat @ 2047**.

Q. *Examine the evolving pattern of Centre-State financial relations in the context of planned development in India. How far have the recent reforms impacted the fiscal federalism in India?*

3.1.2. SUSTAINABLE ENERGY FOR INDIA

Context:

Sustainable energy refers to **energy that meets present needs without compromising the ability of future generations to meet their needs**, ensuring **energy security, environmental protection and economic growth**.

Core Principles of Sustainable Energy

(a) Environmental Sustainability: Energy production should **minimize environmental damage and carbon emissions.**

(b) Economic Sustainability: Energy systems must be **cost-effective and support economic development**.

(c) Social Equity: Energy should be **accessible and affordable for all sections of society**.

(d) Energy Security: Ensuring **continuous and reliable energy supply** for economic growth.

Why Sustainable Energy is Crucial for India

1. **Economic Resilience (The "Import Bill" Crisis)**
   - **Fiscal Stability:** India spends over **$160 billion annually** on crude oil imports. This drain on foreign exchange reserves directly impacts the value of the Rupee.
   - **Inflation Control:** High oil prices lead to **"imported inflation,"** raising transport costs for food and essential goods. Sustainable energy (Solar/Wind) has **zero fuel cost**, stabilizing long-term energy prices.

2. **Energy Security & Geopolitical Autonomy**
   - **The "Hormuz" Risk:** 60% of India's oil comes from the Middle East. Any conflict in the Persian Gulf can cripple the Indian economy in days.
   - **Strategic Autonomy:** By generating power domestically via Renewables and **Green Hydrogen**, India reduces its "Energy Dependency" and can maintain a neutral foreign policy without fear of energy blackmail.
3. **Environmental & Health Mandates**
   - **Air Quality:** 14 of the world's 20 most polluted cities are in India. Moving away from coal-fired plants reduces PM2.5 levels, saving billions in healthcare costs.
   - **Climate Leadership:** As the world's 3rd largest CO_2 emitter, meeting **Net Zero 2070** targets is essential for India's global standing and to avoid "Carbon Border Taxes" imposed by the EU/USA.
4. **The "Demographic Dividend" & Job Creation**
   - **Green Jobs:** The renewable sector is more labor-intensive than fossil fuels. India's RE sector could create **3.4 million jobs** by 2030 in manufacturing, installation, and maintenance.
   - **Rural Electrification:** Decentralized solar (PM-KUSUM) empowers farmers to become "Urjadatas" (energy providers), increasing rural incomes.

Major Sources of Sustainable Energy in India

1. **Solar Energy (The Dominant Lead)**

   Solar power is the "anchor" of India's green transition. India has surpassed Japan to become the **world's 3rd largest solar producer**.
   - **Current Capacity:** ~143.6 GW.
   - **Ground-Mounted:** ~109.5 GW, dominated by massive parks like **Khavda** (Gujarat), which is becoming the world's largest renewable energy zone.
   - **Rooftop Solar:** Reached **~25 GW**, accelerated by the PM Surya Ghar Yojana aiming to solarize 1 crore homes.
   - **Floating Solar:** Increasing deployment in reservoirs (e.g., Omkareshwar Dam) to save land and reduce water evaporation.
2. **Green Hydrogen (The Decarbonizer)**
   - **Production Status:** Costs have dropped below **$4/kg.**
   - **Strategic Hubs:** Three dedicated ports are now "Green Hydrogen Hubs": **Kandla (Gujarat), Tuticorin (Tamil Nadu), and Paradip (Odisha)**.
   - India is integrating Green Hydrogen into "hard-to-abate" sectors like Steel and Fertilizer to reduce dependence on imported LNG.
3. **Wind Energy (Onshore & Offshore)**
   - **Current Capacity:** ~54 GW (Onshore).
   - **Offshore Leap:** Following the VGF (Viability Gap Funding) scheme, the first 1 GW offshore tenders off the coasts of **Gujarat and Tamil Nadu** are now in the execution phase.
   - **Hybridization:** Most new projects are now "Solar-Wind Hybrids" (3.5 GW currently) to ensure a more stable, round-the-clock power supply to the grid.

4. **Nuclear Energy (The "Base Load" Pillar)**

   Under the **SHANTI Act of 2025**, India has opened the nuclear sector to limited private participation to reach **100 GW by 2047**.

   - **Current Capacity:** ~8.8 GW.
   - **Bharat Small Reactors (BSRs):** 220 MW indigenous reactors are being deployed as "captive power plants" for heavy industries.
   - **SMR-55:** India's first dedicated 55 MWe Small Modular Reactor is now under construction, specifically designed for decentralized industrial use.

5. **Bio-Energy & Circular Economy**

   - **Ethanol Blending:** Having achieved **20% blending (E20)** in 2025, India is now testing E100 (pure ethanol) vehicles in select cities.
   - **CBG (Compressed Biogas):** Utilizing agricultural waste (parali) to produce gas, effectively reducing the LPG import bill and urban pollution.

Major Government Policies & Initiatives

1. **PM Surya Ghar: Muft Bijli Yojana (2024–2027):** Decentralized solar adoption through rooftop installations.
2. **National Green Hydrogen Mission (NGHM):** Production of **5 MMT (Million Metric Tonne)** of Green Hydrogen per annum by 2030.
3. **SHANTI Act, 2025 (Sustainable Harnessing of Nuclear Energy):** Ending the state monopoly by allowing **limited private participation** and accelerating the deployment of **Small Modular Reactors (SMRs)** for industrial captive power.
4. **PM-KUSUM:** De-dieseling the farm sector by providing solar pumps and allowing farmers to become **"Urjadatas"** (selling surplus solar power back to the grid).
5. **PM E-DRIVE Scheme (2024–2028):** Accelerate the transition to **Electric Mobility**. Support for e-2Ws, e-3Ws, e-trucks, and e-ambulances, while establishing a pan-India public charging network (EVPCS).
6. **National Policy on Biofuels (Amended 2022):** Achieve **20% Ethanol Blending (E20)** by ESY 2025-26. Using surplus food grains and agricultural residue for fuel.

Challenges in Achieving Sustainable Energy

1. **Storage Infrastructure Gap:** India lacks sufficient **Battery (BESS)** and **Pumped Hydro** capacity to store surplus midday solar power for nighttime use.
2. **Critical Mineral Dependency:** India relies heavily on imports for Lithium, Cobalt, and Rare Earths required to manufacture EV batteries and solar panels.
3. **High Capital Cost:** Renewable projects require massive upfront investment, and high interest rates in India increase the overall "Levelized Cost of Electricity."
4. **Land Acquisition Conflicts:** Solar/Wind farms require vast areas, leading to competition with agriculture and threats to biodiversity (e.g., the Great Indian Bustard).
5. **Transmission Bottlenecks:** Most green energy is produced in a few states (Rajasthan/Gujarat), but the **Green Energy Corridor** lacks the capacity to evacuate all of it to the rest of India.

6. **DISCOM Financial Health:** State-owned distribution companies are in deep debt, making them hesitant to sign long-term Power Purchase Agreements (PPAs) for green energy.
7. **Technological Import Reliance:** Despite "Make in India," a significant portion of high-efficiency solar cells and electrolyzers for hydrogen are still imported.

Way Forward

1. **Integrated Storage Policy:** Accelerate the deployment of **Pumped Hydro Storage** and **Battery Energy Storage Systems (BESS)** to manage the intermittency of solar and wind power.
2. **Mineral Security Partnerships:** Secure long-term supplies of Lithium and Cobalt through the **KABIL** (Khanij Bidesh India Ltd) joint venture and the "Mineral Security Partnership" to reduce import reliance.
3. **Green Hydrogen Scaling:** Transition from pilot projects to industrial-scale production to decarbonize heavy industries like steel, cement, and refineries.
4. **Grid Modernization:** Complete the **Green Energy Corridor** and implement "Smart Grids" that can automatically balance fluctuating renewable inputs..
5. **Incentivizing Domestic Manufacturing:** Use the **PLI (Production Linked Incentive) Scheme** to move beyond assembly and start manufacturing high-efficiency solar cells and electrolyzers in India.
6. **Agricultural Synergy:** Expand **PM-KUSUM** and **Agrivoltaics** to ensure energy production doesn't compete with food security for land use.

Conclusion

India must transition from **energy dependency to energy sovereignty** by integrating Green Hydrogen, SMRs, and DAC, ensuring a resilient, Net-Zero future that decouples economic growth from geopolitical oil shocks.

Q. *In light of rising geopolitical tensions affecting global oil supply, evaluate the role of sustainable energy in strengthening India's energy security.*

3.2. SCIENCE & TECHNOLOGY

3.2.1. SOVEREIGN AI: STRATEGIC AUTONOMY IN THE DIGITAL AGE

Context:

The concept of Sovereign AI gained significant momentum in the present time as a response to "Compute Colonialism"—where AI power is concentrated in the hands of a few Global North corporations.

What is Sovereign AI?

Sovereign AI refers to a nation's capacity to develop, deploy, and govern AI technologies using its own **indigenous infrastructure, data, and talent**, free from external dependencies.

The Four Pillars of the Sovereign Stack:

1. **Data Sovereignty:** Keeping Indian data within national borders and using it to train models that understand local nuances.
2. **Compute Sovereignty:** Hosting the "Compute Bank" (GPUs) locally to prevent "API Gatekeeping" by foreign entities.
3. **Algorithmic Sovereignty:** Developing foundational models (like LLMs) that reflect Indian culture and languages rather than "Western Hallucinations."
4. **Governance Sovereignty:** Ensuring AI ethics and regulations are rooted in Indian legal frameworks (e.g., **DPDP Act 2023**).

Why India Needs Sovereign AI?

1. **Strategic Autonomy (Ending "Digital Colonialism")**
   - **Geopolitical Resilience:** Reduces dependence on the "U.S. AI Stack" (OpenAI, Google) or "China AI Stack" (Baidu, Alibaba).
   - **Kill-Switch Protection:** Ensures critical services (defense, policing, and space) remain operational even if foreign entities throttle access or change geopolitical stances.
2. **Cultural & Linguistic Inclusion (The "Bhashini" Factor)**
   - **Vernacular Access:** Global models are trained primarily on Western data. India needs models like **Vachana** and **BharatGen** to understand the nuances of 22 scheduled languages and local dialects.
   - **Democratizing Tech:** Allows a farmer in rural India to access government advisories in their mother tongue without data leaving the country.
3. **Data Sovereignty & Security**
   - **Zero Data Egress:** Prevents sensitive national data (Aadhaar, UPI, Health records) from being processed on foreign servers, ensuring compliance with the **DPDP Act**.
   - **Shielding IP:** Protects Indian startups' intellectual property from becoming training fuel for foreign frontier models.
4. **Economic Multiplier**
   - **Retaining Value:** AI is expected to contribute nearly **$500 Billion** to India's GDP by 2025-26. Sovereign AI ensures this economic value stays within the domestic startup ecosystem.
   - **Cost Predictability:** Reduces reliance on expensive, "token-based" pricing from foreign giants, offering subsidized compute (like the **₹65/hour GPU access** under IndiaAI Mission).
5. **Population-Scale Governance**
   - **DPI Integration:** Seamlessly integrates AI with India's **Digital Public Infrastructure (Aadhaar, UPI, ONDC)** to improve service delivery in healthcare, agriculture, and education.
   - **Addressing Local Challenges:** Foreign models are "General Purpose"; India needs "Task-Specific" models for local problems like monsoon prediction or regional crop diseases.
6. **Ethical & Biased-Free AI**
   - **Removing Western "Accents":** Prevents the structural bias where Western legal or social norms are treated as the "default" (e.g., the legal interpretation of maritime laws in the EEZ).

- **Auditability:** Sovereign models allow the government to audit algorithms for fairness, transparency, and safety.

Challenges in Implementing Sovereign AI

1. **The "Compute" Deficit:** India faces critical **Hardware Dependency** on foreign GPUs (Nvidia H100s), leading to risks of "API Gatekeeping." Despite the 2026 expansion to ~58,000 units, a massive **Capacity Gap** remains compared to global tech giants.
2. **Data Quality & "Token Inequality":** India generates 20% of global data, but it remains **Fragmented and Siloed** in government records. A lack of annotated datasets for 22 scheduled languages creates **Token Inequality**, making AI more expensive and less accurate for non-English speakers.
3. **Western Hallucinations:** Most base models are trained on Western datasets, leading to **"Cultural Hallucinations"** where AI fails to grasp Indian social norms, caste nuances, or local traditions, resulting in biased outputs.
4. **Talent "Brain Drain" & Skill Gap:** While rich in software engineers, India suffers an **82% shortage** in "Deep-Tech" researchers. High-end talent is often lost to **Salary Arbitrage** from Silicon Valley, leaving a domestic research vacuum.
5. **Regulatory & Ethical Fault Lines:** The lack of a dedicated "AI Law" creates **Legal Fragmentation**. "Black Box" algorithms also raise concerns regarding **Algorithmic Bias** in critical welfare delivery systems like Direct Benefit Transfer (DBT).
6. **Financial & Sustainability Constraints:** Developing foundational models requires **"Patient Capital,"** which is scarce compared to low-risk consumer-tech funding. Additionally, the massive energy/water needs of AI data centers conflict with India's **Net Zero 2070** goals.

Key Government Initiatives for Sovereign AI

1. **IndiaAI Mission:** A ₹10,372 crore "Full-Stack" mission to build a domestic AI ecosystem. It includes a **subsidized GPU-as-a-Service** model (approx. ₹65/hour) to lower R&D costs for startups.
2. **IndiaAI Compute Pillar:** A strategic push to bridge the "Compute Gap" by onboarding **100,000 GPUs** by late 2026, ensuring high-speed domestic processing power for sovereign models.
3. **BharatGen & Bhashini:**
   - **BharatGen:** India's first state-funded multimodal LLM tailored for local social and cultural contexts.
   - **Bhashini:** A mission enabling real-time AI translation across **22 scheduled languages**, democratizing digital access.
4. **AIKosh (National Dataset Platform):** Known as the **"Data-Sagar,"** it hosts 9,500+ indigenous datasets to provide high-quality training fuel, reducing reliance on biased Western data "scrapes."
5. **IndiaAI Future Skills:** A talent-tiering program targeting **13,500+ specialists** (PhDs, PGs, UGs) and setting up **AI Data Labs** in Tier-2/3 cities for localized data curation and annotation.
6. **Sovereign Capacity Hubs:** Regional AI-optimized data centers (e.g., in **Odisha & Tamil Nadu**) providing specialized backbones for local industries like mining, safety, and regional language skilling.

Way Forward

- **Frugal Innovation (Small Language Models):** Shift focus toward **SLMs (Small Language Models)** that are task-specific (e.g., for agriculture or law). These require less "Compute" and energy.
- **Silicon-to-Software Integration:** Align the **India Semiconductor Mission (ISM)** with the AI Mission. Designing indigenous **AI Accelerators (ASICs)** will ensure India is not just writing the code, but also owning the hardware it runs on.
- **Incentivizing "Patient Capital":** Create a dedicated **AI Sovereign Fund** to provide long-term equity to deep-tech startups. This reduces the pressure on startups to seek foreign VC funding that often comes with data-sharing strings attached.
- **Global South Leadership:** Export the **"India AI Stack"** as a Digital Public Good (DPG) to other developing nations. By leading a "Global South AI Alliance," India can set international standards that challenge the U.S.-China bipolarity.
- **Sustainable AI (Green Compute):** Mandate the use of renewable energy for new AI Data Centers and invest in **"Circular Cooling"** technologies to ensure AI growth doesn't compromise India's Net Zero 2070 targets.

Conclusion

Sovereign AI is not just a technological upgrade; it is a **civilizational necessity**. As the world moves toward the "Fifth Industrial Revolution," India cannot afford to "outsource its cognition." By building its own AI stack, India ensures that its digital future is **inclusive, ethical, and truly 'Atmanirbhar'.**

Q. *"The rise of Artificial Intelligence has triggered debates on technological sovereignty." Discuss the need for a Sovereign AI ecosystem in India and the challenges in achieving it.*

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