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Expected EDITORIAL EXPLAINED

for

IAS Mains Examination

23rd to 28th Mar 2026

INDEX

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GENERAL STUDIES 2

1.1. POLITY & GOVERNANCE

1.1.1. JUDICIAL RECUSAL AND CONFLICT OF INTEREST

Context:

- The integrity of the Indian Judiciary is anchored in the principle of **impartiality**. Recently, **Chief Justice of India (CJI) Surya Kant** recused/stepped aside himself from hearing petitions challenging the **Chief Election Commissioner and Other Election Commissioners (Appointment, Conditions of Service and Term of Office) Act, 2023**.
- This legislation notably removed the CJI from the selection panel for appointing **Election Commissioners**, replacing the office with a **Union Cabinet Minister**. The CJI stepped aside citing a potential **conflict of interest**, directing that the case be heard by a bench excluding judges in the **line of succession** for the **office of the CJI**.
- This development has reignited a critical debate on judicial ethics, the **Doctrine of Necessity** and the urgent **need for a clear legal framework** on **judicial recusal** in India.

What is Judicial Recusal and Its Legal Foundations?

Judicial recusal simply means a judge removes himself or herself from a case to avoid any chance of bias. It comes from an ancient **rule of natural justice**: **nemo judex in causa sua** – **no one shall be a judge in their own cause.**

Indian courts have developed clear but flexible rules over time:

- In **Manak Lal v. Dr. Prem Chand (1957)**, the Court said that even a small financial interest is enough for automatic disqualification.
- In **Ranjit Thakur v. Union of India (1987)**, the Supreme Court moved to a practical test: there must be a **real likelihood of bias** or **reasonable apprehension of bias** in the mind of a fair person. A very small or imaginary fear is not enough.

Key point: The decision to recuse is left completely to the **judge's own conscience**. No lawyer or party can force a judge to step aside. India still has **no statute** that lists exact rules for recusal. In contrast, the United States has **Section 455 of Title 28**, which clearly says a judge must disqualify himself if his impartiality "**might reasonably be questioned**".

Key Precedents and the Doctrine of Necessity

- A significant tension exists between the ethics of recusal and the **Doctrine of Necessity**, which states that a judge must hear a case if no other competent forum is available, regardless of potential bias.

- The most relevant earlier case is the challenge to the **National Judicial Appointments Commission (NJAC) Act, 2014** in ***Supreme Court Advocates-on-Record Association v. Union of India*** **(2015).** A **five-judge Constitution Bench** heard the matter. Lawyers asked **Justice J.S. Khehar** to recuse because he would one day become **Chief Justice** and would have an interest in whether the **Collegium system** or the NJAC continued.

Justice Khehar refused to step aside. He gave **two strong reasons**:

1. Every judge on the bench faced the same possible conflict because all of them would be part of the Collegium if the petitioners won.
2. The **doctrine of necessity** applied. This doctrine says that when no other court of equal power exists, the judges must hear the case even if there is a technical conflict. Otherwise, justice would be denied.
    - He added that stepping aside would set a "**wrong precedent**". **Justice Kurian Joseph**, in his separate opinion, said that when a judge recuses, he or she should clearly explain the reasons as part of the constitutional duty of transparency under the oath of office.
    - In contrast, in the **present CEC case**, **two Chief Justices** have chosen to recuse even though the same logic of the NJAC case could have been used. This shows that the Court is treating the matter differently.

Critical Issues and Challenges in the Current Recusal

The recusal has raised several practical and constitutional questions:

- **Conflict that affects everyone**: Under the **seniority rule fixed by the Second Judges Case,** every Supreme Court judge can become Chief Justice one day. So the conflict is not personal to one judge but common to the entire institution.
- **Pre-emptive direction by the Chief Justice**: By ordering that future benches must exclude judges in the line of succession, the **Chief Justice** has decided the issue of bias for judges who have not even heard the case. Recusal is supposed to be an individual decision of conscience, not a command from the **Master of the Roster**.
- **Uncertain future**: The line of succession can change because of resignation, death or ill health. A judge who is told today that he or she is "**outside the line**" might still become Chief Justice tomorrow.
- **Master of the Roster power**: Even after recusing, the **Chief Justice** keeps the **power to choose** which bench will hear the case. This raises the same conflict-of-interest doubt that the recusal was meant to remove.
- **Lack of a clear law**: Unlike the **United States**, India has no statute that lists **objective grounds** for recusal. Everything depends on the personal sense of the judge.

Past examples illustrate the application:

- **Recusal occurred**: Justices Indira Banerjee and Aniruddha Bose recused from West Bengal-related cases in 2021 due to perceived links.

- **Recusal refused**: Justice M.R. Shah declined to recuse in the Sanjiv Bhatt case (2023), holding that public demand alone is insufficient. Justice Arun Mishra also refused recusal in a review of his own judgment.
- **Vague apprehension rejected**: In **State of Punjab v. Davinder Pal Singh Bhullar (2011)**, the Court ruled that mere suspicion or emotional distrust cannot justify recusal.

Impact on the Judiciary and Public Trust

The way recusal is handled has direct consequences for the health of a democracy:

- **Erosion of Institutional Authority:** Frequent or unexplained recusals can give the impression that the judiciary is avoiding "politically sensitive" cases.
- **Bench Hunting:** Without clear rules, lawyers might pressure certain judges to recuse themselves simply to get a bench they perceive as more favorable to their cause.
- **Transparency Deficit:** When oral remarks suggest bias but the written order is silent, it creates a gap in the public record, affecting the transparency of the judicial process.

Global Best Practices

Country	Mechanism
United States	**Section 455 of Title 28** provides a statutory standard requiring judges to disqualify themselves where their impartiality might be reasonably questioned.
United Kingdom	Uses the **"Fair-Minded and Informed Observer"** test; if such an observer perceives a real possibility of bias, recusal is mandatory.
Germany	Parties have a statutory right to challenge a judge for **"fear of bias,"** and the decision is often made by the rest of the bench, not the judge alone.

Way Forward: Strengthening the Judicial Recusal Framework

To strengthen the system, India needs the following practical steps:

- **Enact a Judicial Recusal Law or Guidelines**: Enact a short, clear **Judicial Recusal Act** or issue **binding guidelines** by the **Supreme Court** itself. The law should list **objective grounds** such as financial interest, family links and prior association, while keeping the "reasonable apprehension of bias" test.
- **Mandatory Recording of Reasons**: Make it compulsory for a judge to give **brief recorded reasons** for recusal or for refusing to recuse. This will increase **transparency** without forcing every reason into open court.
- **Application of Doctrine of Necessity**: Respect the **doctrine of necessity** in genuine institutional conflicts, but combine it with an **open acknowledgment** of the conflict so that the public understands the decision.
- **Internal Advisory Committee**: Consider creating a small **internal committee** of senior judges (not including the **Chief Justice** in that case) to give **non-binding advice** on recusal in sensitive matters.
- **Regular Ethics Training**: Train judges regularly on **ethics** and **conflict-of-interest** issues.

- **Separation of Powers in Roster**: Ensure that the **Master of the Roster** power is exercised only after the **recusal issue** is settled, so that the appearance of conflict is completely removed

Conclusion

The principle that **"Justice must not only be done but also be seen to be done"** remains the foundation of judicial legitimacy. While recent recusals show high **personal ethics**, they highlight a **structural vacuum** that requires moving beyond subjective **individual conscience**. Only a **principled, transparent framework** can protect the **Supreme Court's integrity** and ensure the long-term stability of India's **democratic processes**.

Q. *"Judicial recusal in India is guided more by personal discretion than institutional rules." Critically examine.*

1.1.2. FROM FREEDOM TO FORCE? THE DEBATE ON COMPULSORY VOTING

Context:

The announcement of Assembly elections (April–May 2026) and observations by the **Supreme Court of India** have revived the debate on compulsory voting. While low turnout remains a concern, the key issue is whether mandatory voting is constitutionally valid and practical.

As the world's largest democracy, India values free and fair elections with voluntary participation—posing a core dilemma between **greater participation and individual freedom**.

Constitutional and Legal Framework of Voting in India

Constitutional Basis

- **Article 326** provides for **universal adult suffrage**, ensuring that every citizen above 18 years has the right to vote.
- It prohibits discrimination based on religion, race, caste, sex, or place of birth.
- However, this right is **subject to conditions** such as non-disqualification (e.g., unsound mind, crime, corruption).

Statutory Provisions

- **Representation of the People Act, 1950 (Section 19):**
  - Requires a person to be 18+ and ordinarily resident in a constituency to be registered as a voter.
- **Representation of the People Act, 1951 (Section 62):**
  - Grants the right to vote to those listed in electoral rolls.

Nature of the Right to Vote

- The Supreme Court has consistently held that the **right to vote is a statutory right**, not a fundamental right.
- However, elements of voting—such as the right to know candidates and the right to NOTA—are linked to **freedom of expression under Article 19(1)(a)**.

Key Data

- **Rising but Incomplete Participation:** Turnout increased from **58.2% (2009) to 67.4% (2019)**, yet **30%+ voters still abstain**.
- **State vs National Gap: Assembly elections (70–80%)** see higher turnout than **Lok Sabha**, while **urban areas lag (50–60%)**.
- **Social Patterns: Rural turnout (65–80%) > Urban turnout**, highlighting urban apathy vs rural engagement.
- **Inclusion Trends: Women's turnout now matches/exceeds men**, but **youth participation remains inconsistent**.

Concept of Compulsory Voting and Global Pratice

Compulsory voting refers to a legal requirement for eligible citizens to participate in elections, often enforced through penalties.

- Countries like **Australia, Brazil, Argentina, and Peru** have compulsory voting.
- Enforcement mechanisms include:
  - Monetary fines (Australia, Brazil)
  - Denial of public services (Peru)

These countries generally report **higher voter turnout rates**.

Arguments in Favour of Compulsory Voting

Enhancing Democratic Participation

- Ensures **higher voter turnout**, strengthening the legitimacy of elected governments.
- Law Commission (255th Report, 2015) notes a **~7% increase** in turnout in countries with compulsory voting.

Reducing Electoral Distortions

- Prevents situations where candidates win with a **minority of total votes**.
- Promotes more representative outcomes.

Promoting Civic Responsibility

- Voting is seen as a **civic duty**, similar to paying taxes.
- Encourages political awareness and engagement.

Arguments Against Compulsory Voting

Violation of Fundamental Freedoms

- Compulsory voting may violate **freedom of expression under Article 19(1)(a)**.
- The right to vote includes the **right not to vote**.

Practical Challenges in India

India's scale and diversity pose serious constraints:

- **Population size**: Over 900 million voters.
- **Administrative burden**: Monitoring compliance is impractical.
- **Enforcement issues**: Identifying and penalizing non-voters would be complex.

Harsh and Inequitable Penalties

- Fines or denial of services may disproportionately affect:
  - Poor and marginalized communities
  - Migrant workers
- Could lead to **coercive democracy**, undermining voluntary participation.

Risk of Uninformed Voting

- Forced participation may result in:
  - Random or uninformed voting
  - Increase in invalid votes
- This may dilute the **quality of democratic decision-making**.

Views of Expert Committees

Dinesh Goswami Committee (1990)

- Rejected compulsory voting.
- Emphasized **voter awareness and facilitation** instead.

Law Commission of India (255th Report, 2015)

- Acknowledged increased turnout in compulsory voting countries.
- However, concluded that:
  - It is **neither feasible nor desirable in India**.
  - Coercion is not suitable for a democratic society.

Broader Democratic Perspective

Democracy thrives not just on participation, but on **voluntary, informed participation**.

- Compulsory voting shifts focus from **freedom to obligation**.
- True democratic maturity lies in:
  - Awareness
  - Engagement
  - Trust in institutions

India's democratic ethos is rooted in **choice, not coercion**.

Way Forward: Enhancing Voter Turnout Without Compulsion

A democratic approach to increasing voter turnout must focus on **enabling and motivating citizens**, rather than coercion. The emphasis should be on **behavioral change, institutional facilitation, and technological innovation**, making voting a conscious civic choice.

Strengthening Voter Awareness

- Expand **SVEEP** and use social media, influencers, and community outreach.
- Target **urban apathy** and **first-time voters** to build long-term participation habits.

Facilitating Migrant & Urban Voters

- Ensure **paid holiday on polling day**.
- Provide **special transport (buses/trains)**.
- Explore **flexible or multi-location voter registration**.

Leveraging Technology

- Develop **secure remote voting systems**.
- Explore **blockchain-based voting** with safeguards of **security, transparency, and political consensus**.

Enhancing Ease & Inclusivity

- Increase **polling booths** and accessibility.
- Expand **postal ballots** and introduce **early voting** for eligible groups.

Positive Incentives

- Use **recognition, civic rewards, and awareness campaigns** instead of penalties.
- Promote voting as a **national duty and civic pride**.

Strengthening Electoral Trust

- Address **malpractices and misinformation**.
- Ensure transparency in **EVM–VVPAT systems**.

Conclusion

Compulsory voting may raise turnout, but it poses serious constitutional, administrative, and ethical challenges in India, as noted by the Dinesh Goswami Committee and the Law Commission. The core issue is not enforcement, but inspiring citizens to participate. Democracy derives legitimacy from free, informed, and voluntary participation, not mere numbers. Thus, India must move **from compulsion to conviction**—strengthening democracy through awareness, accessibility, and trust.

Q. *Critically evaluate the feasibility and desirability of introducing compulsory voting in India in light of constitutional provisions and expert committee recommendations.*

1.2. SOCIAL JUSTICE

1.2.1. THE TRANSGENDER PERSONS AMENDMENT BILL, 2026: A CRITICAL ANALYSIS

Context:

- The **Transgender Persons (Protection of Rights) Amendment Bill, 2026**, recently passed by both Houses of Parliament, seeks to modify the 2019 framework governing the rights of gender-diverse individuals in India.
- While the government claims that the Bill seeks to **clarify ambiguities** and **improve implementation** of the 2019 Act, critics argue that it **deepens conceptual confusion**, **restricts rights**, and **ignores core structural crises** faced by transgender and intersex communities.

Background: Evolution of Transgender Rights in India

India has taken several progressive steps to recognise the rights of transgender persons. The following points summarise the key developments:

- **Landmark NALSA Judgment (2014)** In the case of **National Legal Services Authority (NALSA) v. Union of India (2014)**, the Supreme Court recognised **transgender persons** as the **"third gender"**.
  - It affirmed the **right to self-identification** of gender.
  - It directed the government to treat transgender persons as a **socially and educationally backward class**.
  - It called for **reservations** in education and public employment.
  - The judgment emphasised that **gender identity** is an intrinsic part of **personal dignity** and is protected under **Articles 14 (Equality)**, **15 (Non discrimination)**, **19 (Freedom of Expression)** and **21 (Right to Life and Dignity)** of the Indian Constitution.
- **Transgender Persons (Protection of Rights) Act, 2019:** The 2019 Act was enacted to implement the directions of the NALSA judgment. Key features include:
  - A **broad definition** of "**transgender person**" covering:
    - Persons whose gender does not match the sex assigned at birth.
    - **Trans-men** and **trans-women**.
    - Persons with **intersex variations**.
    - **Genderqueer** individuals.
    - Socio-cultural identities such as **kinner**, **hijra**, **aravani** and **jogta**.
  - Prohibition of **discrimination** in education, employment, health care and public services.
  - Provisions for **welfare measures**.
  - Establishment of the **National Council for Transgender Persons (NCTP)** and **State Welfare Boards**.
  - Penalties for offences against transgender persons.
- **Limitations of the 2019 Act**: Despite its progressive intent, the 2019 Act faced significant criticism for:
  - **Vague implementation** mechanisms.
  - **Lack of reliable data** on the actual number of transgender and intersex persons.
  - Failure to clearly **separate biological sex** from **gender identity**.

The **Transgender Persons (Protection of Rights) Amendment Bill, 2026**, was introduced to address these gaps. However, the changes it proposes have sparked fresh debate on whether the Bill truly advances rights or creates new barriers for the affected communities.

Key Provisions of the Transgender Persons (Protection of Rights) Amendment Bill, 2026

The **Transgender Persons (Protection of Rights) Amendment Bill, 2026**, introduces the following major changes:

- **Narrowed Definition**: The definition of **"transgender person"** is restricted to **specific socio-cultural identities** such as **kinner, hijra, aravani, jogta, eunuch**, or persons with **biologically-defined intersex variations**, or those **forcibly compelled** into such identity through **mutilation, castration, amputation**, or **any surgical, chemical or hormonal procedure.**
    - It explicitly **excludes** persons with different **sexual orientations** and **non-heteronormative gender-fluid identities**.
- **Removal of Self-Identification**: The right to **self-perceived gender identity** under Section 4(2) of the 2019 Act has been removed.
- **Medical Board Certification:** The simple **District Magistrate** process is replaced by a **medical board** headed by the **Chief Medical Officer**. The **District Magistrate** issues the certificate only after the board's recommendation.
- **Mandatory Reporting** All hospitals must report every **transgender-related surgery** to the District Magistrate and the concerned authority.
- **Stricter Penalties:** Rigorous imprisonment of **5 to 14 years** (**along with fine**) is prescribed for forcing adults or children into **"transgender presentation"** along with begging or servitude.
- **Unchanged Institutional Structure:** The **National Council for Transgender Persons** and **State Welfare Boards** retain their original names and structure.

Significance of the Transgender Persons (Protection of Rights) Amendment Bill, 2026

The **Transgender Persons (Protection of Rights) Amendment Bill, 2026** seeks to address implementation gaps while strengthening constitutional safeguards. Its key significance lies in:

- **Greater Administrative Clarity:** By **narrowing definitions**, it reduces ambiguity and enables **more targeted delivery of welfare schemes**.
- **Stronger Measures Against Exploitation:** Introduces **stricter penalties (5–14 years)** to curb **forced begging, trafficking, and servitude**, protecting vulnerable individuals.
- **Improved Data and Policy Planning:** Medical certification and reporting mechanisms aim to generate **reliable data**, supporting **evidence-based policymaking**.
- **Alignment with Constitutional Principles:** Reflects an effort to balance **welfare and regulation** while promoting **equality and non-discrimination (Articles 14, 15, 21)**.

Critical Issues and Systemic Flaws in the Bill

Despite its stated objectives, the Bill faces strong criticism on multiple grounds. The main concerns are highlighted below:

1. **Deepening Conflation of Sex and Gender**
    - The Bill continues to include **persons with intersex variations** under the "transgender person" category.
    - **Intersex** is a **biological spectrum** (affecting 1-2% globally), while **transgender identity** is a **psychological and social construct**.
    - It incorrectly refers to **male and female** as "gender identity" (they are **sex identities**).

- Failure to separate **biological sex** and **gender identity** in official documents creates new administrative and legal problems.

2. **Erosion of Self-Determination**
   - Removal of the **right to self-perceived gender identity** shifts the framework from self-determination to **medical gatekeeping**.
   - This contradicts the spirit of the **NALSA judgment** and raises concerns under **Article 21** (bodily integrity and privacy).
3. **Neglect of Intersex-Specific Needs**
   - No explicit **ban** on non-consensual "normalising" surgeries on intersex infants.
   - Absence of mandatory **genetic counselling** by medical geneticists.
   - No requirement for **India-specific longitudinal studies** on long-term effects of gender-affirming surgeries and hormone therapies.
   - Inadequate **privacy safeguards** for mandatory surgery reporting.
4. **Legitimisation of Exploitative Structures**
   - New penalties target only **external perpetrators** but leave the **colonial-era hijra jamath-gharana system** largely untouched.
   - Internal hierarchies continue to trap **gender non-conforming children** in bonded labour, begging and prostitution.
   - Lack of dedicated policies for **rehabilitation**, education and protection of minors within these systems.
5. **Absence of Intersectionality and Civil Rights**
   - No **intersectional lens** for caste, disability, poverty or religion.
   - Transgender persons from **Scheduled Caste/Scheduled Tribe** or disabled backgrounds face compounded discrimination without targeted remedies.
   - Complete silence on **civil and family rights** — marriage, adoption, inheritance, divorce and succession.
6. **Contradiction with International Standards**
   - The Bill conflicts with **UN** and **WHO** definitions that treat **intersex** as distinct variations requiring separate protections.
   - It ignores calls to rebrand welfare bodies as **National GIESC Welfare Council** (Gender Identity/Expression and Sex Characteristics).
   - This undermines India's commitments under the **UN CRPD** (**Convention on the Rights of Persons with Disabilities**).

Strategic Way Forward for an Inclusive and Rights-Based Framework

To overcome the limitations and create a more effective and inclusive framework, the following measures are recommended:

- **Adopting the GIESC Framework:** India should move toward the **Gender Identity, Expression, and Sex Characteristics (GIESC)** model. This separates biological traits from gender expression, ensuring both groups receive specific, relevant protections.
- **Banning Non-Consensual Surgeries:** Legislation must explicitly prohibit sex-selective surgeries on infants unless they are life-saving, upholding the right to **bodily integrity** under Article 21.
- **Decentralizing Identification:** Identity should be based on self-declaration (as per the NALSA judgment) rather than clinical "**certification**" by medical boards, which can be humiliating and exclusionary.
- **Inclusive Social Security:** The government must conduct evidence-based research to provide reservations in education and employment, alongside civil rights like marriage and adoption.
- **Rehabilitation of Minors:** Instead of just criminalizing begging, the state must create a robust framework for the protection and education of gender-non-conforming children who have been abandoned by their families.

Conclusion

A truly effective framework must be rights-based, scientifically grounded, and centred on dignity, autonomy, and constitutional equality. Only by addressing these structural gaps can the law move beyond superficial reform and ensure genuine empowerment of transgender and intersex persons in India.

Q. *The Transgender Persons (Protection of Rights) Amendment Bill, 2026 attempts administrative clarity but risks deepening structural inequalities. Critically analyse. 15 Marks*

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2.1. ECONOMY

2.1.1. INDIA'S UPDATED NATIONALLY DETERMINED CONTRIBUTIONS (NDC) 2035

Context:

- India recently submitted its updated **Nationally Determined Contributions (NDCs)** under the **Paris Agreement,** marking a measured enhancement of its climate ambition for the 2031-2035 period.
- While the revised targets strengthen commitments on **non-fossil capacity**, **emission intensity reduction**, and **carbon sinks**, concerns remain regarding the persistent gap between installed capacity and actual clean energy generation, primarily due to inadequate **battery storage** and grid limitations.

Global Climate Framework and India's Position

- **Paris Agreement:** The **Paris Agreement**, adopted at **COP21 in 2015** and effective from 2016, seeks to limit global temperature rise to **well below 2°C** above pre-industrial levels, with efforts to restrict it to **1.5°C**.
    - It adopts a bottom-up approach through **Nationally Determined Contributions (NDCs)**, allowing countries to set their own targets while mandating periodic updates every five years with **progressive enhancement of ambition**.
- In this context, most countries submitted their **2035 NDCs** on time. **India and Argentina** were among the **last G20 nations** to do so. India had committed at **COP30 in Brazil (November 2025)** to update its NDCs by year-end, and the submission was finalised just before the close of **FY 2025-26**.

Evolution of India's Climate Commitments

India's NDCs have evolved with increasing ambition while respecting the principle of **common but differentiated responsibilities and respective capabilities (CBDR-RC)**:

- **First NDC (2015)**: Targeted a **33–35% reduction** in emission intensity of GDP by 2030 from 2005 levels and **40% non-fossil capacity** by 2030 (conditional on international support).
- **Updated NDC (2022)**: Raised the targets to **45% emission intensity reduction** and **50% non-fossil capacity** by 2030, while introducing the **LiFE (Lifestyle for Environment)** initiative.
- **Achievements**: India has already surpassed both 2030 targets — achieving a **36% intensity reduction** (2005–2020) and over **52.57% non-fossil capacity** (approximately 272 GW) as of February 2026.

Salient Features of the Updated NDCs (2035 Targets)

The revised NDCs reflect a calibrated enhancement across three core pillars:

- **Non-fossil fuel share in installed electric capacity** — Raised to **60% by 2035** (from the earlier 50% target by 2030).
- **Emission intensity of GDP** — Strengthened to a **47% reduction by 2035 from 2005 levels** (building on the previous 45% target by 2030).
- **Carbon sink creation** — Increased to **3.5–4.0 billion tonnes of CO_2 equivalent by 2035** through afforestation and forest cover (up from 2.5–3.0 billion tonnes by 2030 and 2.29 billion tonnes already achieved by 2021).

These quantitative targets are complemented by **qualitative measures**, including the **LiFE initiative**, **climate-resilient infrastructure**, and **mobilisation of climate finance and technology transfer**. As a developing country, India prioritises **emission intensity reduction** and **non-fossil capacity expansion** rather than absolute emission cuts, unlike the **EU**'s commitment to **40–49% absolute reductions** below 2005 levels.

Core Challenges in India's Energy Transition

1. **Technical Barriers**

   The shift to **60% non-fossil capacity** requires a complete redesign of the national power system.

   - **Grid Intermittency:** Solar power peaks at noon, but demand peaks in the evening. This mismatch causes **Grid Instability** and leads to **curtailment** (wasting green energy) to prevent grid collapse.
   - **Transmission Bottlenecks:** Renewable-rich zones (like **Rajasthan**) are far from industrial hubs. Building **Green Energy Corridors** faces massive investment needs and **"Right of Way" (RoW)** legal hurdles.
   - **Land Acquisition:** Solar/wind projects are "**land-hungry**," often overlapping with **fragile ecosystems** (e.g., **Great Indian Bustard habitats**) or fertile farmland, triggering local resistance and food security concerns.

2. **Economic Hurdles**

   The financial viability of the transition is hindered by the high cost of energy storage.

   - **High CAPEX of BESS:** While solar costs have dropped, the **Capital Expenditure** for battery systems remains high, making green power more expensive than coal during non-solar hours.
   - **Critical Mineral Vulnerability:** India lacks reserves of **Lithium, Cobalt, and Nickel**. Relying on imports (mostly from China) replaces oil dependency with a new **mineral dependency**, prone to global price volatility.
   - **DISCOM Financial Stress:** Deeply indebted State Power Distribution Companies struggle to pay producers on time, discouraging private investment in expensive storage technologies.

3. **Social Dimensions**

   Decarbonization must not leave the **13 million people** dependent on India's "Coal Belt" behind.

   - **Livelihood Displacement:** A sudden shift away from coal without a safety net could lead to **economic depression** in states like Jharkhand and Odisha.

- **The Re-skilling Gap:** Coal mining skills are not easily transferable to renewable energy jobs. There is an urgent need for **vocational training** and alternative industrial development.
- **Revenue Loss:** Eastern states rely heavily on **coal royalties**. The transition requires a new fiscal framework to compensate for declining state revenues.

4. **Strategic Risks**

Global instability highlights the need for a self-reliant energy ecosystem.

- **Weaponization of Energy:** Global conflicts demonstrate the **"chokehold"** fossil fuel exporters have on the economy, forcing India to spend foreign exchange on imports instead of green infrastructure.
- **Supply Chain Monopolies:** The concentration of solar and battery supply chains makes India vulnerable to **geopolitical tensions** and trade barriers.
- **The Finance Gap:** The failure of developed nations to meet the **$100 billion climate finance goal** leaves the financial burden of the transition largely on India's domestic taxpayers.

Capacity versus Actual Generation-Core Issue

India has achieved remarkable success in capacity addition, meeting the **2030 non-fossil target of 50%** five years ahead of schedule. However, a structural mismatch persists. **Non-fossil sources** account for over **52% of installed capacity** but contribute only about **25% of actual electricity generation**.

This gap arises mainly from:

- The **intermittent nature** of solar and wind power.
- **Inadequate battery storage**, leading to curtailment of surplus renewable energy.
- **Grid infrastructure constraints** that limit seamless integration.

Consequently, **coal-based power** continues to **dominate during peak demand** and **non-solar hours**. Without addressing this gap, the enhanced NDC targets risk being viewed as "**tepid promises**" despite being described as easily achievable by the government.

Strategic Imperative of Battery Storage and Grid Modernisation

Battery Energy Storage Systems (BESS) and **pumped hydro storage** are critical for bridging the **capacity-generation divide**. Long-duration storage is essential to shift daytime solar generation to evening peak demand.

- The **Central Electricity Authority** estimates a requirement of **411.4 GWh** by 2031-32 (236.2 GWh BESS and 175.2 GWh PSP). Modernising the grid through **green energy corridors**, advanced forecasting, and demand-side management will reduce reliance on **fossil fuel backup** and enhance system reliability.

Key Government Initiatives for Renewable Integration and Storage

The Government of India has introduced a comprehensive set of policy measures to bridge the generation gap and support storage deployment:

1. **Viability Gap Funding (VGF) for BESS**
   - Financial support to make Battery Energy Storage Systems (BESS) viable
   - ₹3,760 crore for 13.2 GWh + ₹5,400 crore for 30 GWh
   - Up to 40% capital subsidy via Power System Development Fund
   - Aims to reduce cost barriers and accelerate storage deployment
2. **Production-Linked Incentive (PLI) for Advanced Chemistry Cells**
   - Targets **50 GWh domestic manufacturing capacity**
   - Promotes self-reliance in battery supply chain
   - Reduces dependence on imports (China-dominated market)
   - Supports grid-scale and EV battery ecosystem
3. **Energy Storage Obligation (ESO)**
   - Mandates DISCOMs to procure a share of power from storage
   - Gradually increasing targets ensure demand for storage market
   - Drives long-term investment in BESS and PSP
4. **Co-location Advisory for Renewables + Storage**
   - Requires integration of **minimum 2-hour storage** with new RE projects
   - Improves grid stability and reduces intermittency
   - Promotes **Round-the-Clock (RTC) renewable power**
5. **Green Energy Corridors (GEC)**
   - Dedicated transmission infrastructure for renewable energy
   - Enables transfer from RE-rich regions (Rajasthan, Gujarat) to demand centres
   - Includes **waiver of inter-state transmission charges**
6. **National Green Hydrogen Mission**
   - Promotes hydrogen as **long-duration energy storage**
   - Supports decarbonisation of industry (steel, fertilisers)
   - Enhances energy security
7. **PM-KUSUM & Decentralised Renewable Energy**
   - Promotes solar pumps and decentralised solar plants
   - Reduces grid burden and transmission losses
   - Supports rural energy transition
8. **National Solar Mission**
   - Flagship programme to scale solar energy capacity
   - Encourages large-scale solar parks and rooftop solar
   - Backbone of India's non-fossil capacity growth

Way Forward: Moving from Promises to Performance

To translate the updated NDC targets into tangible climate and energy outcomes, India must adopt a focused **multi-pronged strategy** that bridges the **critical gap** between **installed capacity and actual generation.** The following priorities are essential:

- **Accelerate Battery Storage Deployment**: Fast-track **Viability Gap Funding (VGF)** tenders, introduce incentives for **long-duration storage**, and promote large-scale **hybrid renewable-plus-storage** projects to address the intermittency of solar and wind power.
- **Mandate Round-the-Clock (RTC) Renewables**: Shift future tenders from standalone solar/wind projects to **bundled hybrid models** with mandatory battery storage or pumped hydro to ensure reliable, dispatchable green power supply.
- **Modernise Grid Infrastructure**: Invest in **smart grids**, **AI-based forecasting**, and **demand-side management** systems for seamless integration and real-time balancing of variable renewable energy.
- **Enhance Financing and Innovation**: Mobilise concessional international **climate finance**, strengthen indigenous **R&D** in battery technologies, streamline **regulatory clearances**, and secure **critical minerals** (lithium, cobalt, nickel) through global partnerships and domestic recycling.
- **Scale Up Long-Duration Storage**: Fast-track **Pumped Storage Projects (PSP)** and **green hydrogen** initiatives alongside batteries to meet industrial-scale and seasonal energy storage needs.
- **Strengthen Governance and Monitoring**: Establish robust **Measurement, Reporting, and Verification (MRV)** mechanisms with effective inter-ministerial coordination.
- **Ensure Inclusive and Just Transition**: Create a **National Transition Fund** to re-skill coal workers, link afforestation with rural livelihoods, promote **green jobs**, and implement **Time-of-Day (ToD) tariffs** to improve the **financial health** of **DISCOMs** while balancing load.

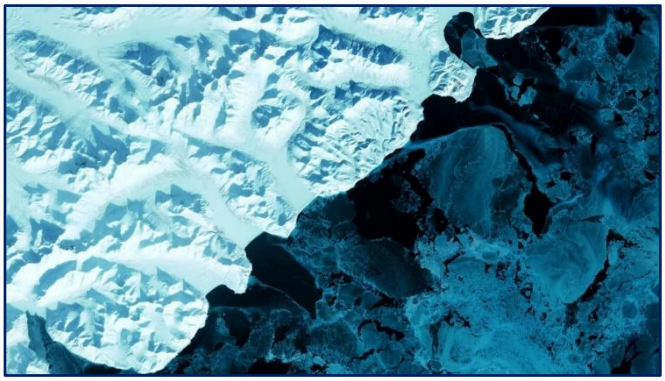
Conclusion

India's updated NDCs for 2035 reflect a **credible and development-sensitive enhancement of climate ambition**, but their success hinges on bridging the **capacity–generation gap**. Without rapid scaling of **battery storage, grid modernisation, and financial viability**, the targets risk remaining **capacity-centric rather than outcome-oriented**. Thus, India's climate leadership will ultimately depend on its ability to transition from **installed potential to reliable, dispatchable clean energy generation**.

Q. *"India's updated Nationally Determined Contributions (NDCs) for 2035 highlight a gap between installed renewable capacity and actual energy generation." Examine the reasons for this gap and suggest measures to address it. 15 Marks*

2.2. ENVIRONMENT

2.2.1. UNDERSTANDING THE CREDIBILITY OF CLIMATE SCIENCE



Context:

- Climate science has been established on the foundation of **systematic observations, physical laws and independent verification**.
- Recent claims questioning the reality of global warming particularly regarding **ocean heat content** and **Earth's energy imbalance (EEI)** have necessitated a closer examination of how scientific credibility is ensured.
- It is demonstrated that climate science derives its strength not from isolated datasets, but from **convergence across multiple independent methods**, thereby ensuring **accuracy, reliability, and policy relevance**.

Background

Climate change refers to long-term shifts in temperature, precipitation, and other atmospheric conditions, primarily driven by **increased greenhouse gas concentrations** from human activities. The **Intergovernmental Panel on Climate Change (IPCC)**, established in **1988** by the **World Meteorological Organisation** and **UNEP**, synthesises global evidence in its **Assessment Reports** (**AR6 being the latest key milestone**).

- **IPCC AR6 Findings:**
  - **>90% of excess heat** is absorbed by oceans.
  - **Recent observations confirm acceleration**: **ocean heat content** reached record highs in 2025, with the **rate of warming** more than doubling since 2005 compared to earlier decades. These facts support international frameworks such as the **Paris Agreement** and inform **India's climate policy** under **Nationally Determined Contributions**.
  - **Earth's Energy Imbalance (EEI)** (difference between **incoming solar radiation** and **outgoing terrestrial radiation**) **increased** from ~0.57 W/m² (1971–2018) to ~0.79 W/m² (2006–2018).
  - **Global temperature rise ≈ 1.1°C** above pre-industrial levels.

Key Scientific Concepts

- **Temperature (Intensive Property):** Independent of mass.
- **Thermal Energy (Extensive Property):** Depends on **mass + temperature**, used to measure **heat content**.

Core Issues Raised and Scientific Clarifications

Recent scrutiny has focused on three specific assertions regarding data handling. Each has been evaluated against established scientific practices, revealing that standard methods already incorporate and resolve the raised concerns.

1. **Claim on Temperature and Heat Measurement**

   Temperature measures **average kinetic energy** per molecule and does not depend on the mass of the material, making it an **intensive property**. Critics argue this prevents meaningful averaging for total ocean heat.

   - However, scientists calculate **thermal energy** (**an extensive quantity**) as the **product of temperature, mass, and specific heat capacity**. This **total kinetic energy** content rises measurably over time, confirming warming.
   - The same logic applies consistently to other metrics such as **average air temperature, atmospheric pressure or sea-level rise** without invalidating them. This distinction clarifies why direct temperature averages, when combined with volume and density data, yield reliable heat-content estimates.

2. **Uncertainties in Argo Floats Data and Ocean Monitoring**

   The **Argo programme** deploys thousands of **free-drifting profiling floats** that measure **temperature and salinity** up to **2,000 metres** depth across the global ocean. Concerns highlight data gaps leading to underreported uncertainties, including mesoscale aliasing and limited deep-ocean coverage.

   Oceanographers address these through:

   - Multiple independent calculation methods that produce consistent results.
   - Validation against known measurement sites and sensitivity tests (removing subsets of data).
   - **Cross-comparison with independent satellite systems**:
     - **Altimetry satellites** measure total sea-level rise.
     - **GRACE satellites** track added water mass via gravity changes.
     - The residual "steric" expansion (due to heat) matches Argo-derived heat content exactly.

   This multi-method convergence demonstrates that uncertainties are neither ignored nor overstated; instead, they are quantified and minimised through rigorous robustness checks.

3. **Claim on Circularity in CERES-Argo Cross-Calibration**

   CERES (**Clouds and the Earth's Radiant Energy System**), operated by NASA, consists of satellite instruments that measure **incoming solar radiation and outgoing shortwave (visible light)** and **longwave (heat) radiation** at the top of the atmosphere. Subtracting outgoing from incoming radiation gives the **net energy flux and thus Earth's energy imbalance**.

   - CERES instruments achieve accuracy of **about 1% for shortwave** and **0.75% for longwave radiation,** implying an absolute uncertainty of roughly **2 W/m² in net flux**.
   - The **EBAF** (**Energy Balanced and Filled**) product adjusts fluxes so the **global mean net flux (July 2005–June 2015)** aligns with **Argo's estimate of 0.71 W/m².**

     Critics label this "**circular**" because Argo informs calibration while CERES validates heat content. In reality:

   - **Balancing** applies a constant offset to the long-term mean only.
   - **Filling** separately patches data gaps caused by clouds.

- The warming **trend** derives from raw monthly differences in CERES data, which the constant adjustment does not alter.

For example, if EBAF adds **3.6 W/m² uniformly**, the difference between any two months **(e.g., 4 vs. 5 W/m² raw becomes 7.6 vs. 8.6 W/m² adjusted)** remains exactly **1 W/m².** Thus, evidence of an increasing energy imbalance comes from raw instrument readings, independent of Argo.

Additional Independent Lines of Evidence

Scientists estimate **Earth's energy imbalance** through several other approaches that align with **CERES-Argo** results:

- **Atmospheric reanalyses**.
- **Deep-ocean temperature** records from research vessels.
- **Physical climate models** informed by observed surface warming.

If the **imbalance** were zero, all these independent systems would need to be wrong for unrelated reasons — a highly improbable scenario. Credible studies perform such independent tests and falsification checks, which the recent paper did not adequately address.

Implications for Global and Indian Policy Frameworks

The credibility of climate science rests on **convergence of evidence** rather than any single dataset or journal prestige. This foundation supports evidence-based policymaking under the **United Nations Framework Convention on Climate Change**, the **Kyoto Protocol**, and the **Paris Agreement**.

For India, a highly vulnerable country with a long coastline and monsoon-dependent agriculture, reliable data justify:

- **Adaptation measures** such as coastal regulation and heat action plans.
- **Mitigation** through renewable energy targets (**500 GW non-fossil capacity by 2030**).
- Claims for **climate finance and loss-and-damage support** in global negotiations, guided by the principle of **common but differentiated responsibilities**.

Delaying action due to unresolved doubts risks exacerbating impacts on food security, biodiversity, and sustainable development goals.

Way Forward: Strengthening Credibility and Climate Action

1. **Strengthening Observation Systems**
   - Expand **Argo network to deeper oceans (below 2000 m)**
   - Ensure **continuity of satellite missions (CERES, GRACE)**
   - Reduce **data gaps and uncertainties**
2. **Promoting Data Transparency and Accessibility**
   - Ensure **open-access climate datasets**
   - Encourage **independent verification by global researchers**
   - Build **public trust through transparency**

3. **Enhancing Scientific Rigor and Peer Review**
    - Strengthen **peer-review mechanisms**
    - Encourage **replication studies and falsification tests**
    - Discourage **selective or biased interpretation of uncertainties**
4. **Improving Climate Literacy and Scientific Temper**
    - Integrate **climate science in education and UPSC curriculum**
    - Promote **evidence-based reasoning in public discourse**
    - Counter **misinformation with scientific clarity**
5. **Integrating Science into Governance**
    - Mainstream climate data into:
    - **Disaster management (NDMA frameworks)**
    - **Urban planning and coastal regulation**
    - Use **scientific evidence for policy formulation**
6. **Strengthening Global Cooperation**
    - Support **IPCC-led synthesis of evidence**
    - Promote **multilateral collaboration in climate research**
    - Align national policies with **global climate goals**

Conclusion

The credibility of climate science does not depend on silencing dissent but on the **requirement of independent proof**. For any new theory to "overturn" current climate science, it must not only point out a minor uncertainty but also explain why multiple independent systems—satellites, ocean floats, ice cores, and physical models—all show a consistent warming trend.

Q. *Uncertainty is inherent in climate science, but it does not undermine its conclusions. Discuss how scientific methods address uncertainties in climate data.*

2.2.2. THE MUSI RIVERFRONT TRANSFORMATION AND THE HUMAN COST

Context:

The **Musi Riverfront Development Project (MRDP)** has been launched by the Telangana government to transform Hyderabad's historic river into a modern urban hub. While the project aims for **ecological restoration** and economic growth, it has sparked intense protests from residents facing **displacement**. The balance between urban renewal and the rights of long-term inhabitants remains a critical point of contention.

About Musi River: Geography and Significance

Historically known as the **Muchukunda** or **Musunuru River**, the **Musi** is a **primary tributary** of the **Krishna River** within the **Deccan Plateau**.

- **Origin and Formation:** The river originates in the **Anantagiri Hills** of the Vikarabad District. It is formed by the merging of **two smaller rivulets**: the **Esi** (8 km) and the **Musa** (13 km).
- **Course and City Layout:** It flows eastward, cutting through the heart of **Hyderabad**. Historically, the river served as the dividing line between the **Old City** and the **New City**. After exiting the urban landscape, it travels through the southern Telangana plains.
- **End Point:** The river completes its **240-kilometer** journey by joining the **Krishna River** near **Wazirabad** in the Nalgonda district.
- **Infrastructure and Reservoirs:** Two major dams, **Osman Sagar** and **Himayat Sagar**, were constructed over the river to control floods and provide water. Additionally, **Hussain Sagar Lake**, a **24-kilometer water body**, was built on a **Musi tributary** to meet the city's irrigation and drinking needs.
- **Historical and Agricultural Significance:** The banks are lined with **Qutb Shahi and Nizam-era** architecture, including historic mosques and bridges. For agriculture, the river features **24 diversion weirs** known locally as ***kathwas***.
- **Current Ecological Crisis:** Due to unplanned urbanization, the river has transformed into a receptacle for **unprocessed domestic and industrial waste** from Hyderabad.

What is the Musi Riverfront Development Project (MRDP)?

The project aims to develop the entire 55-km river course inside Hyderabad in **five phases**. The stated objectives are:

- **Flood mitigation**
- Creation of an **accessible riverfront**
- A **connected city**
- **Sustainable development**
- Promotion of **heritage tourism**

In **Phase I**, **11.2 km** of the Moosa and 9.8 km of the Esi will be covered up to their confluence. A **Gandhi Sarovar Project** is planned on 200 acres, featuring a 123-feet statue of Mahatma Gandhi, a cultural centre, and a museum. The phase is estimated to cost ₹6,500–7,000 crore (excluding land acquisition).

Other features include:

- An **East-West road corridor** on Build-Operate-Transfer model with tolls
- Promenades, bridges, viewpoints, walkways, and greenery
- Sewage treatment plants with nearly 3,000 million litres per day capacity
- Nature-based solutions such as wetlands, sedimentation basins, and vegetated swales

The government plans to divert **2.5 tmcft** of water from **Mallanna Sagar** on the Godavari to make the Musi flow year-round. Over 10,000 properties across 3,279 acres are expected to be acquired for the full project.

Key Challenges Faced by the Musi Riverfront Development Project

The project faces a "toxic cocktail" of social, legal, and environmental hurdles:

- **Displacement & The Human Cost:** Over **10,000 properties** are targeted for acquisition. Residents, including **senior citizens and defence personnel**, face the loss of their homes and secular communities. The government's claim that properties in the **buffer zone** have "zero value" has caused financial panic and emotional trauma.
- **Ecological Scepticism:** Experts argue that **90% of the river's flow** is industrial waste. Beautification is seen as superficial unless the **pollution is stopped at the source**. Dredging tonnes of **toxic sludge** without a clear treatment plan poses a secondary environmental risk.
- **Transparency & Legal Gaps:** The **Social Impact Assessment (SIA)** has been bypassed through legal exemptions. The lack of a public **Detailed Project Report (DPR)** and the cancellation of **Gram Sabhas** have led to a breakdown of trust.
- **Real Estate & Political Motives:** Critics allege the project is a **pretext for land grabbing**. Concerns exist that by diverting Godavari water to the Musi, the government may scrap protective orders (like the 1996 catchment order) to open up land for **private real estate**.
- **Compensation Uncertainty:** The use of **Transferable Development Rights (TDRs)** is criticized as impractical for middle-class families who have existing **bank loans** and need immediate, physical housing.
- **Hydrological Risks:** Some residents argue that the technical definition of "buffer zones" is being applied inconsistently, noting that water has not reached their walls in decades, questioning the **floodplain zoning** accuracy.

Holistic Way Forward for Sustainable River Basin Management

For the **Musi Riverfront Development Project** to succeed without violating human rights or ecological principles, the following pillars are required:

- **Prioritize Upstream Remediation:** Before building promenades, the government must strictly enforce **Zero Liquid Discharge (ZLD)** on industries to stop chemical waste from entering the **Moosa and Esi** rivulets.
- **Basin-Wide Restoration:** Restoration must involve **replanting riparian vegetation** and reviving the **traditional tank systems** in the 40 villages of the catchment area to naturally recharge groundwater.
- **Humane Resettlement:** A **legally binding compensation framework** must be published. This should include "land-for-land" options or market-value cash payouts, ensuring no resident is left with **unpaid bank loans** or homelessness.
- **Democratic Engagement:** The **Detailed Project Report (DPR)** must be made public. Genuine **public hearings** should be conducted to make residents **partners in development** rather than victims of it.

- **Nature-Based Solutions (NbS):** Instead of heavy concrete engineering, the project should utilize **floating wetlands**, sedimentation basins, and vegetated swales to allow the river to breathe and self-purify.
- **Independent Audit & Monitoring:** An **independent committee** comprising environmentalists, urban planners, and citizen representatives should be formed to monitor the project's progress and ensure **transparency in fund utilization** and environmental impact.

Conclusion

The **Musi Riverfront Development Project** is a test of the government's ability to balance **modernization with empathy**. While the ecological revival of the Musi is a noble goal, the current approach risks creating a **humanitarian crisis**. A successful transformation requires the state to prioritize the **rights of its people** and the **health of the river basin** over commercial real estate gain.

Q. *Riverfront development projects aimed at rejuvenating polluted rivers often combine ecological restoration with economic objectives. In this context, critically examine the challenges in restoring rivers like the Musi and also suggest a approach for sustainable river basin management. 15 Marks*

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