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India navigated West Asia crisis efficiently, says Modi

Fuel rationing, LPG disruptions, and price surges avoided with refineries upping production and public OMCs bearing the losses, says PM; politically motivated rumour-mongering failed, he adds

Saptaparno Ghosh
NEW DELHI

India successfully weathered the challenges triggered by the West Asia conflict through effective assessment and strategic, timely decision-making while efficiently using its domestic resources and strong diplomatic ties, Prime Minister Narendra Modi said on Saturday.

The country avoided fuel rationing, ensured cooking gas supplies, and shielded consumers and farmers from global price spikes, with state-run oil marketing firms (OMCs) bearing the losses, he said, adding that certain politically motivated entities which had engaged in rumour-mongering during the crisis had failed and "may be dwelling in an abyss of disappointment".

'Effective strategies'

"India took potent decisions, made correct evaluations, charted effective strategies, used its domestic resources effectively and constructively leveraged its diplomatic power to successfully weather the challenges," Mr. Modi said.

Speaking at the inauguration of the HPCL Rajasthan Refinery Ltd. (HRRL) in Balotra, the country's first greenfield integrated



Crucial sector: PM Narendra Modi during the inauguration of the HRRL petrochemical complex in Balotra, Rajasthan, on Saturday. PTI

refinery-petrochemical complex, Mr. Modi credited domestic refineries for helping the country wade through the crisis by upping their production of liquefied petroleum gas (LPG). India is currently the world's fourth-largest refiner and would continue expanding its refining capacity, Mr. Modi said.

"India has consistently increased its refining capacity and has emerged as the world's fourth-largest refiner... However, we will not stop here, and will continue to increase capacity in the coming years," he added.

The Prime Minister insisted that there had not been any major supply disruptions during the crisis, even in remote areas, barring certain minor hurdles. He pointed out that India had not adopted any ra-

tioning measures for petrol and diesel, unlike certain other countries.

With regard to cooking gas, Mr. Modi told the gathering that prices of domestic LPG – which could have gone up to ₹2,000 per cylinder – were shielded and restricted to less than ₹950 per cylinder and ₹650 per cylinder for Ujjwala beneficiaries.

India also continued to provide urea for ₹300 per bag, though the fertilizer could have been priced at ₹3,000 per bag if it had followed the global price surge after the Russia-Ukraine conflict.

While customers were thus protected, state-owned oil marketing companies absorbed losses of about ₹75,000 crore in the June-end quarter, the Prime Minister said. "This is equivalent to the cost of

Modi inaugurates semiconductor facility in Gujarat

AHMEDABAD

Prime Minister Narendra Modi inaugurated the CG Semi Outsourced Semiconductor Assembly and Test facility at Sarand in Gujarat on Saturday. Semiconductor clusters are coming up across India and these will create large-scale employment, he said. » PAGE 5

building one refinery," he noted.

'Delayed completion'

Mr. Modi accused the previous Congress government of Rajasthan of delaying the completion of the Balotra refinery, claiming that the party had not extended the necessary cooperation. "We signed the MoU for the refinery in 2017. But from 2018 to 2023, Rajasthan had a Congress government. Due to their lack of cooperation, the work here was nearly stalled," he said, adding that the Bharatiya Janata Party's return to power in the State in 2023 had helped revive the project.

The refinery was initially scheduled to be inaugurated on April 22, but was delayed due to a fire that broke out in its crude distillation unit a day earlier.

- **Key Terms and Explanations**
- **Oil Marketing Companies (OMCs):** These are public or private entities responsible for the downstream sector of the petroleum industry, encompassing the refining, distribution, and marketing of petroleum products. In India, state-run OMCs like IOCL, BPCL, and HPCL act as vital fiscal shock absorbers.
- **Greenfield Project:** This refers to an infrastructural project built entirely from scratch on previously undeveloped land, requiring completely new construction without utilizing existing facilities. The HPCL Rajasthan Refinery Ltd. (HRRL) in Balotra serves as a prime example of a massive greenfield integrated complex designed to optimize regional industrialization.
- **Integrated Refinery-Petrochemical Complex:** A state-of-the-art facility that combines traditional crude oil refining (producing petrol, diesel, and LPG) with petrochemical manufacturing (producing polymers, ethylene, and propylene). This integration ensures that the low-value by-products of refining are instantly converted into high-value chemical feedstocks for industries like plastics, textiles, and pharmaceuticals, maximizing resource efficiency.
- **Outsourced Semiconductor Assembly and Test (OSAT):** A critical segment of the global electronics value chain where third-party vendors package, assemble, and test semiconductor chips fabricated by silicon foundries. The establishment of facilities like the CG Semi OSAT facility in Sanand, Gujarat, signifies India's transition from a chip design hub to an active hardware manufacturing ecosystem.
- **Price Insulation and Subsidization:** The economic strategy of utilizing state intervention to decouple domestic retail prices from volatile international commodity markets. A classic manifestation is capping domestic LPG cylinder prices and providing highly subsidized agricultural urea, preventing external geopolitical conflicts from disrupting rural and domestic purchasing power.

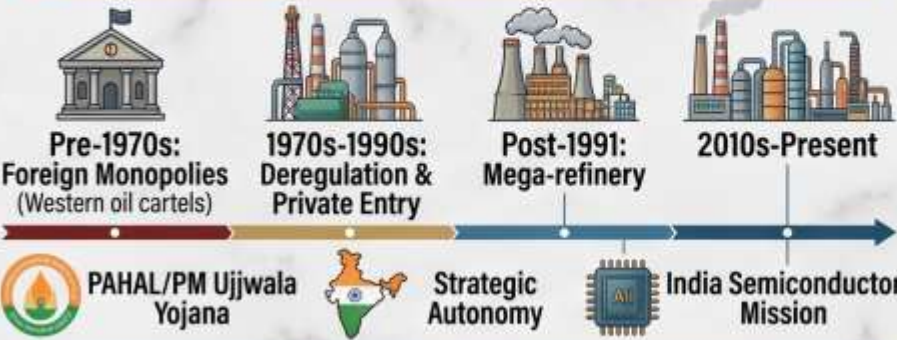
- **Main Arguments and Substantive Parts**

- **Core Thesis**
- The central argument posits that a nation's resilience against global supply chain shocks is contingent upon a robust blend of strategic domestic asset creation, proactive price-buffering mechanisms via state enterprises, and resilient multi-aligned diplomacy. By prioritizing domestic refining expansion and absorbing commercial shocks at the state level, an economy can effectively insulate its citizens from external geopolitical crosscurrents.
- **Substantive Key Points**
- **Strategic Shielding of the Vulnerable Consumer:** Amid severe geopolitical turbulence in West Asia and Eastern Europe, proactive administrative measures successfully prevented domestic fuel rationing and extreme price surges. Retail prices for critical commodities like cooking gas (LPG) and agricultural urea were maintained at fractions of their surging international market values, directly safeguarding household budgets and food security.
- **Public Sector Enterprises as Macroeconomic Anchors:** State-run OMCs acted as institutional cushions, absorbing massive quarterly losses—estimated around ₹75,000 crore in a single quarter—to prevent an inflationary spiral across the wider economy. This financial sacrifice is conceptualized as an investment equivalent to constructing an entirely new mega-refinery, proving that short-term fiscal absorption can preserve long-term economic stability.
- **Scaling Value-Added Downstream Infrastructure:** The continuous scaling of domestic refining capacity—positioning the country as the world's fourth-largest refiner—shifts the structural paradigm from being a vulnerable importer of finished products to a resilient value-adding processing hub. Projects like the HRRL greenfield complex are foundational to this industrial self-reliance.
- **Parallel High-Tech Diversification:** True economic sovereignty requires parallel advancements in foundational technologies. The rapid establishment of semiconductor clusters, such as the OSAT facility in Sanand, complements traditional energy security by building a domestic manufacturing buffer against global technology supply disruptions.

- **Historical Evolution of the Issue**
- **The Era of External Dependency (Pre-Independence to 1970s)**
 - In the early decades post-independence, the domestic oil and energy sector was overwhelmingly dominated by foreign multinational corporations (such as Burmah Shell and Caltex). Refining capacity was minimal, leaving the young republic highly exposed to global price fluctuations and supply manipulations by Western oil cartels.
- **The Turn to Nationalization and Strategic Control (1970s–1990s)**
 - The geopolitical shocks of the 1973 OPEC oil crisis forced a major policy pivot. The state chose to aggressively nationalize foreign oil entities, creating public sector monoliths like IOCL, BPCL, and HPCL. The focus shifted toward setting up indigenous public refineries to secure basic self-reliance, though the sector remained heavily regulated under the Administered Pricing Mechanism (APM).
- **Liberalization and the Refining Boom (Post-1991)**
 - The structural economic reforms of 1991 deregulated parts of the downstream sector, inviting private investments. This era witnessed the rise of mega-refineries, transforming the nation from a net importer of refined petroleum products into a global refining powerhouse and exporter, even while remaining heavily dependent on foreign raw crude.
- **Target Subsidization and Geopolitical Hedging (2010s–2020s)**
 - The introduction of direct benefit transfers (like the PAHAL scheme) and targeted social safety nets (Pradhan Mantri Ujjwala Yojana) structuralized energy access for the poor. Concurrently, foreign policy shifted toward strategic autonomy and multi-alignment—allowing the state to procure discounted crude from diverse geographies during global crises while aggressively pushing for domestic manufacturing high-tech shifts like the India Semiconductor Mission.
- **Way Forward**
- **1. Institutionalizing an Energy Stabilization Fund**
 - Instead of forcing state-run OMCs to absorb ad-hoc financial shocks that disrupt their capital expenditure cycles, India should establish a dedicated, rules-based **Energy Stabilization Fund**. During periods of low global crude prices, windfall taxes or dynamic duties can replenish this fund, which can then be directly deployed to counter under-recoveries during international geopolitical crises.
- **2. Streamlining Federal Infrastructure Execution**
 - To eliminate partisan delays in crucial greenfield projects, a statutory **Joint Center-State Fast-Track Clearance Board** should be created for all mega-infrastructure projects valued above a specific threshold. This would institutionalize land acquisition, environmental clearances, and state-level MoUs, decoupling long-term asset creation from short-term electoral transitions.
- **3. Transitioning Refineries to Clean Energy Hubs**
 - While expanding downstream refining capacity is essential for immediate self-reliance, these integrated complexes must be progressively retrofitted. Future expansions should mandatorily integrate green hydrogen production, carbon capture technologies, and renewable energy inputs, ensuring that the fourth-largest refining network remains viable in a progressively decarbonizing global economy.
- **4. Deepening the High-Tech Component Ecosystem**
 - The success of OSAT facilities must be utilized as a stepping stone to build a comprehensive semiconductor ecosystem. The state must incentivize the next phase of the value chain—attracting advanced silicon fabrication foundries and building domestic chemical and substrate supply lines—to ensure that high-tech manufacturing becomes completely self-sustaining.

INDIA'S GEOPOLITICAL & ECONOMIC STRATEGY FOR ENERGY & INDUSTRIAL RESILIENCE: A Comprehensive Analysis for UPSC CSE

3 HISTORICAL EVOLUTION TIMELINE



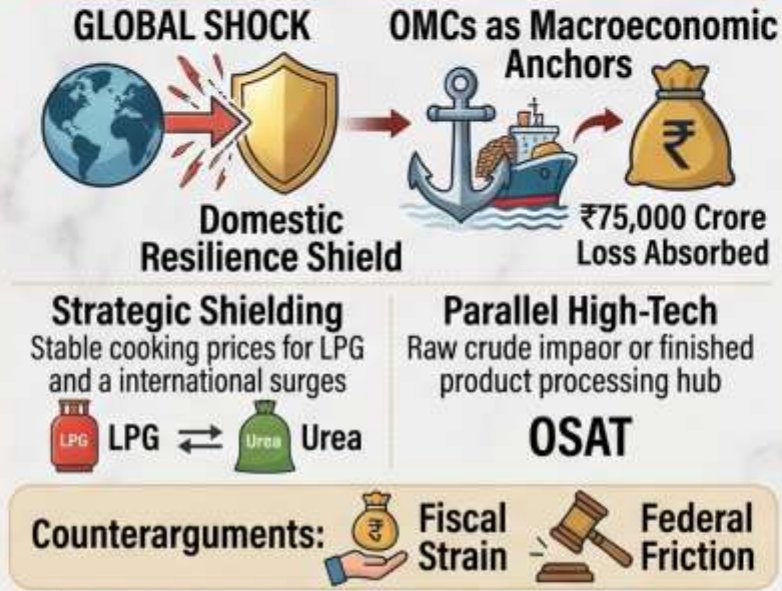
1 KEY TERMS & DEFINITIONS



4 LOGICAL & PHILOSOPHICAL BASE



2 CORE THESIS & SUBSTANTIVE POINTS



5 MULTIDIMENSIONAL ANALYSIS (SPELIT-like grid)



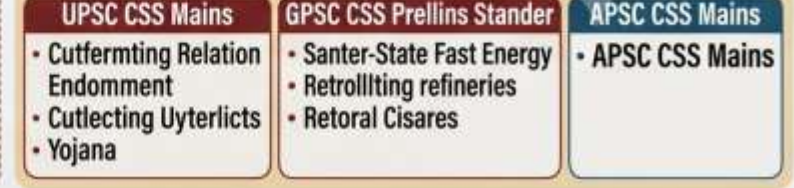
8 WAY FORWARD & POLICY RECOMMENDATIONS



CURRICULUM & UPSC LINKAGES



PREVIOUS YEARS' QUESTIONS (PYQs)



Chinese investment influx good for wider ties, says India's envoy

Ananth Krishnan
BEIJING

Greater investment from China into India will be good both for the economics of the relationship and for broader bilateral ties, Ambassador to China Vikram Doraiswami said on Saturday. The Indian envoy also made a pitch for greater Indian exports to China, especially in areas such as pharmaceuticals, where India is globally competitive.

"Obviously, we would like to be able to export more to China. There is nothing unreasonable about suggesting that," he said, speaking at the World Peace Forum, an annual foreign policy forum in Beijing.

India's trade with China has expanded despite the political freeze on relations since 2020. Both sides have begun the process of normalising relations following Prime Minister Narendra Modi's meeting with Chinese President Xi Jinping in October 2024, in the wake of disengagement along the Line of Actual Control (LAC).

However, trade remains lopsided, with a ballooning deficit. According to Commerce Ministry data, China was India's largest trading partner in 2025-26, with bilateral trade growing to \$151.1 billion, while the deficit stands at \$112.16 billion.

"Particularly in areas where we believe we have



Vikram Doraiswami

a competitive advantage, like pharmaceuticals. For instance, we're one of the world's big exporters of pharmaceuticals to advanced markets. We hope Chinese partners will work with us to ensure that Indian production firms, producing high quality generic medicines, being the same products that have been exported to the U.S. and elsewhere, can be exported to the Chinese market. We think there is a balance of advantage for both countries, including value for China and of course, value for the relationship," the Indian envoy said at a panel on global economic governance during the forum.

'To find ways'

Mr. Doraiswami noted that trade had gone up "regardless of the ups and downs of the larger political relationship". India's exports to China had also increased recently. "That means that the market opportunity is there. We need to find ways of making it easier," he said.

- **Key Terms and Explanations**
 - **Line of Actual Control (LAC):** This is the effective, non-demarcated border that separates Indian-controlled territory from Chinese-controlled territory. Unlike a legally recognized international boundary, the LAC is fluid, divided into western, middle, and eastern sectors, where overlapping perceptions of the border frequently lead to military standoffs.
 - **Trade Deficit:** An economic condition that occurs when a country's total value of imports exceeds the total value of its exports over a specific period. For instance, when bilateral trade reaches \$151.1billion but the trade deficit stands at \$112.16billion, it signifies a stark structural imbalance, meaning one nation consumes far more goods from the other than it sells in return.
 - **Political Freeze / Diplomatic Decoupling:** This refers to a deliberate strategy where a nation freezes high-level diplomatic, political, and cultural exchanges with a rival state due to security provocations, while keeping essential commercial channels open out of economic necessity.
 - **Trade Normalization:** The systematic process of restoring stable, predictable economic interactions and lowering regulatory barriers between two nations after a prolonged period of geopolitical hostility or military confrontation.
 - **Comparative Advantage:** An economic principle stating that a country should specialize in producing and exporting goods that it can manufacture at a lower opportunity cost than its trading partners. A classic example is India's globally competitive generic pharmaceutical sector, which excels in exporting high-quality medicines to advanced Western markets.
- **Main Arguments and Substantive Parts**
 - The intersection of economic pragmatism and national security creates a delicate balancing act for foreign policy makers. The core thesis here revolves around the idea that strategic economic engagement can serve as a stabilizing force in adversarial relationships.
- **The Core Arguments**
 - **Economic Interdependence as a Stabilization Tool:** The central premise is that a calculated influx of Chinese investment into India can act as a catalyst for stabilizing broader, volatile bilateral ties. By embedding financial stakes into the relationship, both nations build a buffer against sudden military escalations.
 - **Resilience of Commerce Over Conflict:** Data demonstrates that economic realities often override political standoffs. Despite a severe political freeze since the 2020 border face-off, bilateral trade expanded to \$151.1billion by 2025-26, solidifying China's position as India's largest trading partner. This proves that deep-tier manufacturing lines are incredibly difficult to decouple overnight.
 - **Redressing the Structural Imbalance:** While economic ties are robust, they are dangerously lopsided. The solution does not lie in shutting down trade, but in aggressively pushing for market access in sectors where India holds a clear comparative advantage, such as pharmaceuticals and generic medicine production.
- **Counterarguments and Strategic Dilemmas**
 - **The Security-Economy Paradox:** Critics argue that opening the doors to Chinese capital poses severe national security risks, particularly regarding critical infrastructure, data privacy, and technological dependencies.
 - **The Trap of Asymmetric Dependence:** Relying heavily on an adversary for raw materials—such as Active Pharmaceutical Ingredients (APIs) for the healthcare sector—can give the trading partner dangerous geopolitical leverage during times of crisis.

- **Historical Evolution of the Issue**
- **The Panchsheel Era (1950s):** The relationship began with high idealism under the framework of the Five Principles of Peaceful Coexistence (Panchsheel). The popular slogan "*Hindi-Chini Bhai Bhai*" defined this era, though it overlooked deep-seated territorial disagreements.
- **The 1962 Conflict and Cold War Frost:** The 1962 border war completely shattered bilateral trust. It led to a total suspension of economic ties, a freeze in diplomatic channels, and decades of mutual suspicion that aligned with broader Cold War geopolitics.
- **The 1988 Breakthrough (The Rajiv Gandhi Visit):** A historic turning point occurred when both nations agreed to decouple the resolution of the border dispute from the development of broader economic and diplomatic ties. This pragmatic approach allowed bilateral trade to grow exponentially over the next three decades.
- **The 2020 Galwan Standoff and Economic Retaliation:** The fatal clashes in the Galwan Valley broke the 1988 consensus. India responded with a sharp political freeze, banned hundreds of Chinese digital applications, and introduced strict regulatory screenings (such as Press Note 3) to restrict opportunistic Chinese takeovers of domestic firms.
- **The Path Toward Disengagement (2024–Present):** Following intensive military and diplomatic dialogue, a breakthrough meeting between the top leadership in October 2024 initiated a formal disengagement process along the LAC. This paved the way for the current policy phase: exploring a calibrated economic re-engagement to manage an asymmetric \$151.1billion trading relationship.
- **Way Forward**
- **Implement a Tiered Screening Mechanism for FDI:** Instead of using a blanket restriction on capital from neighboring countries, India could adopt a traffic-light regulatory framework. Green channels can be designated for non-sensitive, employment-generating sectors like electric vehicle assembly, textiles, and consumer electronics, while strict red channels are maintained for critical infrastructure, telecommunications, and data-heavy industries.
- **Demand Reciprocal Market Access:** India can use its large consumer market as leverage during bilateral talks to demand that China lower its non-tariff barriers. This would help competitive Indian sectors, such as generic pharmaceuticals, information technology, and agricultural products, enter the Chinese domestic market and help narrow the \$112.16billion deficit.
- **Accelerate Domestic Manufacturing and PLI Schemes:** The long-term solution to reducing dependency on external suppliers is strengthening domestic production. The government can expand the scope of Production Linked Incentive (PLI) schemes, particularly for key starting materials (KSMs) and Active Pharmaceutical Ingredients (APIs), to secure the domestic healthcare supply chain.
- **Diversify Import Supply Chains (China Plus One Strategy):** Indian industries should actively diversify their sourcing networks for critical components. Partnering with alternative manufacturing hubs in Southeast Asia, Europe, and the Americas can prevent sudden supply chain shocks during geopolitical tensions.



INDIA-CHINA RELATIONS: NAVIGATING THE GEOPOLITICAL & ECONOMIC CONUNDRUM



1 KEY TERMS & EXPLANATIONS

Line of Actual Control (LAC)



effective, fluid boundary,
overlapping perceptions

Trade Deficit



Structural Imbalance

Political Freeze / Diplomatic Decoupling



Clear commercial pipeline
pause on high-level diplomacy, commerce continues

Comparative Advantage



INDIA'S GENERIC PHARMA
to advanced markets

2 MAIN ARGUMENTS

Core Arguments

Economic Interdependence as Stabilization



Linked gearboxes in stroouting gearboxes prevent's escalation

Resilience of Commerce Over Conflict



Etninular trades rising difficult decoupling

Counterarguments & Strategic Dilemmas

Security-Economy Paradox



Data server ed critical infra monuation and commnod lstatutims

Trap of Asymmetric Dependence



API dependency flow themolecule solutions for their information

3 HISTORICAL EVOLUTION



Define: S/ Decoupler & Discriptions

5 MULTIDIMENSIONAL ANALYSIS

Social & Political

- Gap between nationalist sentiment and market reality like and manre affordable electronics and medicines

Legal & Ethical

- Press Note 3 FDI screening vs.
- Ethical duty for affordable healthcare

International

- Balancing Quad in Indo-Pacific
- Cooperating in BRICS/SCO

Economic

- \$112.16bn/\$151.1bn deficit
- Focus on solar, solar, API, electronic components

4 LOGICAL & PHILOSOPHICAL BASE

Complex Interdependence



Interlinked country maps & moneybags deterrine deterrg war

Mearsheimer's Offensive Realism vs. Economic Pragmatism

China building power vs. Indias
vs.
India's short-term India's short-term growth needs

Strategic Autonomy & Rational Choice



Calculated national interest & naionst over rigid emotions

7 UPSC CSE SYLLABUS MAPPING



9 PREVIOUS YEARS' UPSC & APSC QUESTIONS

UPSC CSE Civil Services Examination (Mains)

1. Implement Tiered FDI Screening
Traffic-light framework for non-sensitive vs. critical sectors critical sectors

Demand Reciprocal Market Access
Leverage consumer market for pharma/IT walT access, narrowing deficit. (2020)

2 Diversify Import Supply Chains
Partner with SE Asia, Europe, Americas (207)

UPSC CSE Civil Services Examination (Prelims)

2020 FDI policy question on the 2021 and count or questionont of answer?
Correct answer (c)

2018 largest trading partner question and answer?
Correct answer (b)

APSC State Services Examination

- Mains:** Reoperative centves of Power
- Prelims:** Cooperative examination

APSC Ito Services Examination

- Mains:** Mains services mains
- Prelims:** Comparative examination

India's essential medicine list lags behind global benchmark; unrevised in 4 years

Bindu Shajan Perappadan
NEW DELHI

India's roster of essential medicines has not been updated in nearly four years, even as the World Health Organization (WHO) has revised its own list twice in the same period, says a civil society network of activists and organisations working for affordable healthcare.

The collective – Working Group on Access to Medicines and Treatments – has written to the government demanding an urgent revision of the National List of Essential Medicines (NLEM), so that such drugs are available at affordable prices. The NLEM is a curated list of medications compiled by the Ministry of Health and Family Welfare. It prioritises drugs that satisfy the critical healthcare needs of India's population based on safety, efficacy, and cost-effectiveness. Medicines on this list – 384 at present – are

Outdated prescription

The National List of Essential Medicines prioritises drugs that satisfy the critical healthcare needs of India's population



POINTS RAISED BY THE COLLECTIVE

- The NLEM, last notified in 2022, contains 384 medicines while the WHO list runs to 523 drugs
- At least 17 active cancer-treating agents, 4 supportive cancer-care medicines, and 9 monoclonal antibodies feature on the WHO list but not on the NLEM

generally dispensed free of cost by government hospitals. The government uses the NLEM to instruct the National Pharmaceutical Pricing Authority (NPPA) to enforce a strict price ceiling on them. The list was last overhauled in 2022.

The WHO Model List of Essential Medicines, meanwhile, was revised in 2023 and again in 2025, and contains 523 medicines – leaving India's list trailing well behind the global benchmark, said the group in its letter on Friday.

"The prolonged delay results in medicines being denied to millions of citizens – who could have had free access to newly recognised essential medicines within the public health system, while also restricting affordable access in the private sector," the letter said, adding that the delay was not merely a bureaucratic lag but a matter with "profound constitutional and human rights implications".

The consequences, the Working Group argues, fall hardest on patients bat-

ting cancer and diabetes. Its letter identifies 17 active cancer-treating agents and four supportive cancer-care medicines that feature on the WHO list but not the NLEM. Also missing, it says, are nine monoclonal antibodies none of which currently appear on India's list. "We urge immediate initiation of a transparent, time-bound, and conflict of interest-free process to revise the NLEM, ensuring that it reflects the latest evidence, public health priorities, and the WHO Model List of Essential Medicines. Timely action is essential to safeguard the constitutional guarantee of the Right to Life for it ensures equitable access to essential medicines for all citizens," said K.M. Gopakumar, co-convenor, Working Group on Access to Medicines and Treatment, which comprises patient advocates, patient groups, civil society organisations, academics, lawyers and journalists.

- **Key Terms and Explanations**

- **National List of Essential Medicines (NLEM):** A curated list compiled by the Ministry of Health and Family Welfare. It prioritizes medications that satisfy the priority healthcare needs of the population based on safety, efficacy, and cost-effectiveness. The primary purpose is to guide public health procurement, optimize state drug budgets, and serve as the basis for price regulation.
- **WHO Model List of Essential Medicines (EML):** A global benchmark revised biennially by the World Health Organization. It acts as a core guide for member nations to develop and update their respective national lists based on evolving global clinical evidence and changing disease burdens.
- **National Pharmaceutical Pricing Authority (NPPA):** An independent regulatory body attached to the Department of Pharmaceuticals (Ministry of Chemicals and Fertilizers). It is mandated to fix and revise ceiling prices of controlled bulk drugs and formulations under the Drug Price Control Order (DPCO), ensuring their availability at fair prices.
- **Monoclonal Antibodies (mAbs):** Laboratory-produced molecules engineered to serve as substitute antibodies that can restore, enhance, or mimic the immune system's attack on targeted cells, such as cancer cells. These represent advanced, targeted biomedical therapies that are typically high-cost.
- **Out-of-Pocket Expenditure (OOPE):** The direct payment made by individuals to healthcare providers at the time of service, without coverage from insurance or public schemes. In India, spending on medicines constitutes a major share of OOPE, often leading to catastrophic health expenses and poverty.

- **Main Arguments and Substantive Parts**

- The intersection of pharmaceutical regulation and public welfare highlights a critical operational lag within the state's healthcare machinery. The core thesis focuses on the structural delays in updating domestic medicine frameworks and how this impacts health equity.
- **The Core Policy Lag and Global Mismatch**
- **Stagnation vs. Dynamic Updates:** The domestic roster of essential medicines has remained unrevised for four years (last updated in 2022, containing 384 medicines). In contrast, the WHO Model List was updated twice in the same window (2023 and 2025), expanding to 523 medicines to incorporate cutting-edge treatments.
- **The Therapeutic Deficit:** This policy freeze has resulted in significant therapeutic gaps. Critical omissions include 17 active cancer-treating agents, 4 supportive cancer-care medicines, and 9 monoclonal antibodies that are globally recognized but completely absent from the domestic controlled list.
- **The Regulatory Cascade and Access Barriers**
- **Price Ceiling Paralysis:** Inclusion in the NLEM serves as the statutory trigger for the NPPA to enforce strict price ceilings. Without this inclusion, life-saving drugs remain unregulated in the private sector, allowing market forces to dictate unaffordable prices.
- **Public Procurement Bottlenecks:** Government hospitals generally dispense NLEM drugs free of cost. The exclusion of newer therapeutics deprives millions of lower-income citizens of access to modern treatments within the public health grid.

- **Historical Evolution of the Issue**

- **The Pre-Independence and Early Era:** Prior to the 1970s, the Indian pharmaceutical market was heavily dominated by multinational corporations, resulting in high drug prices and limited access for the general population.
- **The Hathi Committee Milestone (1975):** This committee laid the foundation for modern pharmaceutical policy in India, recommending indigenous production, quality controls, and a systems-based approach to identifying essential life-saving drugs. This led to the Drug Price Control Order (DPCO) of 1979.
- **The Genesis of NLEM (1996):** India formulated its first formal National List of Essential Medicines in 1996. The objective was to create a focused list to guide public sector drug procurement and promote rational drug use.
- **The Shift to Market-Based Pricing (2012–2015):** The National Pharmaceutical Pricing Policy (NPPP) of 2012 shifted pricing mechanisms from a cost-plus to a market-based pricing model, utilizing the NLEM as the primary schedule for price controls. Revisions in 2011 and 2015 expanded access to meet shifting disease profiles.
- **The Current Stagnation (2022–Present):** The list was last overhauled in 2022, expanding the core matrix to 384 drugs. However, the subsequent four-year freeze has created a gap between domestic regulation and global therapeutic advancements.

- **Way Forward**

- **Institutionalizing a Biennial Revision Cycle:** The Ministry of Health and Family Welfare should establish a statutory, time-bound framework to revise the NLEM every two years, aligning it with the WHO revision calendar. This would help prevent multi-year administrative gaps.
- **Implementing a Transparent, Conflict-Free Mechanism:** The revision process should rely on an independent expert committee operating under clear conflict-of-interest guidelines. Utilizing clear, evidence-based metrics for safety, efficacy, and cost-effectiveness can help ensure the process remains objective and data-driven.
- **Adopting Tiered Pricing and Targeted Subsidization:** For high-cost innovations like monoclonal antibodies, the government can explore innovative pricing mechanisms. Rather than applying uniform price caps that might discourage market supply, the state can utilize bulk public procurement, managed entry agreements, and targeted subsidies to lower costs in the public grid while keeping private channels viable.
- **Strengthening Synergy Between NLEM and Financial Protection Schemes:** The NLEM should be closely integrated with secondary and tertiary healthcare schemes like Ayushman Bharat (PM-JAY). Ensuring that newly added, life-saving cancer therapies are automatically covered under hospital package rates helps convert price regulation into actual financial protection for the patient.
- **Supporting Domestic Bio-similars:** To address long-term fiscal constraints, the state should incentivize the domestic manufacturing of bio-similars through production-linked incentive (PLI) schemes. Boosting local production of advanced biologics can lower market prices naturally, reducing the strain on public procurement budgets when these drugs are added to the NLEM.

UPSC/APSC Special: INDIA'S ESSENTIAL MEDICINE LIST GAP ANALYSIS



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INDIA'S NLEM (2022)



384

Medicines.
Last Revised
4 Years Ago.

139
MEDICINE
DEFICIT

WHO MODEL LIST (2025)



523

Medicines.
Revised twice
(2023 & 2025).

CRITICAL DRUG GAPS: A DEFICIT IN CARE

CANCER AGENTS



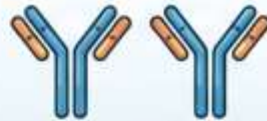
17 Active Cancer-
Treating Agents Missing.
Example: Advanced
targeted therapies.

SUPPORTIVE CARE.



4 Supportive Cancer-
Care Drugs Missing.
Manages chemotherapy
side effects.

MONOCLONAL ANTIBODIES.



9 Monoclonal
Antibodies Missing.
Essential for modern
cancer treatments.

IMPACT OF DELAY ON PATIENTS & SYSTEM

UNREVISED NLEM

NO PROCUREMENT
BY GOVT
HOSPITALS

PATIENTS
DENIED FREE
ACCESS

PRICE CEILING NOT
APPLICABLE

AFFORDABLE
ACCESS RESTRICTED
IN PRIVATE SECTOR

PRICE CEILING
NOT ENFORCED
BY NPPA

HIGH COST
IN PRIVATE
SECTOR

CATASTROPHIC
OUT-OF-POCKET
EXPENDITURE

THREATENS
RIGHT TO
LIFE
(Art. 21)

AXIA IAS POLICY RECOMMENDATIONS



TRANSPARENT PROCESS

Time-bound,
Conflict-of-Interest
Free Revision



REGULAR UPDATES

Biennial (every 2
years)
Revision Calendar



PRICE REGULATION

Expand Drug Price
Control Order to
Novel Therapies



STATE/CENTRE PROCUREMENT

Coordination for
Bulk Drug Purchase



HEALTH EQUITY

Ensure Equitable
Access for All
Citizens

Govt. asks Telegram to take proactive anti-piracy action

Move signals fresh escalation in issues between Centre and Telegram; platform has been accused of 'delayed action against piracy reports'; it was asked to remove over 3,100 URLs in March 2026

Aroon Deep
NEW DELHI

The Ministry of Information and Broadcasting "has demanded that Telegram take proactive action in detecting and taking down pirated content on its platform," a senior official said on Saturday. Telegram has been asked to reply to the Union Ministry's notice within 15 days.

The move is a fresh escalation of issues between the government and the Dubai-headquartered messaging app, following a week-long ban ahead of the rescheduled National Eligibility cum Entrance Test (NEET).

Telegram has been accused in multiple court cases of delayed or little action in response to reports of piracy.

The app has emerged as a haven for pirates since it places few limits on file sizes that users can upload on channels for free, enraging entertainment industry executives who have seen it turn into a convenient hub



Telegram was also served a notice on its username feature by the Ministry of Electronics and Information Technology. REUTERS

for pirated books, newspapers, TV series, and films.

The firm spends tens of millions of dollars on its operations in India without earning back, Telegram founder Pavel Durov has said. A Telegram spokesperson did not have an immediate comment on the notice, in response to *The Hindu*.

Even as Telegram in recent years moved to comply with both court orders and private infringement complaints faster, the I&B Ministry has sent the firm its own orders, including

on the removal of more than 3,100 URLs in March this year. Telegram complied with that order.

This may not be enough, and the Ministry is now demanding that the firm do more to automatically detect piracy. A note shared by a senior official describing the notice said that it was aimed at creating a "clear shift from piecemeal takedown to platform accountability", and that the firm "is required to observe due diligence under the IT Act and IT Rules".

Under Section 3(1)(b) of

the IT Rules, 2021, intermediaries, including Telegram, are required to "make reasonable efforts by [themselves], and to cause the users of [their] computer resource to not [share] any information that... infringes any patent, trademark, copyright or other proprietary rights".

Telegram fought its week-long ban, which has been justified by the National Testing Agency (NTA) in the Delhi High Court as a way to prevent misinformation on leaks made possible by an app feature on backdating the timestamp on messages sent on the platform. Justice Tejas Karia ruled that the ban was proportionate and legal.

Shortly after this order, Telegram was also served a notice on its username feature by the Ministry of Electronics and Information Technology, which had asked WhatsApp to pause the rollout of a similar feature. It is unclear if the IT Ministry has specifically directed Telegram to disable the feature.

- **Key Terms and Explanations**
 - **Intermediary Liability and Safe Harbor:** Digital platforms that store or transmit user-generated content are classified as "intermediaries." Historically, they enjoyed "Safe Harbor" protection—a legal immunity shielded under statutory laws (such as Section 79 of India's Information Technology Act). This principle dictates that a platform cannot be held criminally or civilly liable for illicit content posted by its users, provided it acts merely as a passive conduit. *Example:* If an individual uploads a copyrighted movie to a cloud storage link, the platform is not immediately treated as the thief, provided it removes the content upon receiving a valid legal notice.
 - **Proactive Takedown vs. Piecemeal Takedown:** A piecemeal takedown relies on a reactive, "notice-and-takedown" mechanism where the state or copyright owners must manually identify and flag individual URLs for removal. Conversely, a proactive takedown shifts the compliance burden entirely onto the platform. It mandates the deployment of automated, algorithmic filters (such as hash-matching software) to detect, block, and purge infringing material before it proliferates across the network.
 - **Platform Accountability:** This regulatory paradigm demands that technology firms move away from passive neutrality and actively police their digital ecosystems. Under rules like Section 3(1)(b) of India's IT Rules 2021, platforms must exercise explicit "due diligence," ensuring their computer resources are not weaponized to infringe upon patents, trademarks, or copyrights.
 - **Backdating Timestamps:** A technical manipulation where a user alters the metadata of a message or file to make it appear as though it was transmitted at an earlier time. In high-stakes environments like national competitive examinations, this feature can be weaponized to fabricate evidence of a paper leak, causing widespread public panic and administrative chaos.
 - **Doctrine of Proportionality:** A constitutional standard used by the judiciary to evaluate state actions that restrict civil liberties or corporate operations. It dictates that the administrative measure chosen must be necessary, least intrusive, and directly proportional to the legitimate state objective it seeks to achieve.
-
- **Main Arguments and Substantive Parts**
 - The ongoing dialogue between state regulators and cross-border digital platforms reveals deep systemic tensions regarding governance, accountability, and user freedoms.
 - **The Mandate for Algorithmic Policing**
 - The central administrative thesis focuses on a fundamental shift from reactive to proactive governance. Regulators argue that the sheer volume of digital piracy—ranging from the unauthorized distribution of copyrighted books and newspapers to premium cinema—renders manual URL-by-URL blocking obsolete. With platforms serving over thousands of flagrant copyright violations monthly, the state demands the structural integration of automated screening tools. The core argument states that public interest and the protection of intellectual property rights (IPR) supersede the operational autonomy of tech conglomerates.
 - **The Defense of Architectural Neutrality**
 - On the corporate and structural side, platforms emphasize the astronomical operational costs of maintaining vast, low-barrier digital infrastructures. When a platform offers high file-size allowances, it democratizes data sharing but inadvertently becomes a haven for illicit distribution. Platform operators argue that enforcing automated, sweeping filters risks transforming private messaging spaces into zones of state-mandated surveillance. Furthermore, firms operating with substantial overheads but minimal domestic monetization argue that overly aggressive compliance mandates create an unviable economic environment for foreign tech investments.
 - **Judicial Validation of Preventive Enforcement**
 - A significant substantive element is the judiciary's increasing willingness to validate aggressive state interventions during administrative crises. The temporary suspension of messaging services to protect the integrity of national examinations (such as the National Eligibility cum Entrance Test) highlights a crucial precedent. The judiciary has affirmed that when platform features—like backdatable timestamps—can be used to spread misinformation or destabilize public trust in national institutions, a temporary, targeted ban satisfies the legal threshold of proportionality.

- **Historical Evolution of the Issue**
- **The Pre-Digital Era (1957–2000):** Intellectual property enforcement was governed primarily by the traditional Copyright Act of 1957. Infringements were localized, physical, and addressed through standard civil law enforcement remedies. The concept of an "online intermediary" did not exist.
- **The Dawn of Cyber Law (2000–2008):** The enactment of the Information Technology (IT) Act, 2000, introduced the first framework for the digital economy. Initially, intermediary protections were vague, leading to high-profile arrests of platform executives for user-generated content. This prompted the 2008 IT Act Amendments, which formalised Section 79, establishing strict "Safe Harbor" protections to insulate growing internet businesses.
- **The Judicial Shield (2015):** The landmark Supreme Court ruling in *Shreya Singhal v. Union of India* significantly strengthened Safe Harbor. The court ruled that intermediaries were only required to take down content upon receiving "actual knowledge" via a specific court order or a direct government directive, preventing platforms from acting as private censors.
- **The Regulatory Pivot (2021):** The introduction of the Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules, 2021, changed this dynamic. The rules created a distinct category called "Significant Social Media Intermediaries" (SSMIs) and stripped away absolute safe harbor, replacing it with mandatory compliance duties, automated filtering expectations, and localized grievance officers.
- **The Era of Proactive Accountability (Present Day):** The regulatory landscape has shifted from passive compliance to mandatory, proactive architectural design. The executive branch now expects instant automated detection of illicit material, while the judiciary increasingly sanctions temporary platform shutdowns to protect national administrative integrity against digital manipulation.
- **Way Forward**
- :
- **Co-Regulation and Smart Governance**
- Instead of relying on top-down administrative mandates or strict platform bans, India should adopt a co-regulation model. This involves collaborative frameworks where the government sets clear performance outcomes, while platforms design the technical solutions to meet them. This approach allows tech firms to protect their underlying architecture while fulfilling their public accountability requirements.
- **Deploying Privacy-Preserving Hash Matching**
- To address piracy without compromising user privacy, platforms can utilize privacy-preserving cryptographic technologies. By converting known pirated files or leaked materials into unique digital signatures (hashes), intermediaries can identify and block illicit content at the upload stage. This method allows platforms to police copyright violations without needing to read or decrypt private user conversations.
- **Developing Clear Standard Operating Procedures (SOPs)**
- The executive branch needs to establish clear, public Standard Operating Procedures for blocking orders and platform suspensions. Temporary shutdowns should be treated as emergency measures of last resort, used only when there is an imminent threat to public safety or institutional integrity (such as national exam leaks). These interventions must have strict time limits and be subject to independent judicial oversight to prevent administrative overreach.
- **Empowering Independent Judicial and Algorithmic Audits**
- To prevent automated systems from over-censoring legitimate content, any mandatory AI filtering tool must undergo regular independent audits. Establishing a specialized digital appellate body would allow content creators, citizens, and platforms to quickly appeal erroneous automated takedowns, ensuring that digital enforcement remains fair, transparent, and legally accountable.

EXAMINING THE TELEGRAM-GOVERNMENT STANDOFF: PROACTIVE ANTI-PIRACY & PLATFORM ACCOUNTABILITY

GOVERNMENT MANDATES & JUSTIFICATION

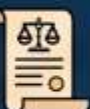
Ministry of I&B and MeitY

- **Mandatory Automated Content Detection** 
- **Shift from Piecemeal Takedowns to Platform Liability**

Old reactive

New proactive

- **Targets Copyright Infringement** 

 **Section 3(1)(b) Due Diligence (IT Rules 2021)**

 **Judicial Precedent for Temporary Bans**
NTA NEET exams context 



SHIFT: FROM PASSIVE NOTICE TO MANDATORY PROACTIVE DETECTION

TELEGRAM'S REALITIES & RESPONSES

Platform Challenges

 **High Operational Costs (Millions of \$)** 

 **Free Channels with No File Limits** 

 **Claimed Faster Compliance and Increased Staffing**

 **Judicial Review of Platform Features**
(e.g., 'backdating timestamps') 

Central licensing net to cover stem cell, gene therapies

Bindu Shajan Perappadan
NEW DELHI

The Union Ministry of Health recently amended the Drugs Rules, 1945 to bring cell and stem cell products, gene therapies, and xenografts under the Centrally Licence Approving Authority (CLAA) framework, closing a long-standing regulatory gap in India's oversight of advanced therapies.

The amendment does not amount to automatic approval of these therapies, nor will it immediately make them cheaper or more accessible, a Health Ministry official clarified on Saturday. Manufacturers will still have to prove safety, quality and efficacy, secure clinical trial and marketing approvals, and comply with the Drugs and Cosmetics Act.

The change lays the regulatory groundwork for safer, more reliable access to advanced treatments over time, with both Central and State licensing authorities now jointly overseeing these products, the official said.

The move comes against the backdrop of clinics across India offering costly, often unproven stem cell treatments for several conditions, including autism and spinal cord injury.

The amendment brings such products under a uniform framework for the first time, addressing a regulatory grey zone that had let some clinics market dubious "stem cell" cures while charging patients large sums. Mandeep Singh Malhotra, director, surgical oncologist at C.K. Birla Hospital, Delhi, said.

Until now, the CLAA system covered only specific high-risk biologics – vaccines, large-volume parenterals, and recombinant DNA-derived drugs – which needed manufacturing licences from State Licensing Authorities with CLAA approval. Stem cell and cell-based products had been classified as "new drugs" since 2018,



The amendment does not amount to automatic approval of these therapies.

requiring regulatory clearance for clinical use, but the Rules had no dedicated provision for issuing manufacturing licences to these categories. The amendment fixes this by revising Rules 75, 75A, 76, and 76A along with the relevant licensing forms.

The updated framework will cover regenerative treatments and CAR-T cell therapies for blood cancers, including lymphoma, gene replacement, and editing products for genetic disorders and cancers, and animal-tissue-derived products, including heart valves used in cardiology and orthopaedics.

Experts note that India's drug regulatory architecture has traditionally been built around its generics industry, which evaluates equivalence to already approved drugs – a model ill-suited to novel cell and gene therapies. The gap became apparent in 2023, when ImmunoACT won approval for NexCAR19, India's first indigenous CAR-T therapy, only after regulators and the company worked out evaluation standards during the process itself.

Analysts caution that while the new framework should curb unregulated and unproven therapies, the added compliance layer could lengthen approval timelines and raise costs, especially for smaller biotech firms. Broader constraints – limited manufacturing infrastructure, a shortage of specialised workforce, and constrained clinical research capacity – remain unaddressed.

- **Key Terms and Explanations**

- **Centrally Licence Approving Authority (CLAA):** This is the apex node within India's drug regulatory framework, operating under the Central Drugs Standard Control Organisation (CDSCO). Unlike routine manufacturing licenses issued by State authorities, the CLAA retains direct approval power over high-risk, critical biological products.
- **Stem Cell Therapy and Regenerative Medicine:** This branch of medicine develops methods to regrowth, repair, or replace damaged or diseased cells, organs, or tissues. It relies heavily on stem cells, which are the body's raw materials—cells from which all other specialized cells are generated.
- **Gene Therapy and Gene Editing:** A collection of techniques that modify a person's genes to treat or cure disease. This can work by replacing a disease-causing gene with a healthy copy, inactivating a malfunctioning gene, or introducing a new gene.
- **CAR-T Cell Therapy (Chimeric Antigen Receptor T-cell Therapy):** A revolutionary form of immunotherapy where a patient's own T-cells (a type of immune system cell) are harvested and genetically altered in a laboratory so they will bind to specific proteins on cancer cells and destroy them.
- **Xenografts:** Tissues, organs, or cells transplanted from one biological species to another, most commonly from animals to humans.
- **Generics-Centric Regulatory Architecture:** A regulatory system designed primarily to assess small-molecule, chemically synthesized drugs. It focuses heavily on proving "bioequivalence"—demonstrating that a generic copy performs identically to an already approved branded drug. This system is fundamentally different from the process-driven protocols needed to validate living, highly variable biological therapies.

- **Main Arguments and Substantive Parts**

- The regulatory transition captures a critical turning point in how India balances cutting-edge biomedical innovation with public safety.

- **The Core Thesis**

- India's legacy drug laws, built for a booming generic pharmaceutical industry, are structurally inadequate for the era of living medicines. Amending the Drugs Rules of 1945 to bring advanced therapies under the central licensing framework closes a historical regulatory gap, aiming to eradicate predatory medical practices while building an institutional pathway for domestic biotechnology.

- **Key Arguments and Supporting Evidence**

- **Eradication of the Regulatory Grey Zone:** For years, a lack of explicit manufacturing rules allowed standalone clinics to exploit desperate patients by marketing expensive, unproven "stem cell cures" for complex neurological and genetic conditions like autism and spinal cord injuries. By centralizing manufacturing oversight, the state establishes uniform safety and efficacy benchmarks.
- **Transitioning Beyond the Generic Paradigm:** The traditional Indian regulatory apparatus was built around copying and scaling existing chemical formulations. Advanced Therapy Medicinal Products (ATMPs), such as CAR-T cells, require an entirely different oversight mechanism because the manufacturing process itself determines the final structure of the living drug.
- **The Joint Oversight Model:** The amendment revises Rules 75, 75A, 76, and 76A, creating a dual-layered safety net. Central and State licensing authorities now jointly oversee these products. This ensures that while local manufacturing environments are monitored, national standards for clinical trials and marketing approvals remain uncompromised.
- **Counterarguments and Structural Challenges**
- **The Compliance Bottleneck:** Industry analysts warn that adding centralized regulatory layers could lengthen approval timelines. This could increase operational costs, creating market entry barriers that disproportionately impact resource-constrained domestic biotech startups.
- **Foundational Infrastructure Deficits:** Tightening licensing rules fixes the legal framework, but it does not automatically solve deeper ecosystem constraints. India still faces a shortage of specialized GMP (Good Manufacturing Practices) facilities, a limited workforce trained in advanced bioprocessing, and constrained clinical research capacity within public healthcare institutions.

- **Historical Evolution of the Issue**

- **The Pre-Independence Foundation (1940–1945):** The enactment of the Drugs and Cosmetics Act (1940) and the subsequent Drugs Rules (1945) established India's primary pharmaceutical guardrails. These laws were designed around conventional chemistry, focusing on simple formulations, shelf-life stability, and basic hygiene in manufacturing.
- **The Late 20th Century Biotech Boom:** The rise of recombinant DNA technology and mass immunization programs forced regulators to adapt. The Centrally Licence Approving Authority (CLAA) framework was introduced to manage high-risk categories like vaccines, large-volume parenterals, and blood products, creating a distinct tier above standard state-level licensing.
- **The 2018 Policy Shift:** Recognizing the rise of cellular therapies, the government explicitly classified stem cell and cell-based products as "New Drugs" under the law. This made clinical trials mandatory for clinical use, but a critical gap remained: the Drugs Rules still lacked a dedicated pathway for issuing official *manufacturing* licenses for these living technologies.
- **The 2023 Regulatory Wake-Up Call:** The approval of India's first indigenous CAR-T cell therapy, NexCAR19, brought these regulatory gaps into sharp focus. Because there was no established evaluation template for advanced cell therapies, regulators and innovators had to design testing and validation standards on the fly during the actual approval process.
- **The Contemporary Integration:** The formal amendment of Rules 75, 75A, 76, and 76A closes this regulatory gap. By explicitly bringing gene therapies, stem cell products, and xenografts under the CLAA net, India has institutionalized its oversight of advanced therapies.

- **Way Forward**

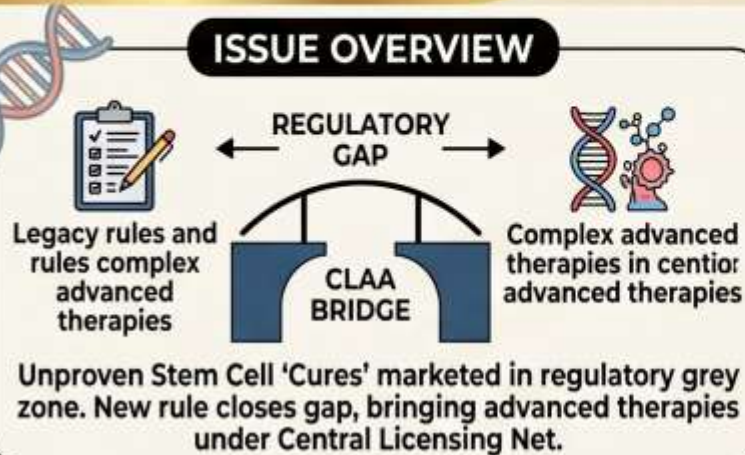
- **Implement Phased Regulatory Sandboxes:** The CDSCO should establish a regulatory sandbox framework for early-stage domestic biotech startups. This would allow innovators to test advanced therapies under adaptive, close regulatory supervision with relaxed initial compliance requirements, speeding up proof-of-concept development without risking patient safety.
- **Invest in Institutional Capacity Building:** The government must actively build technical capacity within both the CLAA and state drug control departments. This means recruiting and training molecular biologists, cell geneticists, and bio-process engineers to serve as specialized regulatory auditors, ensuring evaluations are thorough, fast, and scientifically sound.
- **Develop Shared Public GMP Infrastructure:** To lower the high capital costs faced by domestic innovators, the Ministry of Science and Technology should set up common, state-of-the-art, GMP-certified manufacturing hubs within regional biotechnology parks. These shared facilities can be rented out to startups, significantly reducing the cost of producing therapies for clinical trials.
- **Establish a National Registry for Advanced Therapies:** Launch a centralized data repository to track the long-term clinical outcomes of patients undergoing gene and cell therapies. This will generate vital real-world evidence on safety and efficacy that is specific to the Indian population, helping regulators continuously refine safety standards.
- **Create a Streamlined Single-Window Clearinghouse:** To prevent the joint central-state oversight model from turning into a bureaucratic bottleneck, all applications should be processed through a unified, transparent digital portal. This system must feature strict statutory timelines, ensuring that state-level reviews and final central CLAA clearances move forward concurrently rather than sequentially.

REGULATING STEM CELL & GENE THERAPIES IN INDIA: A COMPREHENSIVE UPSC ANALYSIS

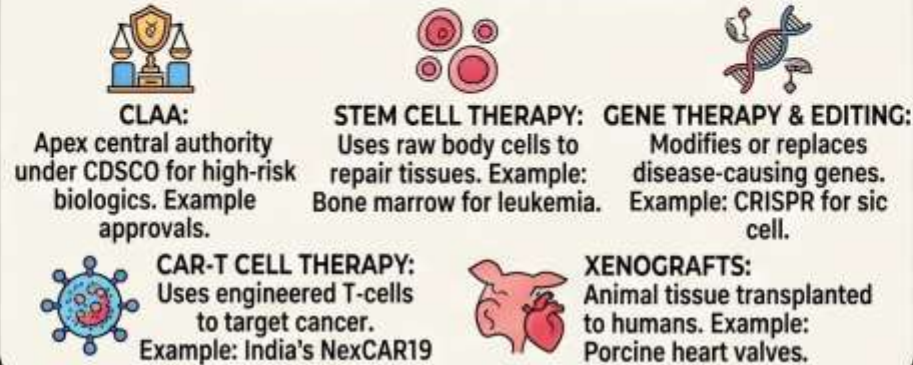
Based on regulatory shift brings them under the Centrally Licence Approving Authority (CLAA)



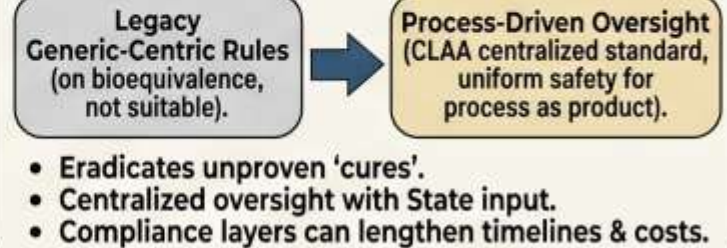
ISSUE OVERVIEW



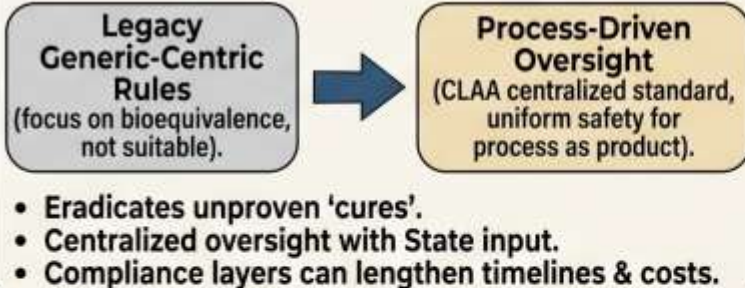
KEY TERMS & DEFINITIONS



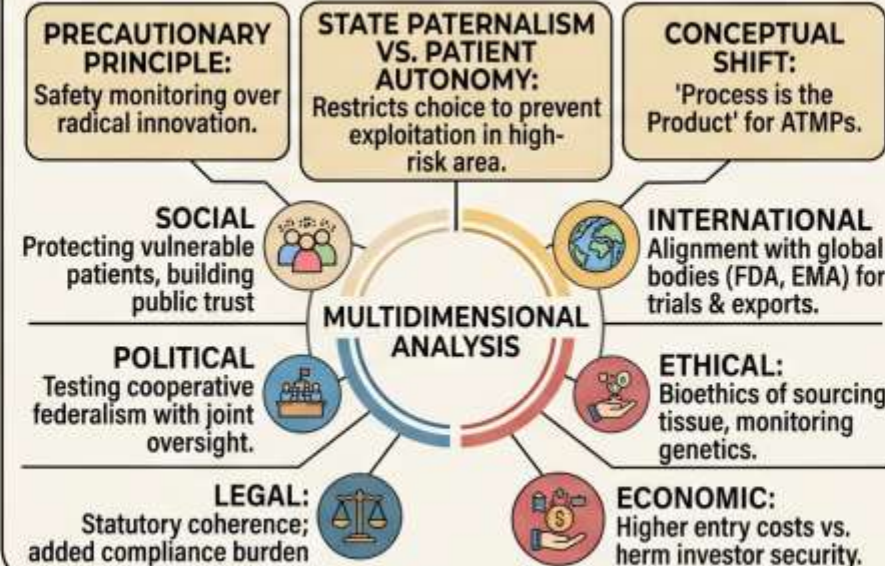
MAIN ARGUMENTS



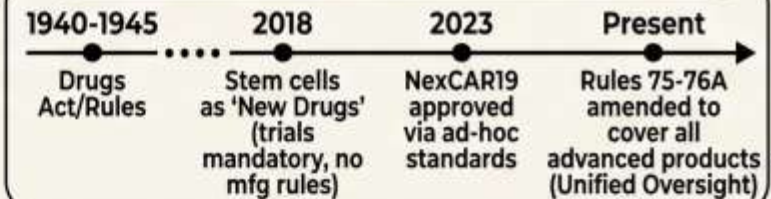
MAIN ARGUMENTS



LOGICAL & PHILOSOPHICAL BASE



HISTORICAL EVOLUTION (TIMELINE)



NCERT LINKAGES



WAY FORWARD



India's semiconductor push will create countless jobs: PM

Modi inaugurates semiconductor facility in Gujarat's Sanand; he says such clusters will bring in economic transformation; he urges youth to tap new opportunities in era of Artificial Intelligence

Abhinav Deshpande
AHMEDABAD

Prim Minister Narendra Modi on Saturday said India is giving birth to semiconductor clusters across the country, and described the current phase as the beginning of large-scale employment and economic transformation.

He said the country is building the entire electronics value chain, from products and components to semiconductors, which will serve as the road map for Viksit Bharat.

He said semiconductor clusters were emerging not only in Sanand (Gujarat) but at multiple locations across India.

Mr. Modi, who inaugurated the CG Semi Outsourced Semiconductor Assembly and Test (OSAT) facility in Sanand, also said India's youth would power the artificial intelligence, robotics and next-generation technology revolution with made-in-India chips.

He said the plant reflected the government's vision of 'Design in India' and 'Make in India' and noted that he had laid the foundation stone for the project in 2024, chip testing began



Future ready: Prime Minister Narendra Modi at the semiconductor facility in Sanand, Gujarat, on Saturday. *Vijay SONI/BJP*

in August 2025, and commercial production had now commenced.

Appeal to youth

Mr. Modi said the coming era of artificial intelligence would open up new avenues for skills and expertise. "The youth of India should not lose this opportunity. I want to tell the youngsters of the country: 'Your ideas, my support,'" Mr. Modi said.

"It (semiconductor industry) is the next step in the electronics revolution that has taken place in India over the past decade," he added as he was handed the first semiconductor chips made at the company, to be exported to Ja-

pan. First, it was the IT revolution that created opportunities for lakhs of Indians to showcase their talent, he said. Then the smartphone and electronics manufacturing boom opened new avenues for employment and innovation. "Now, the world is entering the era of semiconductors and artificial intelligence revolution that will create opportunities for countless people."

Government's goal

The CG facility is part of the India Semiconductor Mission and will undertake the assembly, packaging and testing of semiconductor chips. Mr. Modi said the project was built in part-

nership with companies from Thailand and Japan, and described it as a model of technology, trust and collaboration that would strengthen India's semiconductor sector.

He also said that the government's goal is to build a complete semiconductor ecosystem in India, from chip design to fabrication and packaging. "I'm informed that this unit has the capacity to manufacture 20 crore chips annually and that the company aims to scale up production to more than 500 crore chips a year, which means 1.5 crore chips per day," he said.

He called the project a "success story" and a "revolution".

He said many women employees from the hinterlands of the country who completed their ITI training were now working at the plant. He said many of them had never visited Delhi or Mumbai and had never held a passport before travelling to Malaysia for training.

"They learnt advanced semiconductor manufacturing techniques there and are now part of India's chip manufacturing sector."

- **Key Terms and Explanations**

- **Semiconductor:** These are materials (predominantly Silicon or Gallium Arsenide) whose electrical conductivity falls between that of a conductor (like copper) and an insulator (like glass). They act as the physical brain of all modern electronics, controlling electrical currents to process data. *Example:* The microchip inside a smartphone that runs the operating system.
- **OSAT (Outsourced Semiconductor Assembly and Test):** A critical mid-stream phase in chip manufacturing. While fabrication plants (fabs) print circuits onto silicon wafers, OSAT facilities take these raw wafers, cut them into individual chips, package them in protective housings, and rigorously test them for performance. As shown in **image.png**, the operationalization of the Sanand unit marks India's major entry into this specialized space.
- **India Semiconductor Mission (ISM):** A specialized, autonomous business division within the Digital India Corporation. It serves as the nodal agency tasked with implementing India's strategies for developing a sustainable semiconductor and display ecosystem, managing financial incentives, and building global partnerships.
- **Fabrication (Fab):** The highly capital-intensive process of manufacturing integrated circuits on raw silicon wafers. Fabs require ultra-clean environments (cleanrooms) free of dust particles, massive water resources, and continuous, uninterrupted power.
- **Electronics Value Chain:** The complete sequence of stages required to bring an electronic product from conception to consumption. It spans upstream Research & Development (R&D) and chip design, midstream fabrication and OSAT, and downstream component assembly and final system integration.
- **Viksit Bharat:** The overarching national socio-economic vision aimed at transforming India into a fully developed nation by the centenary of its independence (2047). A key pillar of this vision is achieving technological sovereignty and becoming a net exporter of high-value electronics.

Main Arguments and Substantive Parts

- The paradigm shift in industrial policy highlights a well-structured argument regarding the intersection of advanced technology, job creation, and strategic autonomy.
- **The Core Thesis**
 - Establishing a domestic semiconductor ecosystem is not merely a technical achievement; it is a foundational economic catalyst. The primary argument posits that true self-reliance (*Atmanirbhar Bharat*) and the transition to a developed economy cannot be achieved by relying on imported hardware components, especially in the emerging era of Artificial Intelligence and robotics.
- **Key Pillars of the Development Strategy**
 - **Ecosystem Convergence Over Isolation:** The strategy emphasizes moving beyond fragmented manufacturing. Instead of just assembling final products (like smartphones), the focus is on mastering the entire value chain—from initial product design to advanced testing and packaging. This holistic approach builds economic resilience.
 - **The Job Multiplier Effect:** A critical argument addresses the myth that high-tech manufacturing does not generate mass employment. By establishing integrated clusters, the ecosystem creates a dual-layer employment engine: high-end engineering jobs in design and fabrication, alongside massive opportunities for vocationally trained youth (ITI graduates) in testing, assembly, and maintenance.
 - **Geopolitical Trust as Currency:** Technology transfer cannot happen in a vacuum. As illustrated by the international collaborations outlined in **image.png**, building this ecosystem relies heavily on strategic partnerships with technology leaders like Japan and Thailand. This positions India as a trusted, reliable node in the global supply chain, away from geopolitically volatile corridors.
 - **Democratization of the High-Tech Workforce:** The operational execution breaks traditional class and geographical barriers. By bringing rural youth, particularly women from the hinterlands, into high-tech training and global exposure pipelines (e.g., training facilities in Malaysia), the program transforms advanced manufacturing into an instrument for grassroots social mobility.
- Historical Evolution of the Issue
 - **The Early Phase (1950s–1970s):** Post-independence industrial policy focused heavily on basic heavy industries and public sector undertakings (PSUs) like Bharat Electronics Limited (BEL). While India recognized the importance of electronics, the ecosystem was constrained by capital scarcity and a strict import-substitution regime that isolated domestic industries from rapid global technological shifts.
 - **The Semiconductor Complex Limited (SCL) Initiative (1980s):** In 1983, the government established SCL in Mohali, Punjab, with the objective of manufacturing Very Large Scale Integrated (VLSI) circuits. India was technologically competitive with several Asian peers during this window. However, a devastating fire at the SCL facility in 1989, coupled with bureaucratic delays in rebuilding, severely disrupted India's hardware ambitions.
 - **The Software Boom and Hardware Neglect (1990s–2000s):** With economic liberalization in 1991, India capitalized on its English-speaking, skilled engineering base to drive the Information Technology (IT) and software services revolution. While India became a global software giant, hardware manufacturing was largely neglected, leading to an overwhelming dependence on imports for electronic components, primarily from East Asia.
 - **The Electronics Assembly Era (2010s):** The launch of the National Policy on Electronics (NPE 2012) and the subsequent "Make in India" initiative in 2014 marked a strategic shift. Through targeted fiscal incentives and duty structures, India emerged as the world's second-largest manufacturer of smartphones. However, this phase was characterized mainly by Semi Knocked Down (SKD) assembly rather than deep core manufacturing.
 - **The Shift to Advanced Ecosystems (2020s–Present):** The supply chain vulnerabilities exposed during the COVID-19 pandemic and rising geopolitical tensions forced a comprehensive policy redesign. The government announced a $\approx$ \$10 billion incentive package, launched the India Semiconductor Mission (ISM), and introduced Production Linked Incentive (PLI) schemes. This paved the way for operational advanced packaging and testing units, transitioning India from assembly to core fabrication and packaging.

- **Way Forward**

- To sustain this momentum and transform India into a true global semiconductor hub, a balanced, multi-pronged strategy must be implemented:
 - **Radical Upgradation of Human Capital:** The academic curricula of engineering colleges and ITIs must be modernized in tandem with industry inputs. Universities should establish dedicated chip-design labs and cleanrooms to ensure a steady supply of industry-ready technicians and design engineers.
 - **Long-Term Fiscal and Policy Stability:** Semiconductor investments have long gestation periods and high cyclicity. The government must provide a stable, predictable fiscal and tax environment, ensuring that policy incentives extend smoothly over the next decade to build long-term investor confidence.
 - **Building Specialized, Resilient Infrastructure:** States must move beyond basic land allocation to create specialized industrial zones. These clusters require access to ultra-pure water processing plants, double-circuit uninterrupted green power grids, and zero-liquid discharge effluent treatment systems.
 - **Deepening the Native Design Ecosystem:** While entering the value chain via OSAT facilities is a pragmatically sound mid-stream strategy, the highest margins lie in product design and intellectual property creation. India must expand its design-linked incentive (DLI) schemes to support local, fabless startups, ensuring we own the intellectual property driving our hardware.
- **UPSC Civil Services Examination (Mains)**
 - **GS Paper 3 (2022):** "Is value-added manufacturing more resilient to economic shocks compared to service-led growth? Discuss in the light of India's recent push for electronics manufacturing." (*Similar Theme*)
 - **GS Paper 3 (2023):** "Introduce the concept of Artificial Intelligence (AI). How is AI expected to help India bypass traditional developmental stages? Discuss the infrastructure prerequisites for the same."
 - **GS Paper 3 (2020):** "Account for the failure of manufacturing sector in achieving the goal of labor-intensive exports. Suggest measures for more labor-intensive rather than capital-intensive industries."

COMPREHENSIVE CSE ANALYSIS: INDIA'S STRATEGIC SEMICONDUCTOR PIVOT

LINKAGES
WITH
NCERTs

LINKAGES WITH
UPSC CSE
SYLLABUS

NCERTs
Class 10
Geo (Ch 6)

Class 12
Geo.
Class 12
Econ
(Ch 2&3)
Class 12
Pol Sci

Class 12
Pol
Pol Sci
(Globalization)

CSE Syllabus

GS Paper 3
(Core Linkage)
GS Paper 2
(Governance, IR)

GS Paper 2
(Governance, IR)

GS Paper 1
(Social)

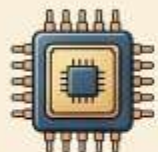
GS Paper 4
& Essay
(Ethics)

(Scripts relevant Optional
Subjects:

**List relevant
Subjects**

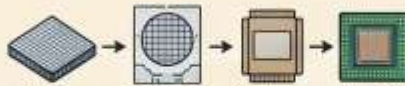
- List relevant
- Contacts
- Optional Subjects

KEY TERMS: THE SEMICONDUCTOR VALUE CHAIN



Semiconductor

Materials (e.g., Silicon) for controlling electrical currents, 'physical brain' of electronics. Ex: Smartphone chip.



Sanand unit operationalization

OSAT (Outsourced Semiconductor Assembly and Test)

Packaging raw wafers into protective housings and rigorous performance testing.



ISM

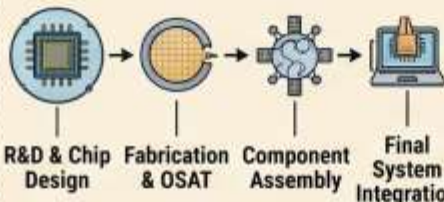
Autonomous nodal agency managing semiconductor/display strategies and global partnerships.



Fabrication (Fab)

Capital-intensive manufacturing of integrated circuits on silicon wafers.

Electronics Value Chain



**2047
Viksit Bharat**

National vision: Technological sovereignty and net electronics exporter by centenary.

HISTORICAL EVOLUTION: INDIA'S HADWARE JOURNEY



LOGICAL & PHILOSOPHICAL BASE



Techno-Nationalism
Tech capability as a core element of national sovereignty and security.



Structural Leapfrogging

Using software strength to skip standard low-tech stages.



Inclusive Capitalism

High-tech driving broad-based, inclusive wealth distribution.



Strategic Interdependence

Building 'trusted corridors' for deep, reciprocal international partnerships.

MAIN ARGUMENTS: FOUNDATIONAL ECONOMIC CATALYST

Core Thesis

End-to-end domestic ecosystem required for true self-reliance, esp. in AI & robotics era.

Ecosystem Convergence over Isolation

'Assembly' → Entire Value Chain Mastery

Job Multiplier Effect



Geopolitical Trust as Currency
Positioning India as a 'trusted reliable node' outside volatile corridors.



Geopolitical Trust as Currency
Positioning India as a 'trusted reliable network' and outside volatile corridors.

Democratization of Workforce

Inclusive manufacturing:
Training rural youth and women for global exposure.

HISTORICAL EVOLUTION: INDIA'S HARDWARE JOURNEY



MULTIDIMENSIONAL ANALYSIS



WAY FORWARD: A SUSTAINABLE STRATEGY



Assam releases booklet showcasing Bodoland forests' butterfly diversity

The Hindu Bureau

GUWAHATI

The Assam Forest Department on Saturday released a special booklet on the butterflies found in the forest landscape of the Bodoland Territorial Region (BTR).

Hagrama Mohilary, the Chief Executive Member of Bodoland Territorial Council (BTC), released the booklet in Kokrajhar, about 220 kilometres west of Guwahati.

Spread across 3,653 sq. km., the Bodoland forest landscape comprises a mosaic of tropical evergreen, semi-evergreen, moist mixed-deciduous forests, and alluvial grasslands situated at the confluence of the Indo-Malayan and In-



Lime butterfly found in BTR of Northeast India.

SPECIAL ARRANGEMENT

do-Gangetic biogeographic zones. The landscape supports 346 of Assam's 620 recorded butterfly species, including several rare, endemic and threatened taxa, making BTR one of the richest butterfly habitats in Northeast India.

According to Sonali Ghosh, the chief of the Forest Department for BTR, the region is the only ecological corridor in the

Northeast where butterfly species of the Eastern Himalayas, Indo-Malayan region, and the Indo-Gangetic plains occur together.

BTR's Ultapani-Manas landscape supports several rare and remarkable butterflies including the endemic yellow-crested spangle (*Papilio elephenor*) and Swinhoe's flat (*Celaenorrhinus zea*). Other notable Eastern Himalayan species recorded from the landscape include the great windmill (*Byasa dasarada*), Moore's cupid (*Shijimia moorei*), Mussoorie bush bob (*Pedesta masuriensis*), and green awlet (*Burara vasutana*).

Among the Ultapani-Manas landscape's Indo-Malayan butterflies is the witch (*Araotes lapithis*).

This landscape also boasts the Indian cupid (*Everes lacturnus assamica*) and the white-line bushbrown (*Mycalesis malsara*), rarely found elsewhere in the Northeast.

Experts from the Northeast Butterfly Meet Network say the BTR represents not only an extraordinary centre of butterfly diversity but also a unique cultural landscape where butterflies have inspired traditional folklore and performing arts. The Bagurumba, popularly known as the butterfly dance of the Bodo community, is believed to have been inspired by the colourful mud-puddling congregations witnessed across the forests during the monsoon.

- **Key Terms and Explanations**

- **Bodoland Territorial Region (BTR):** An autonomous administrative region in Assam established under the Sixth Schedule of the Constitution of India. It comprises districts like Kokrajhar, Chirang, Baksa, and Udalguri, and is governed by the Bodoland Territorial Council (BTC). This framework allows for self-governance by indigenous communities to protect their socio-cultural and linguistic identity while managing local resources.

- **Biogeographic Confluence (Ecotone):** A transition area or intersection where two or more distinct biological realms or geographic zones meet. For instance, the Bodoland forest landscape serves as a unique ecological bridge where the Eastern Himalayas, the Indo-Malayan region, and the Indo-Gangetic plains converge. This zone exhibits the "edge effect," harboring a high diversity of species from all intersecting regions.

- **Endemic Species:** Species that are native to a specific, restricted geographic area and are not found naturally anywhere else in the world. An example within this landscape is the *Papilio elephenor* (yellow-crested spangle), a rare butterfly whose survival depends entirely on the micro-climate of this specific habitat.

- **Mud-Puddling:** A distinct behavioral trait observed in butterflies where they aggregate on wet soil, dung, or damp organic matter. They suck up fluids to extract vital nutrients, particularly sodium and amino acids, which are crucial for their reproductive success. These colorful congregations are common sights during the monsoon season.

- **Ethno-Ecology:** The scientific study of how different groups of people living in specific locations understand and interact with the ecosystems around them. It looks at how traditional knowledge, folklore, and cultural expressions mirror local biodiversity, as seen in the nature-inspired performing arts of indigenous tribes.





- **Main Arguments and Substantive Parts**

- The ecological framework of Western Assam provides insights into the relationship between micro-faunal habitats and indigenous culture.

- **The Significance of the Trans-Regional Bio-Corridor**

- The forest matrix across the Bodoland landscape—spanning thousands of square kilometers—functions as an indispensable ecological corridor. By combining tropical evergreen, semi-evergreen, moist mixed-deciduous forests, and alluvial grasslands, it supports over half of Assam's total recorded butterfly species. This structural variety accommodates complex food webs and provides a refuge for rare, endemic, and threatened taxa.

- **Bio-Indicators and Ecosystem Health**

- Butterflies serve as excellent bio-indicators due to their sensitivity to changes in temperature, humidity, and habitat fragmentation. The documentation of rare species like Swinhoe's flat (*Celaenorrhinus zea*), the great windmill (*Byasa dasarada*), and the white-line bushbrown (*Mycalesis malsara*) in the Ultapani-Manas landscape indicates a resilient, contiguous ecosystem. Monitoring these insect populations allows conservationists to assess the health of the broader forest canopy without relying solely on large mammal tracking.

- **The Intersections of Nature and Culture**

- Conservation strategies are often most effective when integrated with local cultural traditions. The *Bagurumba* dance of the Bodo community mimics the rhythmic movements of butterflies during mud-puddling congregations. This connection highlights a historical co-existence where human communities did not merely exploit nature but internalised its rhythms into their social expressions, forming a strong foundation for community-led preservation.

- **Historical Evolution of the Issue**

- **The Colonial Era (Pre-1947):** The British administration viewed the Brahmaputra Valley and the foothills of the Eastern Himalayas primarily through the lens of resource extraction, focusing on timber and tea cultivation. Formal ecological surveys focused on economically viable timber, largely ignoring micro-fauna like insects and butterflies despite early naturalists noting the region's immense biological wealth.

- **Post-Independence Geopolitics (1947–1990s):** Following independence, the region faced socio-political movements centered around ethnic identity and autonomy. Decades of unrest and insurgency in Western Assam affected institutional forest administration, making field research difficult and leaving fragile habitats vulnerable to illegal logging and encroachment.

- **The Bodoland Accords and Autonomous Governance (2003 & 2020):** A major turning point occurred with the creation of the Bodoland Territorial Council under the Sixth Schedule. This decentralized administrative control over forests and environmental management, shifting power from a centralized state capital to local tribal authorities who have a direct stake in protecting their ancestral lands.

- **The Modern Paradigm of Eco-Tourism and Documentation:** In recent years, the regional administration has shifted focus toward sustainable development. Moving beyond traditional anti-poaching measures, the forest department now actively documents biodiversity through field catalogs. Celebrating local species helps foster regional pride, turning ecological conservation into a tool for peace-building and sustainable tourism.

- **Way Forward**

- **Institutionalizing Community-Led Conservation Reserves:** Pockets of high biodiversity within the Ultapani-Manas landscape should be designated as Community Reserves under the Wildlife (Protection) Act. This formalizes the role of local communities in monitoring habitats and prevents land-use changes.

- **Expanding Scientific Research and Citizen Science:** The regional forest department should collaborate with national research institutions to set up field research stations. Training local youth in digital mapping and monitoring tools can turn the area into a hub for citizen science, providing reliable data on climate impacts.

- **Developing Low-Impact Ecotourism Frameworks:** The local administration should create a structured, low-impact ecotourism model. Providing certification programs for local guides and offering financial support for green homestays helps ensure that tourism revenues flow directly into the local economy.

- **Strengthening Transboundary Conservation Corridors:** Establishing formal communication channels between BTR authorities, state forest departments, and conservation officials in neighboring Bhutan can improve joint anti-poaching efforts and help maintain habitat continuity across political borders.



AXIA
IAS ACADEMY
RISE ABOVE THE REST
ESTD: 2024

UNVEILING BODOLAND'S BUTTERFLY DIVERSITY: A COMPREHENSIVE UPSC/APSC ANALYSIS

FOREST MANAGEMENT, CULTURAL HERITAGE, & GOVERNANCE.

KEY TERMINOLOGIES & GEOGRAPHIC CONTEXT



HISTORICAL EVOLUTION & GOVERNANCE TIMELINE



RARE BUTTERFLY SPECIES & CULTURAL SYNERGY



Papilio elephenor
(Yellow-crested Spangle)



Byasa dasarada
(Great Windmill)



Swinhoe's Flat
(*Celaenorrhinus zea*)



Araotes lapithis
(the witch)

Bio-Indicators
Bio-indicators, we can see signs of culture, biodiversity and environmental processes

Culture-Ecology Linkage
Culture-ecology plants and cultural development & mechanism



Bagurumba dance

MULTIDIMENSIONAL ANALYSIS (RELEVANCE)



MULTIDIMENSIONAL ANALYSIS (IMPACT ASSESSMENT)



UPSC CSE SYLLABUS MAP (RELEVANCE)



WAY FORWARD & SOLUTIONS



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What did SCOTUS rule on birthright citizenship?

Why and how did U.S. President Donald Trump seek to limit birthright citizenship and what did the Supreme Court rule? Has this always been a political issue in the US? What is the link between birthright citizenship and slavery? How has the judgment affected MAGA supporters?

Yarghese K. George

The story so far:

In June 30, 2026, the Supreme Court of the United States (SCOTUS) upheld birthright citizenship provided under the 14th Amendment to the U.S. Constitution. The SCOTUS struck down President Donald Trump's Executive Order (EO) 14160, which sought to end unconditional birthright citizenship that the U.S. grants. With the 6-3 judgment, anyone who is born on U.S. soil becomes a citizen, regardless of the status of their parents. Exceptions include children of foreign diplomats and invading militaries.

What did Trump's executive order say?

Mr. Trump's EO directed federal agencies to stop issuing citizenship-recognising documents – social security numbers and passports – to children born after February 19, 2025 (i) to mothers unlawfully present when the father was not a citizen or lawful permanent resident, or (ii) to mothers lawfully but temporarily present (students, tourists, guest workers) when the father was not a citizen or permanent resident.

What provisions of the U.S. legal system allow and protect birthright citizenship?

The 14th Amendment to the U.S. Constitution, ratified in 1868, says "all persons born or naturalised in the United States, and subject to the jurisdiction thereof, are citizens of the United States and of the State wherein they reside." The Immigration and Nationality Act (INA, 1952), is the foundational body of U.S. citizenship and immigration law, which draws from the above constitutional provision with regard to birthright citizenship. The INA declares that a person born in the U.S. and

The majority judgment took the position that the framers deliberately chose sweeping, universal language so the promise wouldn't be limited to one group or vulnerable to a future court narrowing it

subject to its jurisdiction is a citizen "at birth." Among the questions that SCOTUS examined was whether birthright citizenship is only a statutory guarantee or both statutory and constitutional. One of the judges who struck down the EO – Justice Brett Kavanaugh – limited it as a statutory question.

How and when did birthright citizenship become a political issue in the U.S.?

It was Mr. Trump's 2016 presidential campaign that put the spotlight on birthright citizenship as a question of population management. This was in the broader context of the anti-immigration politics, a central concern of the politics of the 'Make American Great Again' (MAGA) movement. In fact, when the Court heard the oral arguments in the case on April 1, 2025, Mr. Trump was personally present. This showed how critical this was to his politics of influencing the population composition of the country.

But before it was adapted by Mr. Trump, birthright citizenship was more a concern of Democrats, who are traditionally more anti-immigrant than Republicans. Democratic Senator Harry Reid's 1993 Immigration Stabilization Act proposed a narrower reading of the 14th Amendment. The argument against birthright citizenship is based on the assumption that a large number of non-citizens – both authorised residents (such as visa holders) and unauthorised residents (including illegal immigrants) – were having children who would automatically become citizens at birth.

What do numbers suggest about children born to non-citizens in the U.S.?

It has been estimated that births to unauthorised immigrant mothers rose from roughly 1.2 lakh in 1990 (about 2% of all U.S. births) to a peak of approximately 3.7 lakh (3.9 lakh in 2006-2007) (roughly 9% of all U.S. births). This growth mirrored the tripling of the unauthorised immigrant population between 1990 and 2007.

After the 2008 financial crisis, the trend reversed. By 2016, births to unauthorised immigrant mothers had fallen about 36% from the 2007 peak, to roughly 2.5 lakh (about 6% of that year's U.S. births in total).

Pew Research Center's most recent analysis found that births to unauthorised or temporary-status immigrant mothers grew rapidly again between 2019 and 2023, reaching an estimated 9% of all U.S. births in 2023.

What is the argument against birthright citizenship?

Apart from its place within the broader anti-immigration politics of the MAGA movement, opposition to birthright citizenship is also rooted in allegations of its misuse. An

entire industry of 'birth tourism' facilitates expectant foreigners to give birth in the U.S. Opponents also say the 14th Amendment provision was meant to address the citizenship status of freed slaves; it cannot apply universally and unconditionally in the changed circumstances. The SCOTUS held that the text of the Constitution is clear, and changes in circumstances can't justify new meanings to it.

What is the link between slavery and birthright citizenship in the U.S.?

The evolution of the U.S. citizenship regime is closely linked to slavery and racism in the country. In the original Constitution of the U.S., there was no definition of the word citizen; instead, citizenship was guided by multiple factors. In practice, citizenship depended on the laws of individual States governing civil and political rights, including voting and property ownership. The Federal Naturalisation Act, 1790, made it clear that only "free white persons" can be eligible. The result was varied practices across the U.S.: in northern States, free Black residents had some rights including voting rights, but in southern States, citizenship was denied to them.

This changed in 1857, when the Supreme Court held that no Black person can ever be a citizen of the U.S.; and that the political community established by the Constitution did not include them at all. This followed a plea by an enslaved Black man, Dred Scott, for freedom. In 1865, the 14th Amendment abolished slavery, but the 1857 judgment stood as law, making the citizenship status of freed slaves ambiguous.

In 1866, the Civil Rights Act was passed by Congress, legislating that any person born in the country is a citizen. President Andrew Johnson vetoed it, and Congress overturned the veto. To pre-empt a future Congress or a future President from overturning it, the principle of birthright citizenship was written into the Constitution in 1868, as part of the 14th Amendment.

How did that link play in the current case?

The Trump administration argued that birthright citizenship was a remedy for the specific situation of former slaves, and the provision must be read with that narrow view.

The majority judgment took the position that the framers deliberately chose sweeping, universal language so the promise wouldn't be limited to one group or vulnerable to a future court narrowing it the way the judgment in *Dred Scott* had narrowed citizenship before.

What can we expect next?

The Trump administration has said it will pursue a legislative path to end birthright citizenship, but the move will not have enough support for a constitutional amendment in the U.S. Congress. The administration argues that an ordinary statute can achieve the objective but that is contested. For now, birthright citizenship will continue, but so will the political shogfest over it.



Activists celebrate the U.S. Supreme Court's birthright citizenship ruling, on Capitol Hill, in Washington, DC, in

- **Key Terms and Explanations**

- **Jus Soli (Birthright Citizenship):** A Latin term meaning "right of the soil." It is a principle of nationality law where citizenship is automatically conferred on any person born within the territorial jurisdiction of a country, regardless of the nationality or legal status of their parents.
- **Executive Order (EO):** A signed, written, and published directive from the President that manages operations of the federal government. EOs carry the force of law but are subject to judicial review and cannot override statutory laws or constitutional provisions.
- **The 14th Amendment (U.S. Constitution):** Ratified in 1868 during the Reconstruction era, its Citizenship Clause explicitly states: *"All persons born or naturalised in the United States, and subject to the jurisdiction thereof, are citizens of the United States and of the State wherein they reside."* This provides the constitutional bedrock for birthright citizenship.
- **Birth Tourism:** A practice where expectant mothers travel to a country with *jus soli* laws on a temporary visa specifically to give birth, ensuring their newborn automatically acquires that nation's citizenship and the long-term benefits associated with it.
- **The Dred Scott Decision (1857):** A landmark and highly controversial U.S. Supreme Court ruling (*Dred Scott v. Sandford*) which declared that African Americans, whether enslaved or free, were not and could never become citizens of the United States. This ruling was a primary catalyst for the subsequent drafting of the 14th Amendment to permanently correct this exclusion.
- **Immigration and Nationality Act (INA), 1952:** The foundational codification of federal immigration law in the United States. It outlines the statutory framework for visas, naturalization, enforcement, and legal residency, operating directly downstream from the constitutional mandates of the 14th Amendment.

- **Main Arguments and Substantive Parts**

- The core debate centers on the tension between executive-led population management and the enduring sovereignty of constitutional text. The arguments put forth by both sides highlight differing visions of national identity and legal interpretation.

- **The Core Thesis**

- The Supreme Court of the United States (SCOTUS), in its June 30, 2026 ruling, reaffirmed the absolute supremacy of constitutional text over executive action. The Court struck down Executive Order 14160, establishing that unconditional birthright citizenship cannot be altered, restricted, or dismantled by a presidential directive, as the 14th Amendment guarantees this right universally.

- **Arguments Against Unconditional Birthright Citizenship**

- **The Intent of the Framers:** Proponents of restricting birthright citizenship argue that the 14th Amendment was written with a specific, narrow historical context in mind: to guarantee citizenship to newly emancipated African Americans post-Civil War. They contend it was never intended to apply universally to the children of temporary visitors or undocumented immigrants.
- **Systemic Exploitation and "Birth Tourism":** Critics point out that unconditional *jus soli* incentivizes illegal immigration and fosters a commercialized "birth tourism" industry, where foreign nationals leverage constitutional provisions for strategic citizenship advantages.
- **Demographic and Economic Strains:** The argument positions birthright citizenship as a population-management issue. Opponents point to data showing that births to unauthorized immigrant mothers peaked significantly (reaching roughly 9% of all U.S. births in periods like 2006–2007 and 2023), placing long-term fiscal demands on state and federal infrastructure.

- **The Judicial Reasoning and Majority Opinion**

- **Deliberate and Universal Language:** The majority judgment emphasized that the framers of the 14th Amendment deliberately chose sweeping, inclusive language (*"all persons born..."*) rather than restrictive phrasing. This choice was intentionally made to ensure the promise of citizenship could not be narrowed or compromised by future courts or political administrations.
- **Protection Against Political Whims:** The ruling clarified that changes in national demographics or geopolitical circumstances cannot justify assigning new meanings to clear constitutional text. If a policy shift is desired, it must occur through rigorous legislative or constitutional processes, not through executive fiat.
- **Statutory vs. Constitutional Boundaries:** While some jurists viewed aspects of the challenge through a statutory lens via the Immigration and Nationality Act (INA), the collective ruling firmly established that the right is constitutionally anchored, making it immune to unilateral executive reinterpretation.

• **Historical Evolution of the Issue**

• The journey of citizenship law is a reflection of a nation's internal struggles with race, inclusion, and the definition of belonging. Tracing this timeline reveals how a provision meant to fix a historical injustice became the epicenter of modern immigration debates.

- **1790 (The Federal Naturalisation Act):** The early American state lacked a clear, universal definition of citizenship. The Naturalisation Act of 1790 restricted eligibility for citizenship via naturalization strictly to "free white persons," leaving the status of indigenous peoples, enslaved individuals, and non-white immigrants deeply fragmented and state-dependent.
 - **1857 (The Dred Scott Judgment):** The legal fragmentation culminated in the infamous *Dred Scott* ruling, where the Supreme Court held that no Black person could claim U.S. citizenship. This created a profound legal crisis, anchoring institutional racism into the judicial interpretation of the founding documents.
 - **1865–1866 (The Post-Civil War Legislative Battle):** Following the abolition of slavery via the 13th Amendment (1865), the legal status of freed individuals remained precariously ambiguous. Congress passed the Civil Rights Act of 1866 to grant birthright citizenship. Despite being vetoed by President Andrew Johnson, Congress overrode the veto to protect the law.
 - **1868 (Ratification of the 14th Amendment):** To insulate the principle of birthright citizenship from being overturned by future congressional majorities or hostile presidents, the rule was permanently enshrined in the U.S. Constitution under the 14th Amendment.
 - **1990s (Emergence of Bipartisan Restructuring Debates):** Modern anxiety over demographics is not entirely new or unilateral. In 1993, Democratic Senator Harry Reid introduced the Immigration Stabilization Act, which sought a narrower reading of the 14th Amendment, indicating early legislative discomfort with unconditional *jus soli*.
 - **2006–2023 (Demographic Ebbs and Flows):** Data tracks a major surge in births to unauthorized immigrant mothers, peaking at 3.7–3.9 lakh (9% of U.S. births) in 2006–2007, declining after the 2008 financial crash to about 6% in 2016, and climbing back to an estimated 9% by 2023. These numbers regularized immigration as a central electoral talking point.
 - **2026 (The Constitutional Showdown):** The issue reached its modern peak when President Donald Trump issued Executive Order 14160 to halt birthright documents for specific immigrant categories. This culminated in the landmark June 30, 2026 Supreme Court decision that struck down the order and firmly upheld the historic, universal application of *jus soli*.
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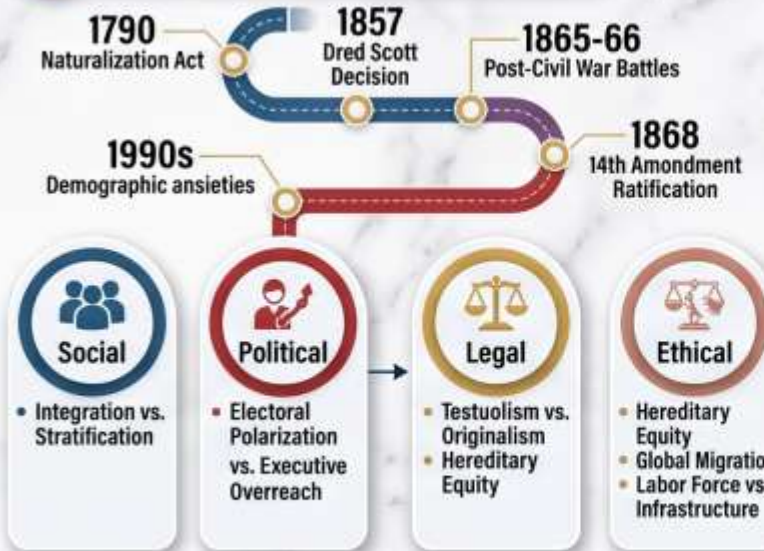
- **Way Forward**

- **Respecting Legislative and Constitutional Paths:** If a sovereign state needs to update its citizenship framework to reflect shifting demographics, it must do so through formal legislative consensus or constitutional amendments. Bypassing these established processes via executive orders damages the rule of law and creates long-term policy uncertainty.
 - **Targeted Administrative Measures:** Concerns like "birth tourism" can be managed through precise consular oversight and stricter enforcement of visa rules, rather than applying broad measures that risk stripping vulnerable populations of their core rights.
 - **Comprehensive Immigration Reform:** Governments should focus on updating legal immigration pathways and creating regularized frameworks for essential workers. Addressing the root causes of undocumented migration reduces the legal friction surrounding children born to non-citizen parents.
 - **Global Policy Coordination:** Nations facing migration challenges should collaborate with countries of origin to improve economic opportunities and security conditions there. Managing migration at its source naturally eases demographic strains on destination states without requiring restrictive adjustments to foundational human rights laws.
-
- **UPSC Civil Services Examination (Mains)**
 - **GS Paper 2 (2024):** "The Indian legal system has transitioned significantly from a birth-based citizenship model toward one defined by lineage and legal status, largely driven by national security considerations. Compare and contrast this approach with the constitutional protections offered under the U.S. legal system."
 - **GS Paper 2 (2018):** "Examine the scope of Judicial Review in the context of executive actions in India and compare it with the trend observed in Western democracies, particularly the United States."
 - **GS Paper 2 (2015):** "What are the main features of the comparative method of studying constitutions? Discuss how comparing the Indian constitutional scheme with other vibrant democracies enriches our understanding of fundamental rights."

KEY CONCEPTS & DEFINITIONS



HISTORICAL EVOLUTION



THE CONSTITUTIONAL SHOWDOWN



WAY FORWARD: SUSTAINABLE POLICY ARCHITECTURE



THE DEBATE & ARGUMENTS

Recreating the philosophical crossroads:

UNIVERSALISM & CONSTITUTIONAL TEXTUALISM

VS

PARTICULARISM & ORIGINAL INTENT

- Intent of Framers
- Systemic Exploitation ("Birth Tourism")
- Demographic & Economic Strains

- Intent of Framers
- Systemic Exploitation ("Birth Tourism")
- Demographic & Economic Strains

MULTIDIMENSIONAL ANALYSIS



NCERT & UPSC LINKAGES



PYQ FOCUS (CIVIL SERVICES EXAMINATION)

- Key themes across U.S. Birthright Citizenship
- 2026 Year: Constitutional Showdown
- 2027 Year: "Conformative Birthright Citizenship"
- 2029: Peak Demographic and Economic Strains

A race to catch up

GLM-5.2

Researchers say Zai's most advanced LLM can seriously challenge leading U.S. systems in specialised coding and cybersecurity tasks

Smriti Sudesh

“Won't take that long.” That was Tang Jie's response after billionaire businessman Elon Musk posted that Chinese artificial intelligence companies were still years away from matching the world's leading AI models. Less than two weeks later, Mr. Tang, the 49-year-old co-founder of Zhipu AI, set out to back up his claim.

On June 16, Zhipu AI (Zai), listed in Hong Kong as Knowledge Atlas Technology, unveiled GLM-5.2, its most advanced large language model yet, alongside ZCode, an AI coding platform designed to write, edit and manage software. Early results suggest the model is now competing closely with Anthropic's latest systems, including Mythos, adding momentum to China's AI race with the U.S. The timing could hardly have been more significant. While American companies continue to dominate the frontier of AI, the U.S. has tightened export controls on advanced chips and AI technologies in an effort to slow Beijing's progress. China, meanwhile, has doubled down on home-grown innovation. Over the past year, companies such as DeepSeek, Alibaba, Baidu and Moonshot AI have unveiled increasingly



REUTERS

capable models. Zai is now seeking to join the list.

Born in China, Tang Jie, also a professor of computer science at Tsinghua University, co-founded Zhipu AI in 2019 as a university spin-off and today serves as its chief scientist. Before launching the company, Mr. Tang was best known for creating AMiner, an academic search engine and knowledge graph platform used by researchers around the world.

Since its founding, Zai has steadily released successive generations of its GLM (Generative Pre-trained Language Models) family of language models, with each version edging closer to the capabilities of leading American systems. GLM-5.2 is the company's biggest leap so far. Researchers say GLM-5.2 is among the first to seriously challenge leading U.S. systems in specialised coding and cybersecurity tasks.

In tests conducted by cybersecurity firm Semgrep, GLM-5.2 outper-

formed Anthropic's Claude Opus 4.8 on certain software engineering tasks. In other evaluations, researchers found it could match the bug-finding capabilities of Anthropic's frontier models. The model has also climbed into the top 10 most-used AI systems on OpenRouter, a platform that provides developers access to hundreds of AI models.

'DeepSeek moment'

The launch has drawn comparisons with DeepSeek, the Chinese startup whose breakthrough model shook the global AI industry last year. According to *South China Morning Post*, some developers in Silicon Valley have described GLM-5.2 as another 'DeepSeek moment' for China's open-source AI ecosystem, praising both its coding capabilities and its affordability.

According to *The Wall Street Journal*, unlike OpenAI's ChatGPT or Anthropic's Claude, GLM-5.2 has

been released as an open-weight model. In simple terms, developers can download, modify and run it on their own hardware rather than relying on Zai's servers. Supporters say that makes cutting-edge AI significantly cheaper and more accessible. Critics, on the other hand, argue the same openness could allow hackers and malicious actors to deploy AI systems without the many safeguards imposed by commercial providers.

Alongside the model, Zai has also introduced ZCode, a coding assistant that can write, edit and manage software projects with minimal human input. Together, the company says, the two products are designed to make AI a more capable partner for software developers.

Yet, for all the excitement, GLM-5.2 is not without its critics. Researchers note that it still trails OpenAI and Anthropic on several complex reasoning and general-purpose tasks. Others point to the constraints Chinese AI companies continue to face because of U.S. restrictions on access to advanced semiconductor hardware.

According to Zai, however, the model delivers near-frontier performance at a fraction of the price charged by comparable proprietary systems.

- **Key Terms and Explanations**

- **Large Language Models (LLMs):** These are advanced deep learning algorithms trained on massive datasets to understand, summarize, generate, and predict textual content. They operate on probability matrices to predict the next logical token or word in a sequence.

- *Conceptual Example:* Think of a highly sophisticated predictive text engine on a smartphone, scaled up billions of times, capable of drafting an entire legal contract or writing a python script based on a simple prompt.

- **Open-Weight vs. Closed-Source Models:** Open-weight models occupy a middle ground in the software ecosystem. While the architecture and model parameters (weights) are public—allowing developers to download, host, and modify the system locally—the raw training data or exact recipe remains proprietary. Closed-source models, by contrast, hide these parameters behind a paid interface (API), forcing absolute reliance on the creator's servers.

- *Conceptual Example:* An open-weight model is like a master chef sharing a complex recipe secret where you can adjust the spices at home on your own stove. A closed-source model is like eating at a high-end restaurant where you can only consume the final dish but can never enter the kitchen.

- **Frontier AI:** This refers to the most highly advanced, capabilities-dense AI systems that operate at the absolute edge of technological possibility. These models possess broad, general-purpose capabilities and occasionally display emergent behaviors that surprise even their creators.

- **Semantic Code Analysis and Optimization Platforms:** These are automated systems designed to read, analyze, and debug software code by understanding its underlying logic rather than just checking text patterns. Tools like Semgrep evaluate how data flows through a program to catch hidden vulnerabilities before deployment.

- **Geopolitical Tech Decoupling and Export Controls:** The strategic deployment of trade restrictions, tariffs, and technological embargoes by nation-states to limit a rival power's access to critical infrastructure. Currently, this manifests as restrictions on high-end graphic processing units (GPUs) and semiconductor manufacturing equipment to maintain strategic asymmetric advantages.

- **Main Arguments and Substantive Parts**

- The contemporary discourse surrounding artificial intelligence highlights a structural pivot: the global AI landscape is transitioning from a unilateral frontier dominated by the United States to a highly competitive, multi-polar race. This shift is characterized by innovative workarounds to hardware limitations and an aggressive turn toward open-source democratization.

- **The Core Thesis**

- The central argument posits that Western dominance in generative AI is facing intense competition from alternative hubs. By focusing on algorithmic efficiency, targeted open-weight models, and specialized domains like software engineering and cybersecurity, non-Western actors are matching or exceeding frontier performance, effectively bypassing stringent hardware sanctions.

- **The Specialized Performance Pivot**

- **Domain-Specific Excellence:** Rather than striving purely for massive, general-purpose models that demand astronomical computational power, contemporary innovations focus on specialized mastery. In areas like autonomous coding, software architecture, and vulnerability detection, these models match or outperform Western frontier models.

- **Algorithmic Arbitrage over Raw Compute:** When access to physical hardware like advanced semiconductor chips is restricted, the focus shifts to software optimization. Developers are squeezing maximum efficiency out of existing computing architectures, proving that smarter software design can neutralize hardware bottlenecks.

- **The Economics of Open-Weight Disruption**

- **The Demolition of Cost Barriers:** Frontier performance was historically tied to massive capital expenditure. The rise of sophisticated open-weight alternatives allows developers worldwide to deploy near-frontier models at a fraction of the cost, completely altering the economics of the global software industry.

- **The Security Dilemma of Open Access:** This democratization presents a double-edged sword. While it fuels decentralized innovation, it removes institutional safety guardrails. Without API controls, malicious actors can strip safety filters and repurpose these advanced systems for automated cyber-attacks.

- **Historical Evolution of the Issue**

- **Pre-2010s: The Era of Theoretical Foundations and Early Academic Hubs:** For decades, artificial intelligence research was confined to university labs, largely concentrated in the United States and Western Europe. Progress was slow due to a lack of computational power, and the field experienced cyclical "AI winters" where funding dried up due to overhyped expectations.
- **2010–2017: The Deep Learning Boom and State-Level Mobilization:** The convergence of massive datasets and modern GPUs sparked a deep learning renaissance. Recognizing this shift, nations globally began drafting formal national strategies. A key milestone occurred in 2017 when major global players outlined explicit roadmaps to achieve global AI leadership, signaling that AI had shifted from a corporate interest to a matter of statecraft.
- **2018–2022: The Transformer Revolution and Geopolitical Frictions:** The invention of the Transformer architecture paved the way for modern Large Language Models. As these models demonstrated early signs of commercial and strategic dominance, technology became a primary point of friction. The global community witnessed the early stages of supply chain protectionism, particularly around semiconductor foundries.
- **2022–2024: The Breakthrough Shock and the Implementation of Chip Sanctions:** The public release of highly capable conversational AI models fundamentally altered public and political awareness. In response to rapid advancements by systemic rivals, the United States implemented strict export controls. These sanctions targeted advanced computing chips and lithography machines, seeking to limit competitors' ability to train frontier-level models.
- **2025–Present: The Open-Weight Counter-Wave and Algorithmic Resilience:** Instead of halting progress, hardware constraints forced a wave of localized innovation. The global AI ecosystem is now defined by the rise of highly optimized open-weight models that match frontier capabilities at a fraction of the cost, shifting the geopolitical bottleneck from hardware ownership to algorithmic ingenuity.

THE GLOBAL RACE: SPECIALIZED, OPEN-WEIGHT MODELS & GEOPOLITICAL DECOUPLING

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The Challenge of Chip Sanctions

2 SPECIALIZED LLM CAPABILITIES: BYPASSING COMPUTE LIMITS

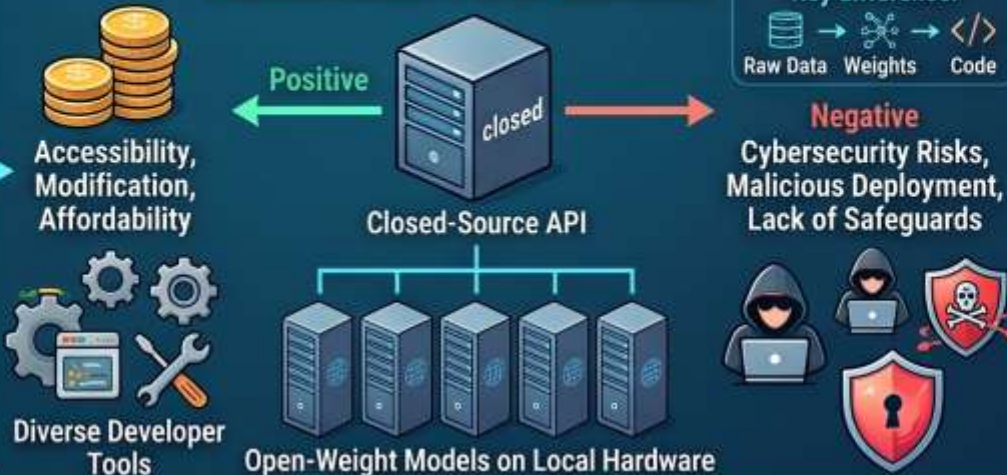


ZCode Coding Platform

- Near-Frontier Performance for Specialized Tasks
- Cost-Effective Algorithmic Arbitrage



3 OPEN-WEIGHT DEMOCRATIZATION: MECHANISM & DILEMMA



4 MULTIDIMENSIONAL IMPACT



On the cusp of big upgrade, CERN collider faces hard question

As the Large Hadron Collider switches off its beams for a four-year overhaul costing \$1.5 billion, the question is no longer what it has found but whether something even bigger is worth building

Jacob Koshy
GENEVA

The heatwave sapping Europe this June did not spare CERN – the European Organisation for Nuclear Research – whose dull grey buildings give little hint of the underground that sets the lab apart from any other hive of colossal engineering on earth. Here, in tunnels beneath the Franco-Swiss border, physicists drive protons – among the particles at the heart of every atom – to a sliver below the speed of light and smash them together, reading the debris for clues to how the universe is built. The machine that does this is called the Large Hadron Collider (LHC).

At the 'A Large Ion Collider Experiment' (ALICE) detector, one of four that make sense of those collisions, scientists sit glued to monitors, watching the multicoloured swarms of particles each collision leaves behind. Somewhere in that mess, they hope, is a sign of new matter, a clue to why matter alone survived or something else that has eluded the physicists probing the first fractions of a second after the Big Bang.

This July, the control centre will go quiet as the LHC's beams are turned off ahead of its third 'Long Shutdown'. In the next four years and at an expense of roughly \$1.5 bil-

The Lord of the Rings

CERN's flagship machine runs to around 2041; a successor must be conceived now or not at all



A view of the LHC tunnel. PHOTO BY DREW CERN

lion, the LHC will be upgraded to its 'High-Luminosity' version.

The classic image of the LHC is its 27-km ring a hundred metres underground. Inside, protons are energised step by step to 6.8 teraelectronvolts (TeV) per beam. One TeV is about the energy of a flying mosquito. Trivial as that sounds, the LHC crams that whole mosquito's worth into a speck a trillion times smaller, packing the energy so densely that a single collision briefly recreates the furnace of the newborn universe.

If the upgrade goes to plan, the proton beams will zip around at the same TeV but collide five times more often. This is literally more bang for buck as it translates to greater odds

of sighting exotic particles.

Since its first collisions in 2009, the LHC's high point remains the discovery of the Higgs boson in 2012 – the particle tied to a field that gives elementary particles their mass.

"We were very lucky with the Higgs boson, that within the first few years of operation we found it," Archana Sharma, a CERN physicist and among the first Indians the laboratory employed, told The Hindu. "Now, perhaps dark matter is around the corner, and we need more data, and this is exactly why we are upgrading the LHC."

The LHC has only confirmed what the Standard Model theory has already predicted. Ordinary matter is built from quarks – the elementary grains that

• The Large Hadron Collider (LHC) is poised for four years for a \$1.5-billion upgrade that will turn it into its 'High-Luminosity' version

• Physicists are hoping the higher collision rate post-upgrade will reveal what dark matter is and other elusive physical signals

• Physicists are searching for new phenomena because the Standard Model can't explain dark matter's existence, and other anomalies

• Recent experiments at the LHC investigated the fundamental imbalance between matter and antimatter within our vast universe

• CERN has also endorsed a new 91-kilometer-long collider to explore the universe's greatest mysteries after the LHC's time

• Despite the high costs and scepticism among some physicists, international collaboration remains vital to push the boundaries of particle physics

of discovering signs of dark energy, dark matter, and a theory that can accommodate the Standard Model as well as what it can't explain. These signs have stubbornly failed to appear so far.

The LHC runs to about 2041; a successor must be conceived now or not at all. In May 2026, the CERN Council endorsed the Future Circular Collider (FCC) as a 91-km-long tunnel. A build-or-abandon decision is due around 2028. The current cost estimate is nearly \$19 billion. A 100-TeV proton machine might follow later, perhaps in the 2070s.

Not all are convinced. In its first phase, the FCC will smash particles at lower energies than the LHC does today, because it will be built for precision, not raw power. But the physicist Sabine Hossenfelder has long argued that such a machine would mostly pin down quantities already known, just to a few more decimal places.

Whether that ambition survives an age of war and frayed exchequers is the harder question. At CERN, Dr. Sharma noted, "for every penny there is a huge discussion", then consensus. India has worked at CERN since the 1960s; her wish is that its industry join at the design stage rather than miss the boat.

(The author was at CERN as part of a media visit organised by the Swiss Department of Foreign Affairs)

bunch in twos and threes inside the protons and neutrons of every atom – held together by the strong force. The LHC has verified this architecture in fine detail. It has also verified the existence of about 80 new hadrons, the composite particles quarks form. Its heavy-ion collisions have briefly created the quark-gluon plasma, the searing soup of unbound particles that filled the universe in its first microseconds. It has drawn ever-tighter limits on where undiscovered particles cannot be hiding, probed why matter so narrowly outlasted its mirror-twin antimatter, and measured numbers that feed astrophysics.

The upgrades and future plans for an even bigger collider are in the hope

- **Key Terms and Explanations**
- **Large Hadron Collider (LHC):** The world's largest and most powerful particle accelerator, housed in a 27-kilometer subterranean ring beneath the Franco-Swiss border. It accelerates beams of protons or ions to nearly the speed of light before smashing them together to study the fundamental debris of the universe.
- **High-Luminosity LHC (HL-LHC):** A major structural upgrade designed to drastically increase the "luminosity" or collision rate of the LHC. By producing five times more collisions than the original machine, it allows scientists to gather massive volumes of data, increasing the mathematical probability of discovering rare, exotic particles.
- **The Standard Model of Particle Physics:** The overarching theoretical framework that describes three of the four fundamental forces of nature (strong, weak, and electromagnetic forces, leaving out gravity) and classifies all known subatomic particles. Think of it as the ultimate periodic table for the basic building blocks of the universe.
- **Higgs Boson:** Discovered at CERN in 2012, this elementary particle is the physical manifestation of the Higgs field, which permeates space and imparts mass to other fundamental particles. Without it, matter as we know it would not exist.
- **Quark-Gluon Plasma (QGP):** An ultra-dense, high-energy state of matter where composite particles like protons and neutrons melt into a "soup" of free-floating quarks and gluons. This state briefly replicates the exact physical conditions of the universe within its first few microseconds after the Big Bang.
- **Future Circular Collider (FCC):** A proposed, next-generation 91-kilometer ring collider envisioned as the successor to the LHC. It aims to push the boundaries of energy levels and precision testing forward into the latter half of the 21st century.
- **Dark Matter and Dark Energy:** Mysterious, invisible components that collectively make up roughly 95% of the universe. They cannot be directly observed or explained by the Standard Model, making them the holy grail of modern physics.
- **Main Arguments and Substantive Parts**
- The discourse around modern experimental physics revolves around a critical tension: the pursuit of fundamental cosmic truths versus the fiscal realities of hosting mega-science projects during periods of global economic strain.
- **The Core Thesis:** Fundamental physics has reached a pivotal crossroads. While the Standard Model has been spectacularly validated, it remains incomplete because it fails to explain phenomena like dark matter. Resolving these anomalies requires an unprecedented scale of engineering and capital, triggering an intense debate over whether the potential scientific returns justify the massive economic investments.
- **The Case for Capital Upgrades and Expansion:** Proponents of projects like the HL-LHC and the proposed FCC argue that science cannot advance without data. The current LHC has confirmed what we already predicted, but it has not broken through to "new physics." By dramatically increasing collision frequencies, the upgraded HL-LHC seeks to force anomalies into view, giving researchers the raw data needed to locate dark matter and understand the matter-antimatter imbalance that allowed our universe to exist.
- **The Sceptic's Counter-Argument:** Critics voice significant concern over the law of diminishing returns. The early phases of a massive project like the FCC may prioritize structural precision over raw power, potentially smashing particles at lower energies than the current LHC configuration. Sceptics argue that spending tens of billions of dollars simply to pin down existing numbers to a few more decimal places—without any guarantee of finding new particles—is an inefficient use of global scientific funds.
- **The Geopolitical and Financial Subtext:** Mega-science no longer operates in an economic vacuum. In an era marked by geopolitical conflict and strained national exchequers, funding bodies are scrutinizing every penny. The decision to commit to a multi-billion-dollar project requires an absolute international consensus, making the upcoming decade a defining moment for the future of global collaborative science.

- **Historical Evolution of the Issue**
- **The Post-War Genesis (1950s–1960s):** Founded in 1954, CERN emerged as a beacon of post-WWII European integration, pooling resources to prevent a scientific brain drain to the United States. Recognizing the immense value of fundamental research, India began building informal collaborative bridges with CERN as early as the 1960s, driven by its early leadership in nuclear and cosmic ray physics.
- **The Era of Mega-Colliders (1970s–2000s):** As the questions in physics grew larger, the machines required to answer them outgrew individual national budgets. This era saw the design and eventual construction of the 27-km LHC. India became a crucial partner during this phase, contributing sophisticated hardware—such as precision magnets and detectors—alongside top-tier intellectual capital.
- **The Triumph of the Standard Model (2012–2017):** The discovery of the Higgs Boson in 2012 marked a historic milestone, validating decades of theoretical predictions. Recognizing its deep institutional footprints in the CMS and ALICE experiments, India formally elevated its status, becoming an Associate Member State of CERN in 2017. This opened the door for Indian industries to bid directly for high-tech CERN contracts.
- **The Modern Conundrum (2026 and Beyond):** With the endorsement of the 91-km FCC framework, the scientific community faces a critical transition. The upcoming timeline demands a definitive "build-or-abandon" decision, forcing participating nations to decide whether to embark on a multi-decade financial and engineering commitment.
- **Way Forward**
- **Adopting a Phased and Modular Financial Framework:** Rather than committing to a massive, multi-billion-dollar upfront expense for projects like the FCC, international consortia should implement a milestone-based, modular construction strategy. This approach allows funding states to review progress at every phase, ensuring that investments scale up only as specific technical and precision benchmarks are met.
- **Maximizing Commercial and Industrial Spillovers:** To justify the use of public funds, mega-science labs must actively build bridges with the private sector during the initial design phase. By deliberately steering research toward marketable spin-offs in fields like quantum computing, advanced metallurgy, and green cryogenics, these facilities can generate direct economic returns long before any new particles are discovered.
- **Deepening India's Role from Component Supplier to Co-Designer:** For countries like India, the goal should be moving beyond simply manufacturing precision parts to taking a leading role in the conceptual and architectural design phases of next-generation machines. This strategic shift ensures that domestic scientists and engineers acquire high-value intellectual capital, which can then be used to accelerate indigenous tech ecosystems back home.
- **Emphasizing Hybrid Experimental Models:** To mitigate the high costs of building ever-larger physical tunnels, the global scientific community should expand funding for alternative, hybrid research methods. Investing in cosmic-ray observatories, space-based telescopes, and high-precision, low-energy table-top physics experiments can complement collider data, offering alternative pathways to uncovering dark matter.



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CERN'S LARGE HADRON COLLIDER: UPGRADE & THE FUTURE COLLIDER (FCC) DEBATE - A COMPREHENSIVE UPSC ANALYSIS

KEY TERMS

Large Hadron Collider (LHC) Large hadron neoclassical obsolescence of the standard anomaly of curvatures and egotism.	Standard Model Definitions of various atomism atom.	Higgs Boson Higgs field effect effect error combinatorial fields.
Quark-Gluon Plasma (QGP) Quark-Gluon Maori promotes to peace experience.	Future Circular Collider (FCC) Dark matter relativists relativists distant rotations izetionary relativists inion galaxy ecosystem.	Dark Matter/Energy Energy

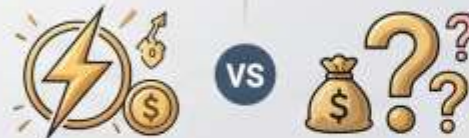
MAIN ARGUMENTS

PRO: Upgrades & Exploration

- Increase luminosity 5x
- Force anomalies to light
- Confirm Standard Model

CON: High Cost & Scepticism

- \$19B cost for FCC
- Precision vs. raw power
- Diminishing returns



HISTORICAL EVOLUTION



MULTIDIMENSIONAL ANALYSIS

Social Public imagination vs. resources	Political Soft power, diplomacy, India's voice	Legal Cross-border ops, IPR spillovers (Medical imaging)	Ethical Resource prioritization, pure vs. applied science	International Multilateral collaboration, borderless ecosystem	Economic Immense capital investment, transformative spillovers (WWW, cryogenics)
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HL-LHC UPGRADE (High-Luminosity LHC)



FCC (Future Circular Collider)

The HL-LHC upgrade increases collision rates, while the proposed 91-km FCC (Future Circular Collider) aims for raw power and precision, sparking a debate on diminishing returns and massive costs vs. new physics.

UPSC CSE SYLLABUS LINKAGES

GS3 (Science & Tech, Achievements, Indigenization)	GS4 (Ethics, Public Funds, Welfare vs. Science)
ESSAY (Science and Human Ambition)	OPTIONALS (Physics, Philosophy)

INDIA'S ROLE & BENEFIT

Associate Member (Since 2017)	Hardware contributions (Magnets, Detectors)
Intellectual capital (CMS, ALICE)	Industrial opportunities and co-design

WAY FORWARD

Balanced solutions:	
Phased and Modular Funding (FCC checkpoints)	Deepening Indian Role (co-designer status)
Spillover Focus (marketable spin-offs)	Hybrid Experimental Models (Cosmic rays, telescopes)

UPSC PYQs: Specially Prelims

- GS3 (2018):** India's Role in LHC
- GS3 (2019):** Mega-Science projects vs. scarce resources
- GS4 (2021):** Science curiosity vs. state needs
- Prelims (2013):** Higgs Boson definition
- Prelims (2016):** S&T terms (Standard Model, Singularity, String Theory)



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