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# Daily

# **CURRENT AFFAIRS**

 January 21st, 2026



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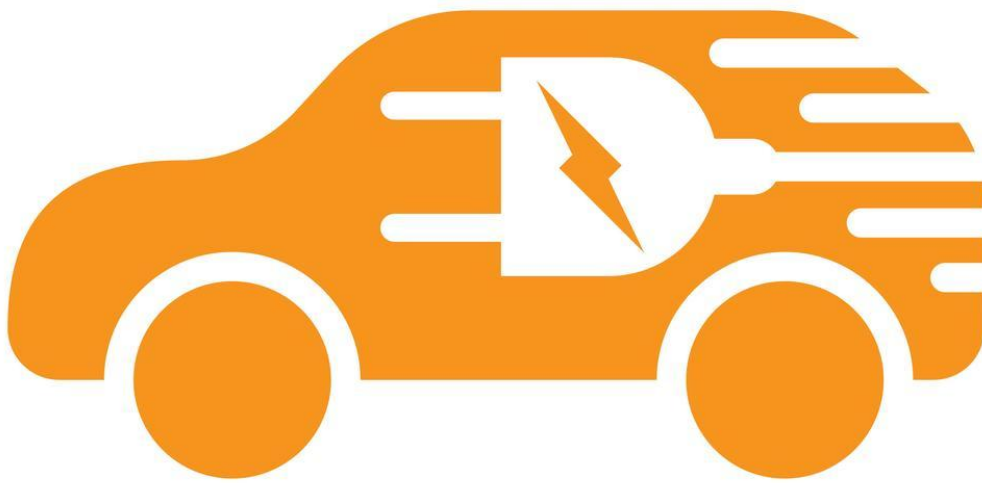
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# 1. The EV boom is accelerating a copper crunch

## Why in the News?

The rapid global adoption of electric vehicles (EVs) is intensifying concerns about a looming copper crunch. While EVs are central to decarbonisation strategies, recent data shows that copper demand linked to EV batteries, motors, wiring, charging stations, and power grids is rising faster than supply. With projections indicating a structural copper deficit emerging as early as 2026, analysts warn that material constraints—rather than technology or policy—may soon dictate the pace of the EV transition.



## Background

- Copper is the backbone of electrification. Compared to internal combustion engine (ICE) vehicles, EVs require four to five times more copper, making the metal indispensable to the green transition.
- Over the last decade, EVs have moved from niche products to the fastest-growing segment of the global automobile industry. Between 2015 and 2025, global EV sales rose from about 0.55 million to nearly 20 million units.
- In the same period, EV-related copper consumption surged from roughly 27,500 tonnes to over 1.28 million tonnes, revealing copper as the hidden driver of the EV revolution.
- However, copper supply has failed to keep pace due to long mine development cycles (10–15 years), declining ore grades, environmental opposition, and chronic underinvestment in new capacity.
- This mismatch is transforming the EV transition into a resource-constrained transformation, not merely a technological one.

## Feature

One striking feature of the EV boom is the near one-to-one relationship between EV sales growth and copper demand.

- Between 2016 and 2024, copper demand elasticity with respect to EV sales mostly exceeded 1.0, meaning copper consumption grew faster than EV adoption.
- EV-related copper demand jumped from around 39,000 tonnes in 2016 to over 1.1 million tonnes in 2024, while EV sales expanded from 0.75 million to nearly 17 million units.
- In 2019, elasticity peaked at 1.76, driven by larger battery packs, increased power electronics, and the rapid expansion of charging infrastructure.
- Although efficiency gains may reduce elasticity to around 0.9 by 2025, absolute copper demand will continue to rise because of the sheer scale of EV deployment.

## Challenge: Entering a Global Copper Deficit Phase

- While demand accelerates, supply growth is plateauing, creating what analysts describe as a “jaw-opening deficit.”
- Declining ore grades in existing mines
- Environmental and social resistance in major producers like Chile, Peru, and the U.S.
- Lengthy approval and construction timelines for new mines
- In 2024, global supply may exceed demand by about 0.3 million tonnes, but by 2026, demand is projected to touch 30 million tonnes, while supply lags near 28 million tonnes. The deficit could widen to 4.5 million tonnes by 2028 and nearly 8 million tonnes by 2030, equivalent to the combined output of the world’s ten largest copper mines.

## Such shortages could:

- Raise EV production costs
- Delay charging infrastructure rollout
- Undermine global decarbonisation targets
- Copper scarcity, rather than battery chemistry, may soon become the main bottleneck of electrification.

## Way Forward

To prevent geology from dictating climate ambition, coordinated global action is essential:

### Scaling up recycling

- Urban mining and circular economy models can significantly reduce primary copper dependence.
- EV batteries, power cables, and electronics offer high recycling potential.

### Accelerating responsible mining

- Streamlining approvals while maintaining environmental safeguards.
- Investing in technologies to improve recovery from low-grade ores.

### Material and design innovation

- Reducing copper intensity through improved motor design and power electronics.
- Exploring partial substitutes where feasible, without compromising efficiency.

### Strategic resource diplomacy

- Long-term supply agreements with copper-rich regions.

- Integrating critical minerals into energy security planning, especially for emerging EV markets like India.

## Conclusion

The EV revolution is not only transforming mobility but also reshaping the global metals economy. Copper has emerged as the vital artery of electrification, and the world is approaching an unprecedented phase where demand may decisively outstrip supply. For policymakers, investors, and planners, the lesson is clear: the energy transition is inseparable from resource strategy.

## 2. DGCA directs airline operators to appoint a 'chief of flight safety'

### Why in the News?

India's aviation regulator, the Directorate General of Civil Aviation (DGCA), has directed all airline operators to appoint a 'Chief of Flight Safety' and establish a dedicated Flight Safety Department. The move follows repeated findings from accident and incident investigations that point to recurring causal factors and systemic deficiencies in aviation operations.



### Background

- India's aviation sector has witnessed rapid expansion in traffic, fleet size, and operational complexity.
- Traditionally, aviation safety improvements relied heavily on reactive measures, i.e., learning from accidents after they occurred.

- Global aviation standards now emphasise Safety Management Systems (SMS), which promote a proactive and preventive safety culture.
- Investigations in India have shown that without strong institutional leadership for safety, lessons from past incidents do not always translate into systemic reform.

## Features

### **Appointment of Chief of Flight Safety (CFS):**

- Responsible for oversight and implementation of safety protocols.

### **Creation of a Flight Safety Department:**

- Staffed with an adequate number of competent personnel.

### **Deputy Chief of Flight Safety:**

- Mandatory nomination.
- Cross-functional requirement:
- If CFS is a pilot, the deputy must be an engineer, and vice versa.

### **Integration with Safety Management System (SMS):**

- Safety awareness and accident/incident prevention programmes must be aligned with SMS.

### **Internal Safety Audits:**

- Mandatory audits across operations, maintenance, and ground support services.

### **Crew Fatigue Management:**

- Enforcement of Flight and Duty Time Limitations (FDTL) to prevent fatigue-related risks.

### **Applicability:**

- Applies to scheduled, non-scheduled, and cargo airline operators.

## Challenges

### **Compliance Burden for Smaller Operators**

- Regional and non-scheduled operators may face manpower and cost constraints.

### **Availability of Skilled Safety Professionals**

- Limited pool of experienced aviation safety experts with SMS expertise.

### **Cultural Resistance**

- Transition from a compliance-based mindset to a just-in-time and reporting-oriented safety culture can face internal resistance.

### **Effective Enforcement**

- Mere creation of posts without functional autonomy may reduce the reform to a box-ticking exercise.

### **Way Forward**

#### **Capacity Building**

- DGCA should support training and certification programmes in aviation safety and SMS.

#### **Ensuring Independence of Safety Function**

- The Chief of Flight Safety should have operational independence and direct access to top management.

#### **Digital Safety Reporting Systems**

- Anonymous, non-punitive reporting platforms to encourage hazard reporting.

#### **Periodic Regulatory Audits**

- DGCA to conduct outcome-based audits, not just document-based inspections.

#### **Alignment with Global Best Practices**

- Harmonisation with ICAO safety oversight and global benchmarks.

### **Conclusion**

The DGCA's directive marks a structural shift from reactive to preventive aviation safety governance in India. By institutionalising safety leadership through a Chief of Flight Safety and embedding SMS across airline operations, the regulator aims to strengthen systemic resilience, accountability, and safety culture. The success of this reform, however, will depend on genuine implementation, skilled personnel, and regulatory vigilance, rather than mere formal compliance.

## **3. The 'Donroe doctrine', a broken international order**

### **Why in the News?**

The concept of the 'Donroe Doctrine' has entered strategic discourse after the United States, under President Donald Trump, carried out an extraordinary operation in early 2026 by abducting Venezuelan President Nicolás Maduro and incarcerating him in the U.S. This act, justified by Washington as a modern reinterpretation of the Monroe Doctrine, has raised serious questions about sovereignty, international law, and the viability of the post-1945 global order.

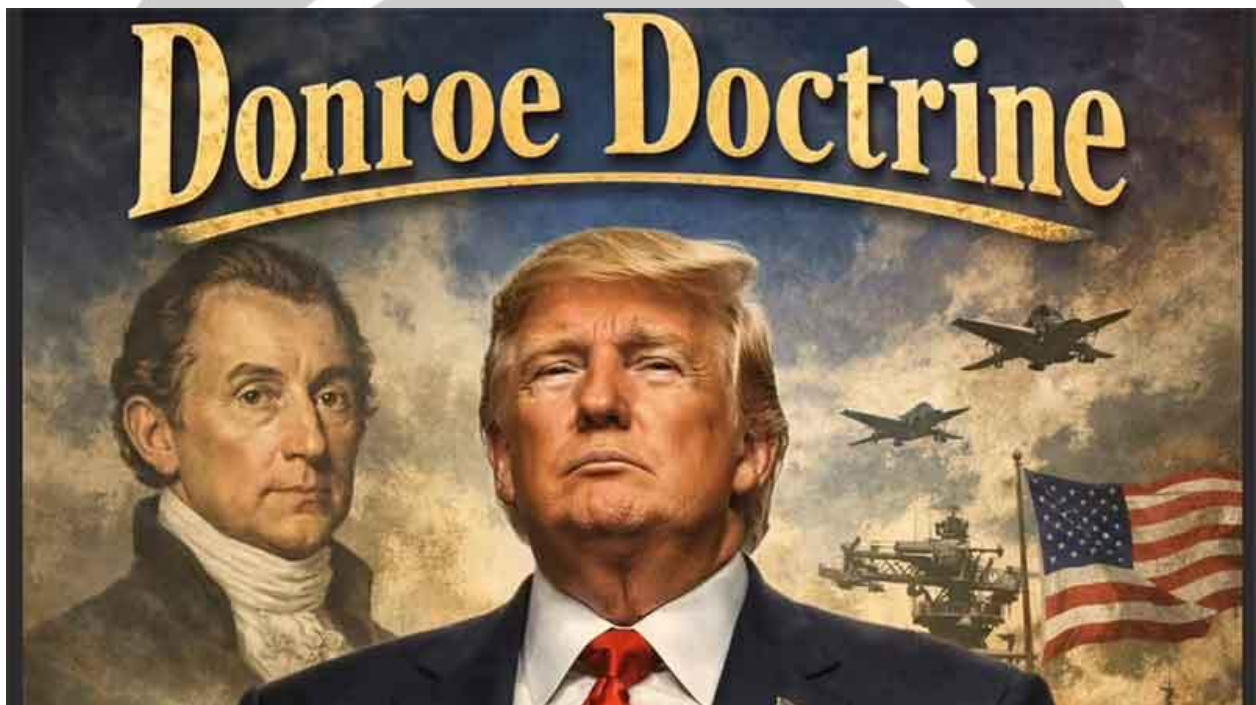
## Background

- The Monroe Doctrine (1823) asserted U.S. primacy in the Western Hemisphere and opposition to external interference.
- Over two centuries later, this doctrine appears to have been revived and radicalised, transforming from a defensive principle into an assertive enforcement mechanism.
- The muted global response to the Venezuela operation suggests a fractured international system, where power politics increasingly override legal and multilateral norms.
- The episode reinforces the belief that the liberal international order is giving way to a 'free-for-all' geopolitical environment.

## Features

### Reassertion of Hemispheric Primacy

- The U.S. claims the role of sole security guarantor in the Western Hemisphere.
- Explicit rejection of non-Hemispheric powers positioning forces or influencing regimes in the region.



### Doctrine Backed by Force

- The Venezuelan operation reflects a 21st-century version of "shock and awe", signalling readiness for unilateral military action.
- Implicit warnings to countries such as Cuba, Colombia, Mexico, and even extra-regional territories like Greenland.

### Codification through Strategy

- The U.S. National Security Strategy (NSS), November 2025, formally endorses:
- Denial of strategic space to rivals
- Restoration of U.S. preeminence
- Reduced tolerance for diplomatic ambiguity

## Regional Implications

## Europe

- Criticised for strategic dependency on the U.S.
- Pressured to assume primary responsibility for its own defence.
- Signals of a possible U.S.–Russia understanding to stabilise Europe, potentially at Ukraine's expense.

## West Asia

- Temporary pause in Israel's military campaign, but peace remains elusive.
- Iran faces internal unrest and external pressure, increasing risks of regional escalation.
- Gaza and the surrounding regions remain highly volatile.

## Afghanistan–Pakistan Region

- Resurgence of the Tehreek-e-Taliban and other extremist groups.
- Democratic backsliding in Pakistan, with military dominance overshadowing civilian leadership.
- Renewed U.S.–Pakistan military cooperation alters regional security equations.

## China and the Indo-Pacific

- China has effectively absorbed U.S. tariff pressures and leveraged control over rare earth exports.
- Expanding influence in Southeast Asia, the Indian Ocean, and global supply chains.
- The Eastern Pacific is no longer an uncontested U.S. sphere of influence.

## Challenges for the International Order

### Erosion of Sovereignty

- Precedents like Venezuela weaken the sanctity of state sovereignty.

### Normalisation of Unilateralism

- Power-based enforcement replaces rule-based governance.

### Geopolitical Emulation

- Risk that China and Russia justify similar actions in their perceived spheres of influence.

### Decline of Multilateral Institutions

- UN and international law are increasingly sidelined.

## Notes for New Delhi (India's Dilemma)

- India faces strategic uncertainty amid:
  - U.S. pressure over Russian oil imports
  - Warming U.S.–Pakistan ties
  - China's economic and trade leverage
- India's relative isolation in West Asia and tariff vulnerabilities deepen anxieties.
- Positive counterweights include:

- I2U2 (India–Israel–U.S.–UAE)
- India–Middle East–Europe Economic Corridor (IMEC)
- Stabilisation with China after the Tianjin summit (2025) remains fragile and unlikely to deepen in 2026.

## Way Forward

### For the Global System

- Revitalisation of multilateralism and international law.
- Collective resistance to unilateral precedents that normalise coercion.

### For India

- Strategic autonomy with diversified partnerships.
- Economic resilience against tariff and supply-chain coercion.
- Enhanced focus on internal security and counter-terror preparedness.

## Conclusion

The 'Donroe Doctrine' symbolises a broken and brutalised international order, where power increasingly trumps principle. As 2026 unfolds, the world confronts a landscape marked by unilateral interventions, weakened norms, and intensifying great-power rivalry. For India and much of the Global South, this represents not just diplomatic discomfort but a structural challenge to sovereignty, stability, and strategic choice.

## 4. How reusability can lead to sustainable, cost-effective access to space

### Why in the News?

The global space sector is undergoing a structural shift driven by reusable rocket technologies, led by private players such as SpaceX. With successful repeated reuse of Falcon 9 first stages and rapid progress on Starship, the cost of access to space has fallen dramatically. The commercial space economy is projected to exceed \$1 trillion by 2030, bringing sustainability, higher launch cadence, and wider participation into focus.

### Background

For nearly four decades, space exploration was dominated by government agencies using expendable launch vehicles (ELVs). Each rocket stage was discarded after a single use, making space access costly and infrequent.

Key physical constraints shaped rocket design:

- Gravity and aerodynamic drag during ascent.
- Tsiolkovsky's rocket equation, which highlights the “weight problem” — over 90% of a rocket's mass is propellant, leaving <4% for payload.
- Staging evolved as a workaround, allowing rockets to shed dead weight mid-flight.

Human spaceflight missions are three to five times costlier than satellite launches due to life-support, safety, redundancy, and reliability requirements, making cost reduction even more critical.

## Features

### From Disposable to Transportation Model

Reusable rockets mark a paradigm shift from one-time use to aircraft-like operations.

- Falcon 9 first stage returns via retro-propulsion + aerodynamic braking, landing vertically on land or droneships.
- Over 520 successful recoveries, with some boosters flown 30+ times.

## Technological Innovations

- Vertical integration and in-house manufacturing
- 3D printing of rocket components
- Autonomous guidance, navigation, and control
- Modular engine and stage design



## Global Momentum

- Blue Origin has demonstrated booster recovery for New Glenn.
- China's private sector (e.g., LandSpace) is experimenting with reusable orbital-class rockets.
- Indian Space Research Organisation is advancing Reusable Launch Vehicle (RLV) concepts and first-stage recovery technologies.

## Challenges

### Structural and Material Fatigue

- Extreme thermal cycling (cryogenic fuel → combustion heat)
- High-pressure loads and g-forces during ascent and re-entry
- Microfractures in engines and fuel tanks

### Refurbishment Economics

- Increasing inspection, testing, and part replacement costs
- Diminishing marginal savings after multiple reuses
- Balancing safety, reliability, and turnaround time

### Technological Complexity

- Precision landing systems
- Autonomous decision-making under uncertainty
- Heat protection and re-entry dynamics

### Indian Context

- Slower induction of disruptive technologies
- Dependence on multi-stage expendable systems like PSLV and LVM-3
- Need for commercial competitiveness in a rapidly evolving market

## Way Forward

### Reusability as a Design Non-Negotiable

Future launch vehicles must integrate partial or full recovery from the design stage itself.

### Optimised Architecture

- Fewer stages (2-stage systems replacing earlier 3–4 stage designs)
- Better energy distribution between stages
- Compact, high-efficiency engines

### Advanced Materials & Propulsion

- Higher propellant density
- Improved engine life cycles
- Lightweight, fatigue-resistant materials

### Indian Strategy

- Accelerate RLV and first-stage recovery programmes
- Encourage private sector participation under IN-SPACe
- Focus on high launch cadence + low refurbishment time
- Align launch vehicle design with emerging global standards of full reusability

## Conclusion

Reusable rocket technology represents the single most transformative innovation in modern spaceflight. By drastically lowering costs, increasing launch frequency, and reducing material waste, reusability enables sustainable, affordable, and scalable access to space.

## 5. Enhancing China-India youth ties

### Why in the News?

China–India relations have shown gradual stabilisation and forward movement following high-level engagements between Xi Jinping and Narendra Modi in 2024–25. Alongside trade recovery, visa easing, resumed flights, and cultural events, youth exchanges are increasingly being highlighted as a confidence-building pillar of bilateral ties. Initiatives such as youth delegations, university-level interactions, and cultural showcases underscore the renewed emphasis on people-to-people diplomacy.



### Background

- China and India together account for the largest youth populations globally, including the highest numbers of students enrolled domestically and studying abroad.
- Historically, youth exchanges formed a crucial component of bilateral relations through education, culture, sports, and media.
- The COVID-19 pandemic and border tensions disrupted these channels, creating a trust and perception deficit, especially among younger generations.
- With both countries targeting centenary national goals, leadership in Beijing and New Delhi increasingly views Gen Z and Gen Alpha as strategic stakeholders in national rejuvenation and global engagement.

### Features

#### Chinese Youth: Engines of Modernisation

- High human capital indicators: near-universal compulsory education, rising university enrolment, and strong STEM participation.
- Youth leadership in:
  - Digital economy (AI, fintech, platform-based work)
  - Strategic sectors (space, quantum technology, deep-sea research)
  - Creative and cultural industries
- Growing global exposure: millions of Chinese students have studied abroad since 1978, with a high return rate, strengthening innovation at home.

## **Youth-to-Youth Engagements**

- Pre-pandemic exchanges across campuses, art, sports, and journalism.
- Recent photo exhibitions in Mumbai universities, highlighting Indian youth experiences in China, aimed at rebuilding familiarity and empathy.
- Cultural diplomacy milestones, such as performances by Lang Lang in India.

## **Improving Enabling Environment**

- **Resumption of:**
  - Pilgrimage to Mount Gang Renpoche and Lake Mapam Yun Tso
  - Tourist visas
  - Direct flights
- Sharp growth in bilateral trade is creating opportunities for young entrepreneurs and professionals.

## **Challenges**

### **Trust Deficit**

- Lingering impact of border tensions and geopolitical competition.

### **Asymmetry in Perceptions**

- Limited first-hand exposure leads to stereotypes and media-driven narratives.

### **Institutional Gaps**

- Absence of sustained, large-scale youth exchange frameworks comparable to trade or diplomatic mechanisms.

### **Language and Cultural Barriers**

- Low mutual language proficiency restricts deeper academic and social collaboration.

## **Way Forward**

### **Institutionalise Youth Exchanges**

- Annual China–India Youth Dialogue
- Expanded scholarship and semester-exchange programmes.

### **University-to-University Partnerships**

- Joint research labs in AI, climate studies, public health, and space sciences.

## **Digital and Start-up Collaboration**

- Youth-led innovation forums and hackathons.

## **Cultural and Sports Diplomacy**

- Co-hosted festivals, music tours, film weeks, and sporting leagues.

## **Narrative Building**

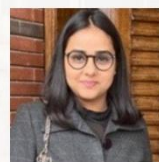
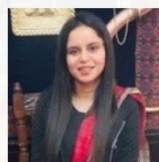
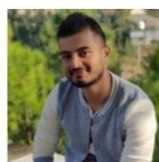
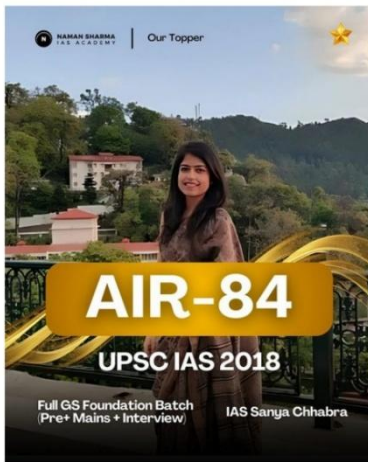
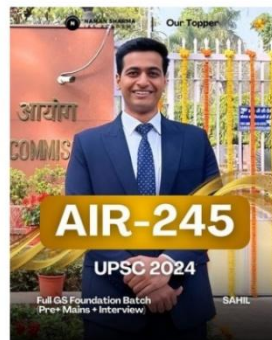
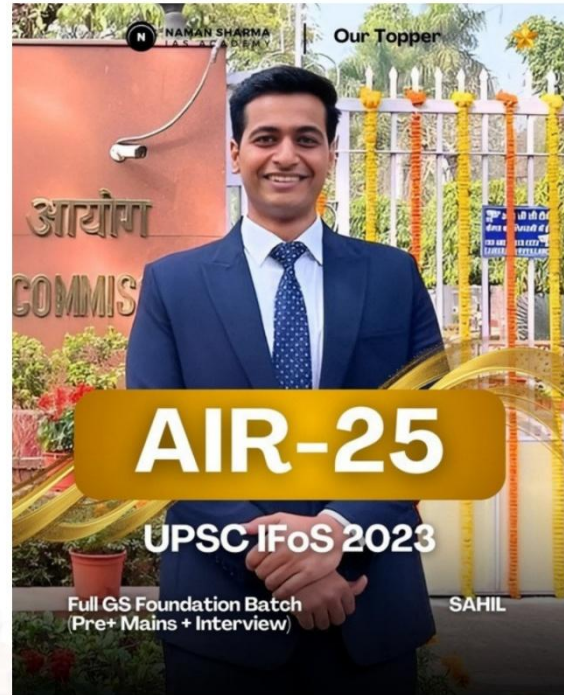
- Promote authentic youth stories through social media, documentaries, and campus media.

## **Conclusion**

Rabindranath Tagore reminded parents to educate children for a different time, and Mao Zedong entrusted the future to the youth. China and India today face a similar historical moment. In an era of geopolitical uncertainty, mutual understanding among young generations offers the most sustainable foundation for stable bilateral relations.



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