Securing India’s Critical Mineral Future

This editorial is based on “A critical mission: Recycling critical minerals can offer near-term cushion” which was published in The Business Standard on 09/09/2025. The article brings into picture the Union Cabinet’s ₹1,500 crore scheme (2025-31) to develop recycling capacity for critical minerals like lithium, cobalt, nickel, and rare earths, aiming to cut import dependence and manage e-waste.

For Prelims: Critical minerals, National Critical Minerals Mission, Geological Survey of India, Mines and Minerals (Development and Regulation) Act, 2025 (MMDR Act), Niyamgiri Hills of Odisha

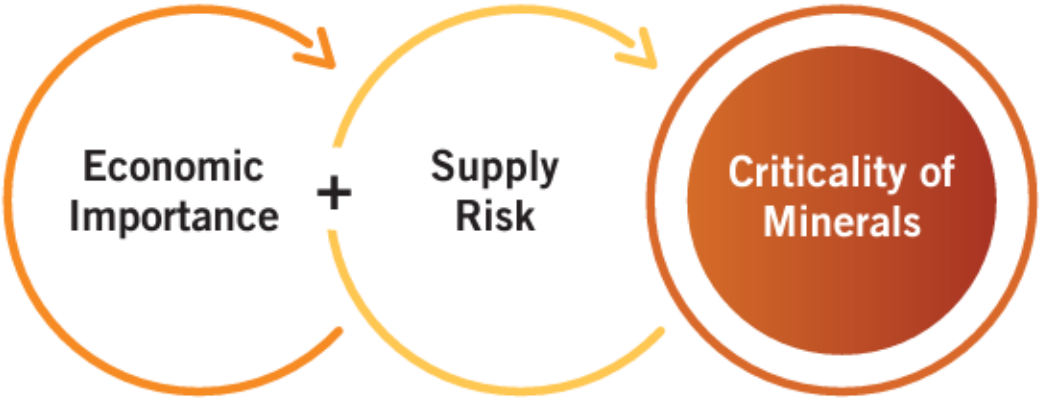
For Mains: Strides that India Undertaken to Strengthen its Critical Minerals Ecosystem, Key Issues Associated with India's Critical Mineral Ecosystem.

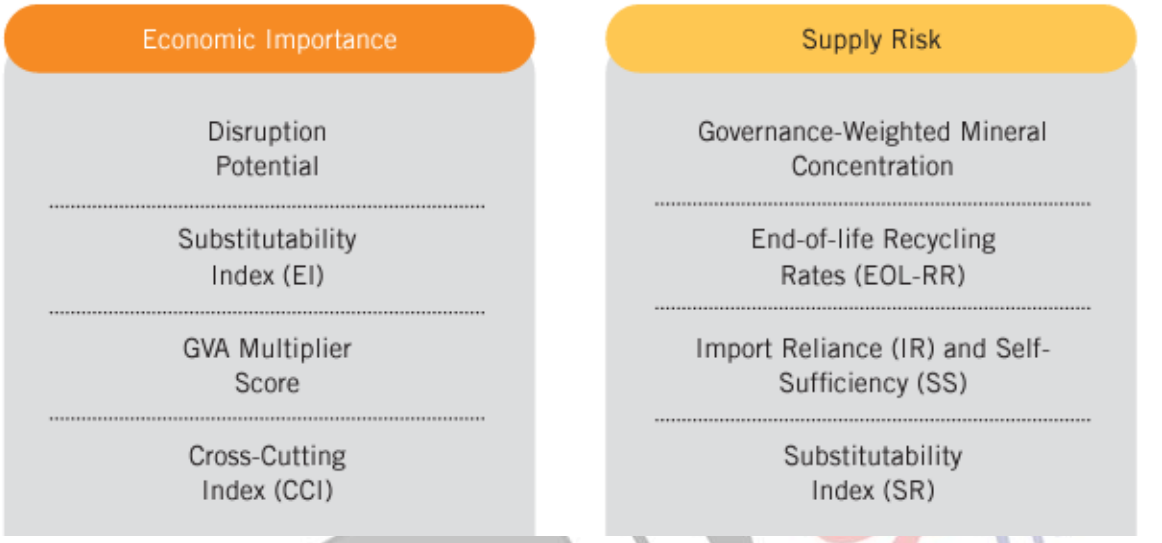
India's Union Cabinet has approved a **₹1,500 crore incentive scheme** to build **recycling capacity for critical minerals under the National Critical Minerals Mission,** running from 2025-26 to 2030-31. The initiative addresses India's overwhelming dependence on imports of lithium, cobalt, nickel, and rare-earth elements that are essential for clean energy technologies and advanced manufacturing. Unlike mining projects that take years to yield output, recycling offers an immediate pathway to supplement supply chains while tackling mounting electronic and battery waste. This recycling initiative forms a **crucial pillar of India's multipronged strategy for mineral security,** complementing domestic exploration, overseas acquisitions, and the broader goal of achieving strategic autonomy in the clean energy transition.

What Strides has India Undertaken to Strengthen its Critical Minerals Ecosystem?

- **Domestic Exploration and Mining: Securing Future Supplies: India is aggressively expanding its domestic exploration efforts to reduce dependence on imports.**
    - The government has set ambitious targets under the National Critical Minerals Mission (NCMM) to identify 1,200 critical mineral deposits by 2030.
        - This effort addresses India’s growing need for minerals like lithium, cobalt, and rare earths essential for clean energy and EV production.
    - The Geological Survey of India (GSI) has already undertaken 195 exploration projects in 2024-25, focusing on key areas like Rajasthan for rare earth elements.
        - India is expected to auction over 100 critical mineral blocks by 2031, with a strategic focus on untapped reserves such as cobalt in Andhra Pradesh and lithium in Jammu & Kashmir.
- **Recycling and Urban Mining:** Recycling critical minerals, especially from e-waste and spent batteries, has become central to India’s strategy.

    - The ₹1,500 crore incentive scheme under NCMM aims to establish 270 kilotonnes of recycling capacity, recovering 40 kilotonnes of critical minerals annually.
        - This initiative not only reduces reliance on fresh mining but also tackles the growing e-waste problem.
    - The scheme will generate 70,000 jobs and attract ₹8,000 crore in investments, showcasing India's push towards a circular economy.
        - This, coupled with India’s plan to achieve 5% recycled content in all new non-ferrous products by FY28, demonstrates the government’s proactive approach to boosting recycling capacity.
- **International Partnerships:** India is securing long-term access to critical minerals through international collaborations, mitigating risks of geopolitical disruptions.
    - Through Khanij Bidesh India Ltd (KABIL), India has forged agreements with countries like Argentina, Chile, and Australia for lithium and cobalt exploration rights.
    - In January 2024, KABIL signed a deal with Argentina to explore five lithium-rich blocks.
        - This partnership will help India ensure a steady supply of lithium, addressing the gap in domestic production and reducing dependence on China, which dominates lithium processing.
- **Technological Innovation and R&D:** India is heavily investing in research and development to improve extraction, processing, and recycling technologies for critical minerals.
    - The **NCMM targets the filing of 1,000 patents in critical mineral technologies by 2030,** fostering innovation across the value chain.
    - For instance, India has already granted patents for new extraction techniques that could lower dependency on imports.
        - Additionally, the **creation of 7 Centres of Excellence (CoEs)** will drive breakthroughs in mineral processing and advanced material sciences.
- **Policy and Regulatory Reforms:** India has undertaken significant policy reforms to foster growth in the critical minerals sector, making it easier for both public and private players to engage in exploration and mining activities.
    - The **Mines and Minerals (Development and Regulation) Act, 2025 (MMDR Act)** was amended to give the central government exclusive powers to auction 24 critical minerals, ensuring better control over domestic mineral resources.
    - The government is also **fast-tracking approvals for critical mineral projects**, reducing bureaucratic delays.
        - The **introduction of the new Exploration Licence (EL)** will further incentivize private sector participation, accelerating India's mineral exploration activities and enhancing its self-sufficiency.
- **Strategic Stockpiling:** India is **developing strategic stockpiles of critical minerals** to safeguard against global supply disruptions and geopolitical tensions.
    - As part of the NCMM, the **government plans to create a national stockpile of at least 5 critical minerals**, ensuring uninterrupted access during crises.
        - Strategic reserves will provide a buffer, reduce supply chain risks, and ensure that critical sectors like clean energy and defense aren’t impacted by market fluctuations or geopolitical standoffs.





What are the Key Issues Associated with India's Critical Mineral Ecosystem?

- **Heavy Dependence on Imports: India's reliance on imports for critical minerals, especially lithium, cobalt, and graphite, poses a significant vulnerability to its energy transition and technological ambitions.**
  - As India seeks to ramp up EV adoption and solar power capacity, securing a stable supply of these minerals becomes crucial.
  - **India is 100% import-dependent for minerals like lithium and cobalt**, with **China being the dominant supplier, controlling over 70% of the global lithium production.**
  - **In FY 2023-24, India spent over ₹34,000 crores importing critical minerals,** highlighting the economic strain and geopolitical risks tied to this dependence.
- **Lack of Advanced Extraction Technologies: India faces a significant gap in advanced mining and mineral extraction technologies, making it difficult to efficiently exploit domestic resources.**
  - While the government is investing in research, the pace of innovation in this field remains slow, preventing India from maximizing its mineral potential.
  - Recent auctions of **deep-seated mineral blocks (lithium in J&K)** have seen little commercial extraction progress: **licensing, geological data accuracy, and mining technology are all major bottlenecks.**
    - Recently, the Indian government **cancelled the auction of 5 critical mineral blocks, including a rare earth element (REE) block in Karnataka**, due to poor response..
- **Environmental and Social Concerns: Mining and extraction processes have adverse environmental and social impacts, which India must address to ensure sustainable growth in the critical minerals sector.**

    - Land acquisition, resettlement issues, and the environmental degradation caused by mining activities are major challenges.
    - A study on **three coal mines in central India (Madhya Pradesh and Chhattisgarh**) found that between **1994 and 2022, mining activities degraded 35% of the native land cover.**
        - In states like **Jharkhand and Odisha**, **untreated mine runoff pollutes rivers and groundwater with heavy metals and toxins,** making the water unsafe for drinking and agriculture.
    - In terms of social concerns, one of the most prominent examples of social resistance is the decade-long conflict ove**r bauxite mining in the Niyamgiri Hills of Odisha.**
- **Market Volatility and Price Fluctuations: The global market for critical minerals is highly volatile, with prices fluctuating dramatically based on supply chain disruptions, geopolitical tensions, and changing demand patterns.**
    - India's dependence on global markets makes it vulnerable to price hikes, affecting the cost of renewable energy projects.
    - For example, a 2022 Mckinsey report stated that surging EV demand has seen lithium prices skyrocket by around **550% in a year.**
        - Though, **oversupply has sent lithium prices to multi-year lows in 2025.**
- **Inadequate Workforce and Skill Development: India's critical minerals sector lacks a skilled workforce capable of supporting complex extraction, processing, and technological advancements.**
    - Despite the **National Critical Minerals Mission (NCMM) establishing Centres of Excellence at major IITs and research labs in 2025,** most new mining projects—especially for rare earths and lithium—still depend on foreign consultants for project design and ongoing expertise.
    - Without **a skilled workforce in place, India may struggle to innovate and operate critical mineral projects efficiently,** further increasing dependency on foreign expertise and technology.
- **Slow Development of Downstream Industries: Critical minerals are not just about mining but also about integrating into downstream sectors like EV batteries, semiconductors, and defense.**
    - India's battery manufacturing ecosystem (**e.g., National Programme on Advanced Chemistry Cell (ACC) Battery storage)** is still developing, creating a mismatch between mineral availability and industrial use.
    - **Lack of a clear linkage between mineral policy and industrial policy** prevents efficient utilization.

What Measures can India Adopt to Enhance its Critical Mineral Supply Chain?

- **Development of Deep-Seated Mineral Extraction Technologies: To unlock the vast untapped potential of critical minerals, India must invest in the development of advanced extraction technologies tailored to deep-seated and hard-to-reach mineral deposits.**
    - This will ensure that valuable resources, such as cobalt and lithium, found in challenging geological formations can be efficiently mined without compromising environmental standards.
    - By focusing on innovation in mineral extraction, India can reduce its reliance on foreign technologies and foster homegrown capabilities in mining.
- **Public-Private Partnerships for Mineral Exploration:** Encouraging robust public-private partnerships (PPP) can facilitate faster exploration and development of critical mineral reserves within India.
    - By combining government incentives with private sector expertise and investment, these partnerships can expedite the process of discovering and utilizing mineral deposits.
    - The government could set up collaborative ventures with mining firms to provide risk-sharing frameworks, ensuring that exploration activities move forward swiftly and cost-effectively.
- **Streamlining Regulatory Processes for Faster Approvals:** India's mineral sector often suffers

from delayed regulatory approvals that impede the pace of exploration and production.
    - By establishing a fast-track approval mechanism for critical mineral projects, India can accelerate the development of its critical mineral reserves.
    - This could include simplifying environmental clearances and expediting land acquisition processes through digital platforms to reduce bureaucratic hurdles and ensure timely project execution.
- **Leveraging Blockchain for Transparent Mineral Supply Chain:** Integrating blockchain technology into India's mineral supply chain can increase transparency, traceability, and efficiency.
    - Blockchain can help monitor the journey of minerals from extraction to processing, ensuring that the supply chain remains secure and free from unethical practices such as illegal mining or conflict sourcing.
    - This technology can also provide real-time data on inventory levels, demand forecasts, and pricing, aiding in better decision-making.
- **Promotion of Urban Mining and E-Waste Recycling:** India can tap into urban mining by improving infrastructure for e-waste recycling, a key source of critical minerals such as cobalt, nickel, and rare earth elements.
    - Establishing state-of-the-art recycling plants dedicated to extracting valuable minerals from old electronics, batteries, and other consumer products can significantly reduce dependency on newly mined resources.
    - Furthermore, incentivizing the informal sector to formalize and participate in recycling will enhance collection efficiency and mineral recovery rates.
- **Bilateral and Multilateral Resource Acquisition Deals:** To safeguard its mineral supply chains, India should expand its international engagement with mineral-rich countries through strategic partnerships and agreements.
    - By negotiating **bilateral deals for access to critical mineral resources** and processing facilities, India can secure long-term supply commitments, diversifying its sources away from over-reliance on a few countries.
    - **These partnerships can include joint ventures**, preferential trade agreements, and equity stakes in foreign mining operations.
- **Enhancing Domestic Mineral Processing Capacity: India must significantly enhance its domestic processing capacity for critical minerals, particularly for minerals such as lithium, cobalt, and rare earths, where it currently depends on foreign refiners.**
    - By building world-class processing plants and investing in cutting-edge refining technologies, India can move up the value chain, ensuring that it does not just export raw minerals but also benefits from downstream industries like battery manufacturing, electronics, and clean energy technologies.
- **Fostering Research and Development in Alternative Materials:** To reduce its dependency on scarce critical minerals, India should promote R&D into alternative materials and technologies.
    - Research into substitute materials for lithium, cobalt, and rare earths in applications like batteries, solar panels, and electric vehicles could help mitigate supply risks.
    - Government funding, academic partnerships, and industry collaboration can drive breakthroughs in material science, providing India with alternatives that can be sourced more sustainably and at lower costs.
- **Establishing Regional Mineral Processing Hubs:** Creating dedicated mineral processing hubs in key mineral-rich states, with advanced infrastructure and facilities, could provide economies of scale in processing and refining.
    - These hubs could be modeled on industrial parks that offer integrated facilities for mining, beneficiation, smelting, and recycling.
    - This approach would not only streamline operations but also create job opportunities and foster regional economic development while ensuring greater control over the mineral value chain.
- **Adopting a Circular Economy Approach:** India can enhance its critical mineral supply chain by adopting a circular economy approach, where minerals are reused and recycled at the end of their lifecycle.
    - A national policy encouraging the circular use of materials, combined with incentives for businesses to design products with recyclability in mind, can ensure that resources are utilized efficiently.
    - This would help conserve mineral resources, reduce waste, and contribute to sustainability

goals by closing the loop in the supply chain.

Conclusion:

A robust critical minerals ecosystem is indispensable for India's clean energy transition, self-reliance, and sustainable industrial growth. By strengthening domestic exploration, recycling, and international partnerships, India can reduce vulnerabilities and foster resilience. Such measures directly advance**SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), and SDG 12 (Responsible Consumption and Production).** With timely reforms and innovation, India can align mineral security with its broader vision of **Atmanirbhar Bharat and Net-Zero 2070 goals.**

Drishti Mains Question:

Discuss the significance of critical minerals in India's clean energy transition. How can recycling serve as a complementary pathway to traditional mining?

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims:

With reference to the management of minor minerals in India, consider the following statements: (2019)

1. Sand is a 'minor mineral' according to the prevailing law in the country
2. State Governments have the power to grant mining leases of minor minerals, but the powers regarding the formation of rules related to the grant of minor minerals lie with the Central Government.
3. State Governments have the power to frame rules to prevent illegal mining of minor minerals.

Which of the statements given above is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

Ans: (a)

Q. What is/are the purpose/purposes of 'District Mineral Foundations' in India? (2016)

1. Promoting mineral exploration activities in mineral-rich districts
2. Protecting the interests of the persons affected by mining operations
3. Authorizing State Governments to issue licenses for mineral exploration

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (b)

Mains

Q. Despite India being one of the countries of Gondwanaland, its mining industry contributes much less to its Gross Domestic Product (GDP) in percentage. Discuss. (2021)

Q. “In spite of adverse environmental impact, coal mining is still inevitable for development”. Discuss. (2017)