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Securing India's CRITICAL MINERAL FUTURE

A Policy Blueprint for Resilience and Growth

CAIG
CENTRE FOR ACCELERATING INDIA'S GROWTH
An initiative of NFPRC

February 2026

Securing India's Critical Mineral Future: A Policy Blueprint for Resilience and Growth

Suggested Citation: Khandelwal, Y., & Choudhary, S. (2026). Securing India's critical mineral future: A policy blueprint for resilience and growth. Nation First Policy Research & Change Foundation.

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Acknowledgments: We are grateful for the insights and comments by Mr Noel Therattil, Research Analyst, Centre for Social and Economic Progress (CSEP), which helped in shaping the policy brief. We sincerely acknowledge the valuable contributions of the CAIG team, particularly Mr. Ashish Verma and Mr. Rahul Kumar Dubey, for their support in developing the infographics and peer-reviewing of the report.

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February, 2026
CAIG, NFPRC
New Delhi

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Table of Contents

About the Policy Brief

India has launched a first-of-its-kind scheme to promote domestic manufacturing of sintered Rare Earth Permanent Magnets (REPM), with an outlay of ₹7,280 crore to build a 6,000 metric tons per annum (MTPA) annual domestic capacity by 2030[1]. This marks a major step towards a resilient, localised supply chain for sunrise sectors including electric mobility, electronics, defence, renewable energy and aerospace. The initiative reflects India's broader critical minerals strategy, anchored in the vision of Aatmanirbhar Bharat and Viksit Bharat, and signals a deliberate move to reduce reliance on concentrated suppliers, particularly overcoming China's weaponised interdependence, at a time when critical minerals are increasingly seen as the "fossil fuels of the future."

Beyond this momentum, India's critical minerals ecosystem needs to take structural considerations in governance, technology readiness, exploration capability, and build investor confidence to scale up the development of the critical mineral ecosystem. This policy brief maps the current landscape of the sector, assesses the governance architecture, and examines key policy instruments such as the National Critical Minerals Mission (NCMM), the Mines and Minerals (Amendment) Act 2025, and India's growing international partnerships for securing mineral supply chains.

Drawing on global experiences, including China's vertically integrated dominance and Japan's approach to diversification through recycling, midstream investments, and strategic alliances, the brief highlights lessons relevant for India's growth trajectory and strategic autonomy. Based on this analysis, the brief offers focused recommendations to address persistent bottlenecks, including import dependence, outdated exploration and classification norms, limited midstream and refining capacity, and the underdeveloped potential of urban mining.

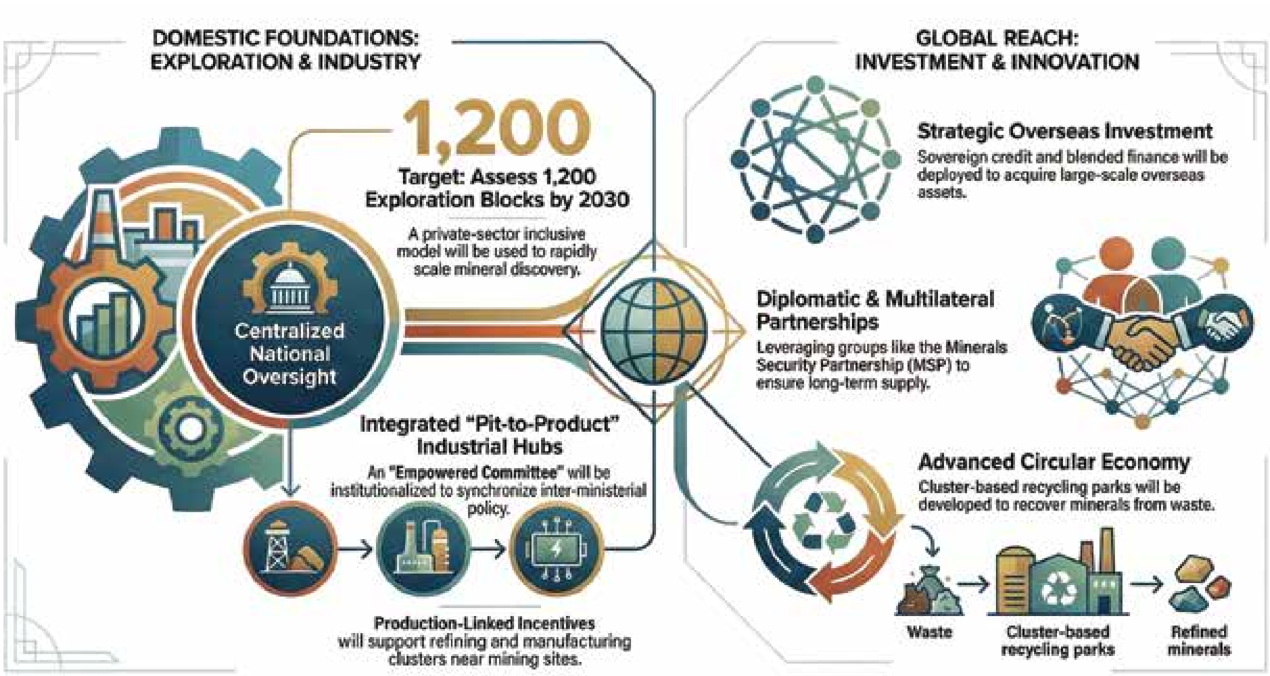

Figure 1. Roadmap for Achieving Critical Mineral Reliance (Author's analysis, Ai generated Image).

1Cabinet Approves Rs.7,280 Crore Scheme to Promote Manufacturing of Sintered Rare Earth Permanent Magnets (REPM), Prime Minister of India.

1. Background

Critical minerals are minerals essential for economic development and strategic sectors, whose limited availability or concentration in a few regions poses a significant risk to supply chains. Referred to as "fossil fuels of tomorrow", their demand has surged over the past decade with the growth of clean energy, digital infrastructure, electric mobility, and advanced manufacturing.

In India, critical minerals support key sectors such as electronics, telecommunications, renewable energy, transportation, and defence. Acknowledging their importance, the Government of India's Critical Minerals List 2023 identified 30 minerals, such as lithium, cobalt, copper, rare earth elements, and tungsten, as vital for national priorities.[2] India's ambitious renewable energy target of 500 GW by 2030[3] and the push for domestic manufacturing of batteries, solar modules, and electric vehicles will further increase demand for reliable access to these minerals.

Globally, however, production and processing are heavily concentrated in a small number of countries (Figure 2). This concentration gives dominant players significant influence over prices, trade flows, and technology supply chains. For India, reducing exposure to these external risks and securing diversified, long-term mineral supply will be an important component of its economic sovereignty and strategic planning.

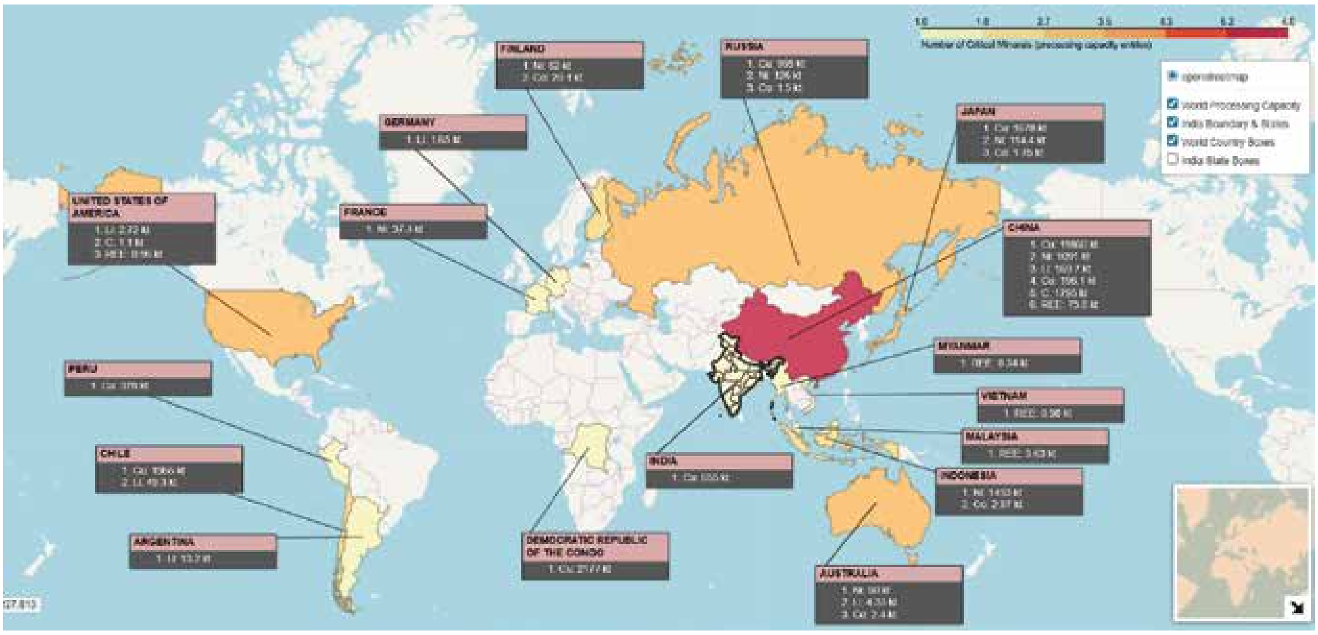

***Figure 2.** Global Critical Mineral Processing Capability (Data source: IEA Critical Mineral Data Explorer).*

2Report of the Committee on Identification of Critical Minerals, Ministry of Mines 2023.

3PIB, 13th November 2024.

2. India's Policy Response for a self-reliant Critical Mineral Ecosystem

India has given a prompt policy push to develop its critical minerals ecosystem, as self-reliance is not only central to its developmental ambitions but also positions it as a credible interlocutor in reshaping global supply chains. By advancing a policy framework that blends domestic exploration with international partnerships, India signals its readiness to collaborate with resource-rich nations and suppliers seeking to diversify away from China's dominance. This approach is reinforced by investments in workforce skills, institutional capacity, and a business environment conducive to innovation and resilience, making India a compelling alternative in the global minerals landscape. The strategy reflects a balance of strategic ambition and diplomatic pragmatism, underscoring India's intent to steadily reduce external dependencies while laying a robust foundation for its clean energy transition and industrial growth.

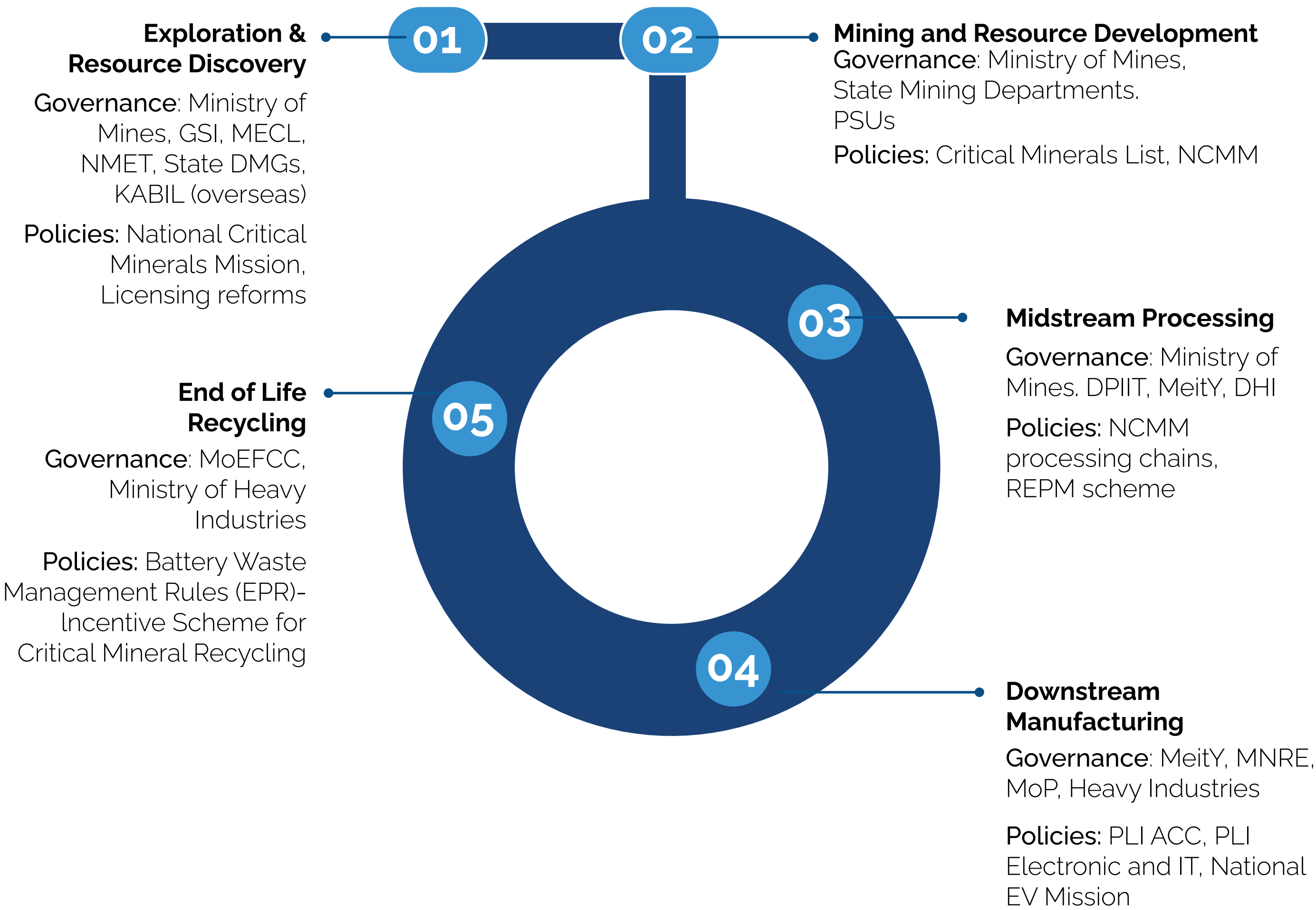

Figure 3. India's Policy and Governance Structure Across Critical Minerals Value Chain.

2.1 The National Critical Minerals Mission

The National Critical Minerals Mission (NCMM) is India's flagship effort to build a secure, resilient and future-ready critical minerals value chain. With a seven-year outlay of ₹16,300 crore in central funding and an additional 18,000 crore expected for PSUs such as Hindustan Copper Limited (HCL), National Mineral Development Corporation (NMDC), Coal India Limited (CIL). The Mission aims to accelerate large-scale exploration, expedite auctions of strategic mineral blocks, and catalyse domestic processing through dedicated Mineral Processing Parks. The mission sets ambitious targets including completion of 1,200 exploration projects by 2030–31, partnerships for 50 overseas mineral acquisitions, and facilities to recycle at least 10% of annual critical mineral consumption. Its governance structure, including a Cabinet Secretary-led committee for strategic coordination paired with a mission secretariat for operational implementation, acknowledges both the technical complexity and strategic importance of mineral security, providing the policy coherence and sustained attention necessary to translate strategic intent into operational capability.[4]

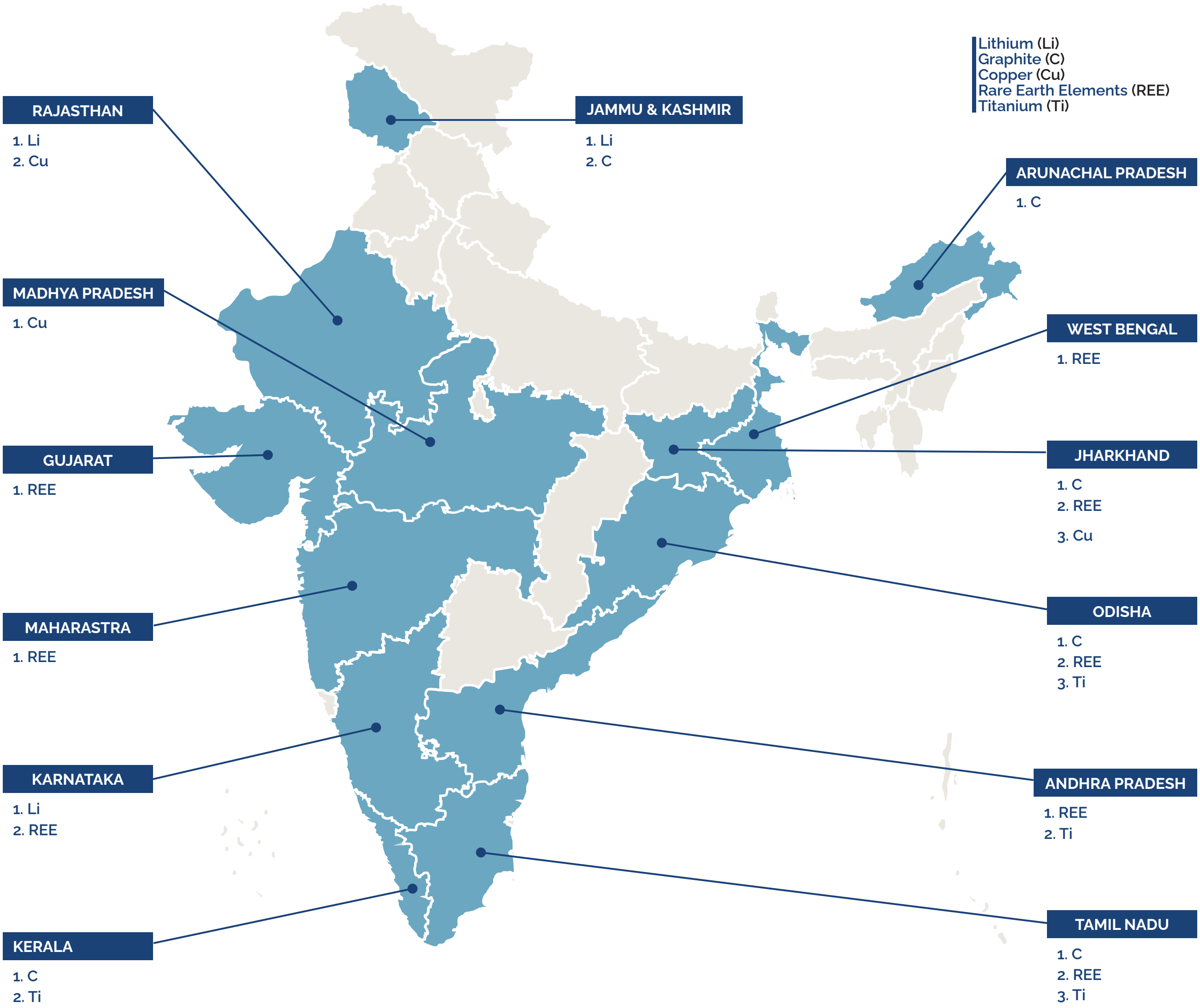

Figure 4. India's Key State-Wise Critical Minerals Sites and Inferred Deposits (Source: Ministry of Mines Annual Report, 2024).

4PIB, 20th December 2023.

2.2 Domestic Regulatory and Institutional Reforms

The government's 2025 amendment to the Mines and Minerals (Development and Regulation) Act creates a more transparent and flexible framework to attract domestic and foreign investment in critical minerals mining. Key reforms include removing the 50% sale cap on captive mines to allow full commercial sale of output, expanding the National Mineral Exploration Trust (NMET) to fund mine development alongside exploration, and enabling addition of critical minerals like lithium, cobalt, and nickel to existing leases without extra royalty. The establishment of a National Mineral Exchange and provisions for larger lease areas further improve predictability and scale.[5]

The ₹4,000 crore allocation for the GSI represents substantial government commitment to accelerating domestic exploration and development.[6] Translating this into comprehensive resource mapping using advanced exploration technologies can establish the knowledge foundation necessary for long-term planning. The launch of the sixth tranche of critical mineral block auctions in September 2025 signals the government's ongoing commitment to strengthening domestic exploration capacity and maintaining steady progress in critical mineral development.[7]

2.3 Expansion of midstream capabilities — the Rare Earth Magnet example

In a quest to improve mid-stream capabilities for rare earth magnets, the Central Government has approved a ₹7,280 crore scheme to promote domestic manufacturing of sintered REPM.[8] The scheme is designed to expand India's annual rare earth magnet manufacturing capabilities to 6000 MTPA in the next five years. It combines ₹6,450 crore in sales-linked incentives, rewarding firms based on actual market performance, with ₹750 crore in capital subsidies to lower entry barriers for new manufacturing facilities. By tying incentives to sales volumes rather than upfront grants, the policy ensures accountability and encourages competitive scaling, while the capital support addresses the high initial investment costs of rare earth processing.

2.4 International Partnerships and Diversification

At the international level, India's partnership strategy underscores a deliberate effort to diversify supply chains and reduce reliance on a few dominant global suppliers. India has recently joined the US-led Pax Silica initiative to secure global semiconductor and critical mineral supply chains. This strategic partnership integrates India's massive workforce and design depth into the global high-tech table, providing the "atmanirbhar" foundation needed to end technological dependencies. India's participation in the Minerals Security Partnership (MSP) provides access to alternative sourcing networks, while bilateral agreements such as the one with Australia, eliminating tariffs on 29 critical minerals, enhance trade-based cooperation. The India–US Critical Minerals Cooperation Agreement, signed in October 2024, strengthens collaboration on lithium, cobalt, nickel, and rare earth supply chains, indicating a structured approach towards building resilient mineral networks through multilateral and bilateral engagement.

5The Mines and Amendment Bill, 2025, PRS Legislative Research.
6The Indian Express, 30th January 2025.
7The Indian Express, 30th January 2025.
8Cabinet Approves ₹7,280 Crore Scheme to Promote Manufacturing of Sintered Rare Earth Permanent Magnets (REPM), Prime Minister of India.

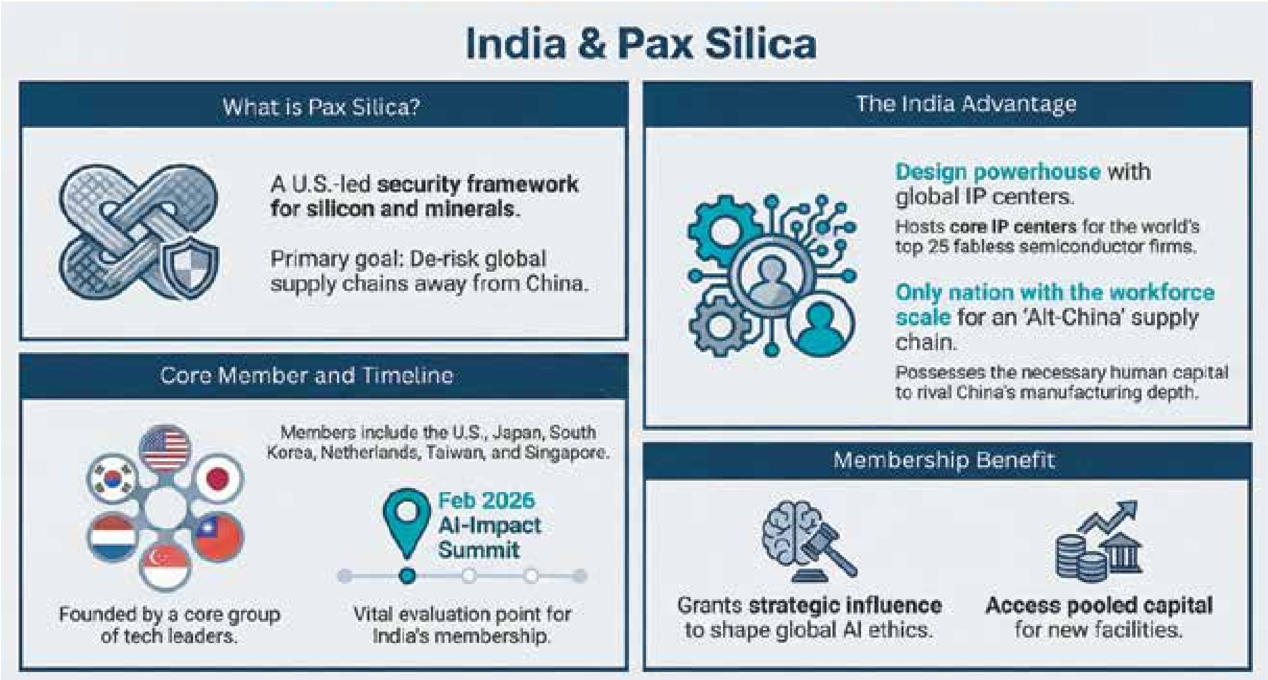

Figure 5. India and Pax Silica — Forging a Secure Tech Future.

India's diplomatic outreach with resource-rich countries demonstrates proactive efforts to secure long-term mineral supplies. India has already secured critical mineral blocks in Argentina and is in advanced negotiation stages with Chile and Zambia. In November 2023, India's Altmin and Bolivia's state-owned company Yacimientos de Litio Bolivianos (YLB) signed an agreement for lithium supply, technology-sharing, and a pilot cathode materials plant.[9] In February 2025, Mineral Exploration and Consultancy Limited (MECL) partnered with Argentina's Catamarca province to jointly explore and develop lithium resources with provisions for long-term supply.[10] Khanij Bidesh India Limited (KABIL) has taken a leading role in overseas acquisitions, with its ₹200 crore investment in Argentina's Catamarca province marking India's first overseas lithium project, a symbol of its pursuit for mineral security. During Chilean President Gabriel Boric Font's visit in April 2025, agreements were signed between Chile's Corporación Nacional del Cobre de Chile, the national copper corporation (CODELCO) and Hindustan Copper Limited, alongside negotiations for a Comprehensive Economic Partnership Agreement including a dedicated critical minerals chapter.[11] India is also negotiating a Free Trade Agreement with Peru, where five Indian companies have invested $61 million in the mining sector. These initiatives demonstrate India's growing operational footprint abroad and a commitment to translating strategic intent into tangible resource access.[12]

2.5 Creating Assured Demand and Market Confidence

India's policy addresses critical market failures through strategic stockpiling and public procurement, providing predictable demand signals necessary for long-term capital commitments that private investors require. The Production-Linked Incentive (PLI) scheme for Advanced Chemistry Cell (ACC) battery manufacturing already creates downstream demand for components relying on secure critical mineral supply. Government commitment through advance purchase agreements and strategic reserve development provides the market confidence necessary for domestic industry development.

9Times of India, 17th November 2023.
10PIB, 19th February 2025.
11PIB, 1st April 2025.
12Economic Times, 22nd September 2025.

2.6 Recycling and Circular Economy Infrastructure

India is creating both supply-side incentives and demand-side mandates to develop critical minerals recycling infrastructure. Under the NCMM, the government has introduced the ₹1,500 crore Incentive Scheme to scale up India's recycling capacity, creating a secondary feedstock stream of 3 lakh tonnes by 2031. To promote utilisation of secondary feedstock such as black mass within the country, the Ministry of Environment, Forest and Climate Change has imposed export restrictions, classifying it as hazardous waste. To complete the recycling-to-manufacturing loop, the Battery Waste Management Rules, 2022 have set minimum use obligation targets for the use of recycled critical minerals in battery manufacturing.

***Figure 6.** Structural Improvements Required in India's Battery Recycling Ecosystem. (Ai generated image)*

2.7 Investment in Alternate — Critical Mineral-free Technologies

Indian companies are increasingly exploring alternatives to technologies reliant on critical minerals, aiming to reduce dependence on volatile global supply chains and geopolitical risks. For instance, Reliance Industries acquired UK-based Faradion to tap into sodium-ion battery technology, a promising substitute for lithium-based systems. Similarly, ONGC has invested in aluminium-air battery ventures, targeting energy storage and electric mobility applications. On the motor front, startups like Simple Energy and Chara Technologies are developing rare earth-free electric motors, which could be deployed in electric two-wheelers, industrial machinery, and Heating, Ventilation and Air Conditioning (HVAC) systems. While these innovations hold significant promise, challenges remain in scaling production, bridging R&D gaps, and validating performance across diverse use cases. Commercial adoption will hinge on cost competitiveness, efficiency benchmarks, and ecosystem readiness.

Overall, India's policy response represents a comprehensive framework that balances strategic security with pragmatic sequencing, moving India from reactive risk management to proactive value chain positioning in the global critical minerals landscape.

3. Structural Considerations in India's Critical Minerals Ecosystem

India has undertaken major steps to build a resilient critical minerals ecosystem, supported by recent institutional, policy, and investment measures. As this ecosystem continues to expand, several structural aspects merit further strengthening to help India realise its long-term strategic objectives. These relate to exploration maturity, governance coordination, midstream capabilities, and circular-economy readiness. The following sections outline these areas in a forward-looking manner to support ongoing policy development.

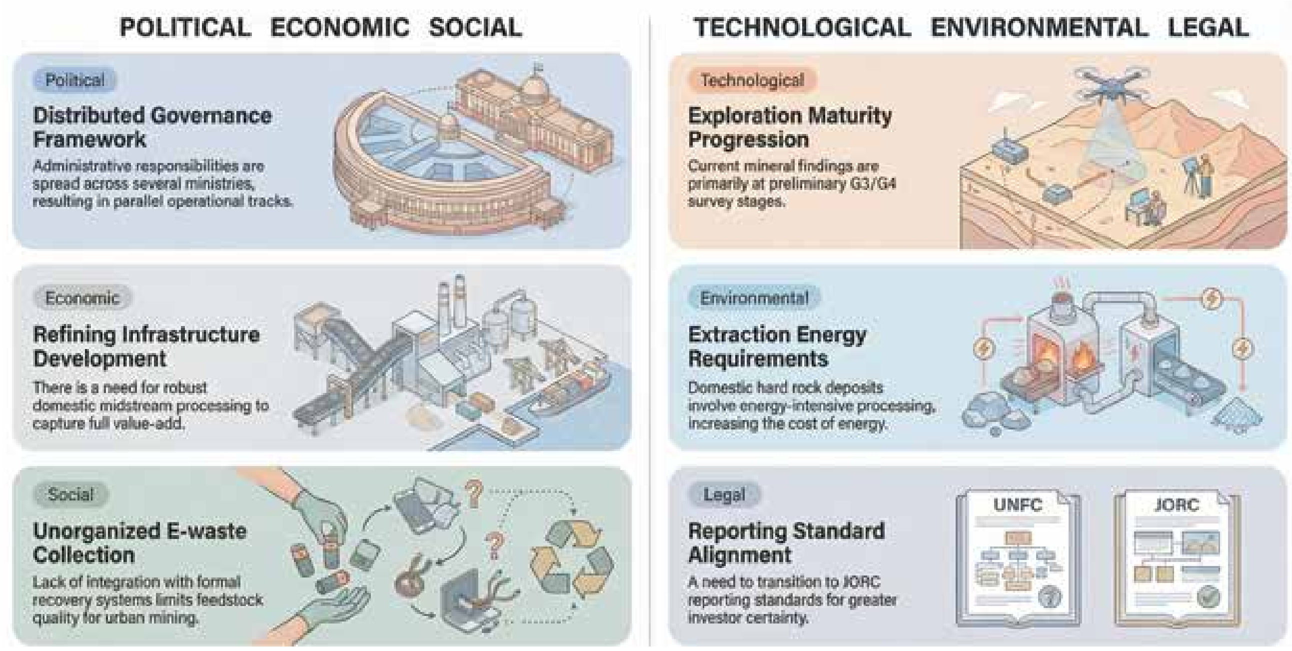

Figure 7. PESTEL Analysis - Building On India's Existing Critical Minerals Infrastructure.

3.1 Institutional Coordination Across the Value Chain

The critical minerals value chain spans exploration, processing, environmental regulation, manufacturing, trade policy, and overseas partnerships (Figure 3). This naturally involves multiple ministries and specialised agencies. The Ministry of Mines anchors domestic exploration and policy development through the GSI, Indian Bureau of Mines (IBM), MECL, and its policy and international cooperation divisions. Downstream demand is shaped by ministries overseeing renewable energy, electronics, heavy industries, environment, commerce, and finance. Overseas acquisition and diplomatic coordination involve KABIL and the Ministry of External Affairs. Rare earths and atomic minerals follow an additional governance pathway under the Department of Atomic Energy through Indian Rare Earth Limited (IREL).

Given this wide distribution of responsibilities, the system progresses through several parallel institutional tracks. Inter-ministerial platforms such as the Empowered Committee for Critical Minerals and NCMM working groups provide important points of alignment, although these typically meet periodically. As India's domestic and international engagement on critical minerals expands, deeper and more continuous coordination across these pathways will remain important for coherent policy implementation.

3.2 Exploration Maturity and Classification Standards

Many of India's recently identified lithium, rare earth, and other critical mineral deposits remain at early exploration stages such as G4 and G3. These stages offer preliminary geological indications but are insufficient to establish commercially viable reserves. As downstream demand rises, advancing these deposits towards higher-confidence categories will become increasingly crucial to support self sufficiency.

India currently uses the United Nations Framework Classification (UNFC) system for reporting mineral resources. Most international investors reference standards such as the Joint Ore Reserves Committee (JORC) Code. The divergence between these frameworks can limit data comparability and reduce clarity for potential bidders, particularly during auctions. As exploration deepens, enhancing the precision and standardisation of resource classification will be essential to support investor confidence and reduce information gaps.

3.3 Deep-seated Deposits and Commercial Viability Gaps

The challenges in developing India's lithium sector include the predominance of deep hard-rock deposits[13] that demand significantly higher energy for extraction and processing compared to brine sources. Processing hard rock lithium involves high-temperature calcination around 1,100°C, which is nearly nine times more energy-intensive.[14] Additionally, most deposits are at the G3 exploration stage, indicating inferred resources with low geological confidence and unproven commercial feasibility.

The United Nations Framework Classification (UNFC) classifies mineral resources across four confidence levels — G1 (fully confirmed, commercially viable), G2 (well-evidenced but needing further study), G3 (inferred with limited confidence), and G4 (early-stage, broadly indicated only).

These geological and energy-intensive processing constraints collectively limit India's ability to scale domestic production of critical minerals.

3.4 Midstream Capabilities and Circular-Economy Infrastructure

Midstream processing, which covers refining, separation, and value addition, remains the most concentrated segment of global critical mineral supply chains. Internationally, only a small number of companies control a large share of refining capacity for key minerals. Entry barriers are steep: processing technologies are capital and energy-intensive, environmentally sensitive, and often protected by proprietary know-how developed over decades. Establishing such facilities requires not only large-scale investment and technical expertise but also stable policy frameworks, reliable raw material supplies, and strong environmental governance. Once integrated into manufacturing ecosystems, these facilities become difficult to substitute, reinforcing structural dependencies worldwide.

Against this backdrop, India faces a pronounced midstream deficit. While exploration and partnerships with countries such as Argentina, Australia, and Peru are progressing under KABIL, the lack of domestic processing, refining, and value-addition infrastructure severely limits India's ability to capture value within its borders.[15]

India generates a growing volume of black mass from end-of-life batteries, currently about 30,000 tonnes each year. By 2030, a large stock of battery systems from vehicles and stationary storage will reach end-of-life, significantly increasing potential secondary supply. While policy support for recycling has expanded, the broader ecosystem is still developing. Feedstock availability remains fragmented, collection networks are uneven, and domestic processing capacity for recovered materials is limited. A considerable share of black mass continues to move overseas because refining and offtake systems in India are still evolving.

As secondary supply becomes a more important contributor to global critical mineral availability, India will require greater emphasis on structured collection flows, domestic refining routes, and clearer market pathways so that recyclable material can be re-integrated into national supply chains.

13India's Lithium Resource, Indus Research.

14Making India a Hub for Critical Minerals Processing, CEEW.

15Economic Times, 22 September 2025.

4. China's Systematic Network Control over Critical Minerals Market

The biggest vulnerability for India in the global critical mineral landscape is China's weaponised control over the ecosystem. China's position in critical mineral markets represents the most comprehensive example of systematic vertical integration, referring to the deliberate consolidation and coordination of multiple stages of the value chain, from resource extraction and processing to manufacturing and distribution.

China controls around 60-70% of global rare earth mining production, its grasp on rare earth processing is even more pronounced, with approximately 90% of the world's rare earth processing capacity under its control.[16] (Figures 8,9)

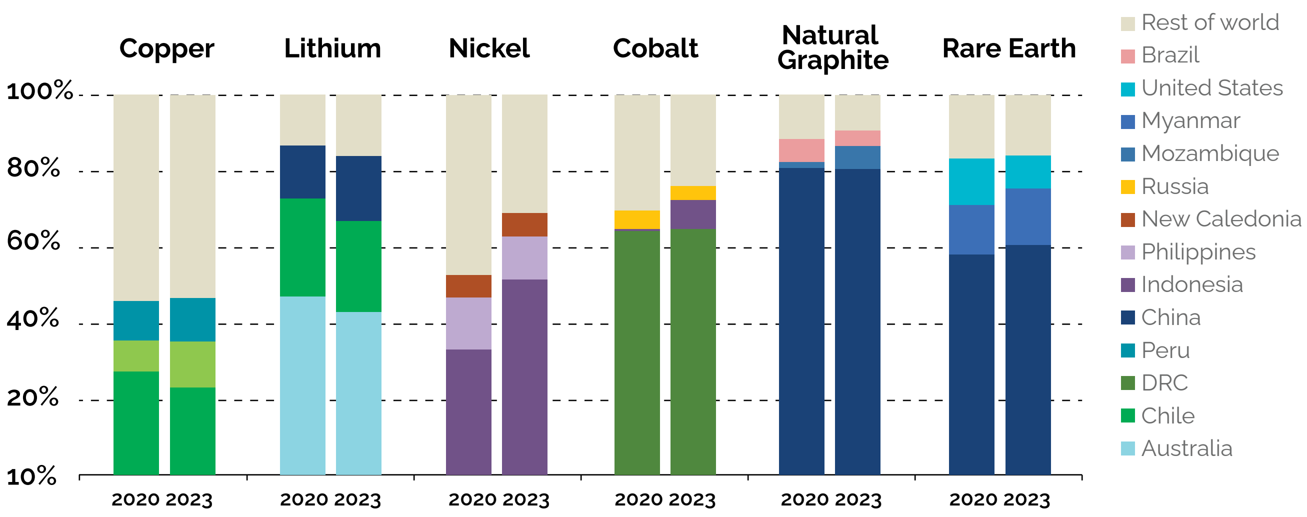

Figure 8. Global Distribution of Critical Mineral Raw Material Production.[17]

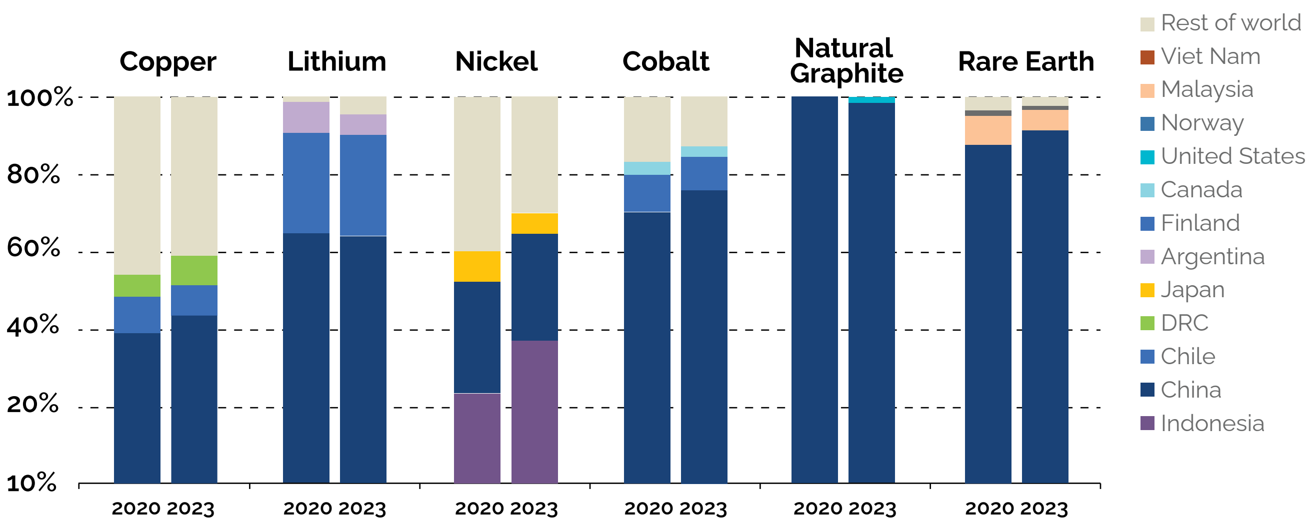

Figure 9. Chinese dependence on Critical Mineral Refining Capacity.[18]

16IEEFA, October 2024.

17IEEFA, India's Hunt for Critical Minerals.

18IEEFA, India's Hunt for Critical Minerals.

It dominates the battery grade lithium refining and over 70% of battery pack assembly.[19] This means China does not merely extract the minerals but is the central hub for refining, adding value, and producing critical components like EV motors, batteries and wind turbines.

China's dominance in the critical minerals value chain reflects not only its rich natural resource base but also decades of deliberate strategic planning and investment. Over the years, China has systematically expanded its global footprint through state-backed enterprises and strategic funding mechanisms that secure upstream mining assets and downstream processing capacities abroad. Its approach combines direct equity acquisitions, long-term offtake agreements, and joint ventures with host countries to ensure both resource access and technological control. Between the years 2000 and 2021, the Chinese Government and state owned institutions have granted loans of US$ 56.9 billion for overseas mining and processing projects of five critical minerals, reinforcing this pattern of assertive expansion.[20] Domestically, China has further consolidated its rare earth sector by merging six major firms into two state-controlled conglomerates, the China Rare Earth Group and the China Northern Rare Earth Group. This consolidation enables coordinated decision-making in production and exports, creating what network theory terms "hub nodes" with outsized influence over global supply chains.[21] These integrated investments and policy alignments have collectively given export monopoly to Chinese firms for critical minerals, making the country a central node in the world's critical mineral ecosystem, allowing it to exercise significant geopolitical and economic leverage.

4.1 Implications for Different Countries

For many countries, supply chain security is now heavily shaped by China's policy choices, export controls, and market interventions. Price swings, geopolitical tensions, and sudden restrictions pose real risks to global clean energy deployment and industrial stability. Recent measures such as China's 2023 licensing requirements for gallium and germanium and the 2025 export ban on several rare earth elements,[22] highlight how strategic minerals can quickly become leverage points in global politics. These actions underline the vulnerability created by dependence on a single dominant supplier, especially for inputs critical to clean energy systems, defence manufacturing, and advanced technologies.

4.2 Case Study: China's Rare Earth Restrictions on Japan

In 2010, following a territorial dispute in the East China Sea, China halted rare earth exports to Japan.[23] Without resorting to military engagement, this move inflicted immediate economic disruption. Within weeks, Japanese manufacturers faced acute material shortages that crippled the production of hybrid car batteries, wind turbines, and advanced electronics.[24] This episode exemplified what Farrell and Newman (2019) described as "weaponised interdependence," wherein control over critical nodes in supply networks is exploited for strategic coercion. Although Japan subsequently diversified its supply sources, invested in recycling, and forged international partnerships, its structural vulnerabilities persist.

19Council On Strategic Risks, 30th May 2025.
20India's Need to Secure Critical Minerals for Energy Transition, India Exim Bank.
21Baker Institute, 19 December 2022.
22 CSIS, 14th April 2025.
23CNBC, 23 September 2010.
24SPF, 9 July 2025.

4.3 Case Study: China's Adaptive Response to Indonesia's Export Restrictions

Indonesia, one of the world's largest producers of nickel, which is a key input for electric vehicle batteries, had sought to move up the value chain by imposing complete export bans in 2020 on unprocessed mineral ores to encourage domestic refining and industrialisation.[25] This policy shift aimed to capture greater economic value within the country rather than exporting raw materials. When Indonesia imposed export bans on unprocessed critical minerals, Chinese companies responded by investing in local refining facilities, eventually gaining majority stakes in key processing plants.[26] By doing so, China maintained influence even when direct access to raw materials was restricted, creating what Farrell and Newman describe as self-reinforcing networks systems that grow stronger over time and are increasingly difficult for competitors to challenge.

4.4 Implications of China's Dominance for India's Strategic and Industrial Security

India's critical minerals supply chain is still at an early stage of development. Of the 30 minerals identified as critical, India remains fully import dependent for at least 10. The India Exim Bank identifies lithium, cobalt, nickel, copper, graphite and rare earth elements (REEs) as the most important for the clean energy transition.[27] India currently imports more than 60 percent of its total requirements for these minerals.

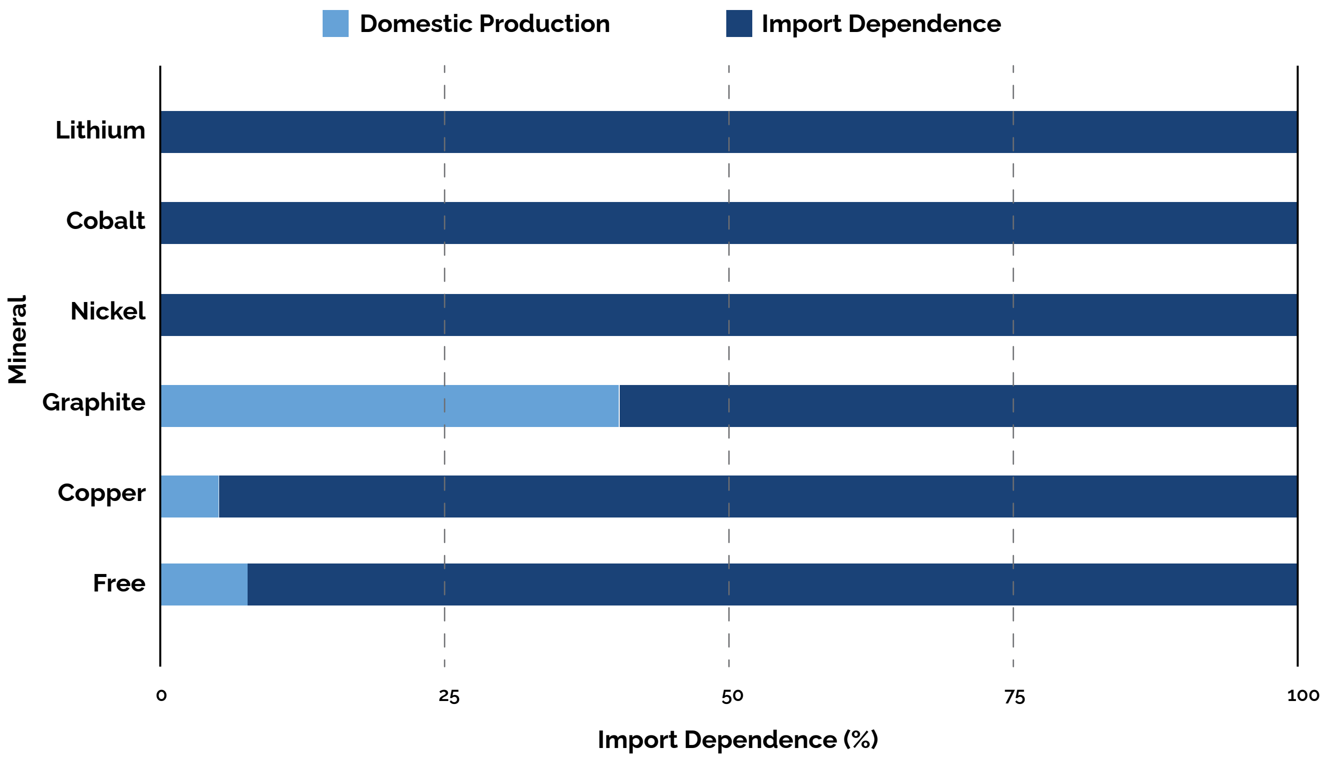

***Figure 10**. India's Critical Minerals Import Dependence (Source: EXIM Import Bank of India, 2025).*

25International Energy Agency, 19th March 2024.

26Hinrich Foundation, 5 November 2024.

27India's Need to Secure Critical Minerals for Energy Transition, India Exim Bank.

Many of the critical minerals supply chain nodes pass through the Chinese Control Networks. China alone accounts for over 85% of India's bismuth imports, 82% of lithium, 76% of silicon and 62%[28] of the REE, creating multiple potential chokepoints. Given tumultuous bilateral relations and India's previous experiences of supply vulnerability, any disruption or restriction from China could have cascading effects on key national priorities, including energy security and industrial competitiveness.

Recent events illustrate the practical dimensions of this vulnerability. India's largest automobile manufacturer, Maruti Suzuki, was forced to reduce production following China's export restrictions on rare earth minerals in 2025, demonstrating how supply chain disruptions abroad directly impact domestic industrial activity.[29] The broader implications extend beyond immediate production losses. India's position reflects what network theory identifies as peripheral positioning within global supply chains, a vulnerability that compounds with each new dependency created by the clean energy transition.

China's market dominance extends beyond mere supply concentration. Although China has recently relaxed some export restrictions by allowing select companies limited access, this move underscores its discretionary control over who benefits from these resources. Such positioning allows China to influence market trends and indirectly shape the strategic and policy decisions of other countries, creating an uneven dependence that limits India's sovereign choices in technology and industry development.

28Datanomics : India looks at options amid crunch of rare earth materials | Economy & Policy Analysis - Business Standard.

29Reuters, 11th June 2025.

5. Global Lessons: Insights from Japan's De-risking Experience

5.1 Japan's Response: Building Resilience After Crisis

Following the 2010 rare earth crisis, Japan implemented comprehensive measures including advanced recycling technologies that now recover up to 95% of rare earth elements from electronic waste, a process researchers term "urban mining." The country established strategic partnerships with the United States, Australia, and Canada while investing heavily in alternative materials research and substitution technologies.[30]

Japan's 2020 International Resource Strategy emphasised securing stable supplies for high-tech industries and clean energy transitions through diversification and circular economy principles. The country's innovative approaches included using recycled materials for the 2020 Tokyo Olympics medals, demonstrating its commitment to resource efficiency and sustainability. These efforts represent sophisticated applications of circular economy principles that reduce primary resource demand while enhancing supply chain resilience.

Japan's trajectory reveals that while complete elimination of import dependencies may be unrealistic for resource-poor nations, strategic interventions can significantly reduce vulnerability. The country's experience demonstrates that technological capabilities in recycling and substitution, combined with diplomatic diversification, create meaningful buffers against supply shocks even when structural dependencies persist.

5.2 Lessons for India

Japan responded to supply disruptions after they occurred, India has the opportunity to build resilience proactively. The weaponised interdependence framework suggests that countries establishing early positions in critical supply chain networks gain structural advantages that compound over time.

For India, Japan's approach offers three critical lessons. First, parallel development of domestic refining capacity alongside exploration initiatives can capture greater value from mineral imports and partnerships, reducing dependence on foreign processing. Second, early-stage investment in recycling infrastructure creates long-term resilience. Urban mining becomes increasingly viable as India's electronic waste streams grow with economic development. Third, government-backed R&D in material substitution can reduce exposure to specific critical minerals where supply concentration is highest.

Importantly, Japan's experience underscores that dependency reduction is a continuous process rather than a binary outcome. The combination of technological innovation, circular economy practices, and strategic partnerships may not eliminate vulnerabilities entirely, but it transforms them from acute crisis points into manageable risks. For India, this means complementing its diplomatic and exploration-led initiatives with systematic investments in downstream capabilities that strengthen internal value chains while maintaining the policy coherence across trade, environment, and industrial sectors necessary for long-term resource security.

30World Economic Forum, 13th October 2023.

6.Way Forward

India's path towards critical mineral security demands a calibrated strategy that simultaneously strengthens domestic capabilities, diversifies global partnerships, and embeds sustainability across the mineral value chain. The following measures outline a forward-looking roadmap to translate policy intent into operational and strategic advantage.

6.1 Strengthening Institutional Governance

The existing Empowered Committee on Critical Minerals must be institutionalised with a permanent secretariat, defined meeting schedules, and a broadened mandate that covers the full value chain, from exploration and processing to sectoral demand and overseas collaborations. Formal inclusion of the Department of Atomic Energy (DAE), Ministry of Electronics and Information Technology (MeitY), Ministry of Heavy Industries (MHI), Ministry of New and Renewable Energy (MNRE), Ministry of Commerce and Industry (MoCI), Ministry of Finance (MoF), Ministry of Environment, Forest and Climate Change (MoEFCC), and the Ministry of External Affairs (MEA) would strengthen coordination. This approach would bring greater continuity and coherence to India's governance framework for critical minerals.

6.2 Modernising Exploration and Resource Assessment

Modernising resource classification standards and scaling National Mineral Exploration Trust (NMET) operations to achieve the mission target of assessing 1,200 exploration blocks by 2030 will address challenges like Jammu and Kashmir's Reasi district where auctioned blocks lack detailed G1 level exploration. This requires integrating NMET activities with the National Geoscience Data Repository portal, standardising trace element assessment protocols, establishing proper resource classification guidelines, expanding private sector participation beyond the current public sector undertaking-dominated model, and implementing sustained capacity building with streamlined approval processes to build investor confidence.

6.3 Building Domestic Processing Capabilities and Industrial Clusters Assessment

India should develop an integrated critical-mineral processing and refining ecosystem stationed in dedicated industrial clusters near potential mining and recovery sites. These clusters should co-locate beneficiation, advanced hydrometallurgical and pyrometallurgical refining, alloy/compound production, and downstream manufacturing (e.g., battery-grade materials, rare-earth oxides, magnet alloys). A dedicated Production-Linked Incentive type scheme for processing and value-addition should be introduced to support CAPEX-heavy separation and refining capacity. This must be complemented by technology transfer partnerships through mechanisms such as the Quad Critical and Emerging Technology Working Group under the broader Quadrilateral Security Dialogue framework, which prioritizes secure and resilient critical and emerging technology supply chains, promotes collaboration on critical minerals processing, supports diversification away from concentrated supply sources, and facilitates joint research, standards alignment, and trusted value chains among member countries (India, the United States, Japan, and Australia). Leveraging the Quad's focus on resilient rare earth and critical mineral supply chains can enable rapid acquisition of advanced separation, solvent extraction, ion-exchange, and refining technologies. Cluster-level demand assurance frameworks through offtake guarantees from EV, renewable, electronics and defence industries should be facilitated to anchor predictable markets. A phased incentive structure that rewards higher purity, recovery efficiency, and environmental performance will reduce processing costs, accelerate domestic capability, and align India with global best practices on diversified sourcing and strategic value-addition.

6.4 Advancing Circular Economy and Recycling Infrastructure

India should build on the current recycling subsidies under the NCMM by establishing a comprehensive recycling and circularity programme that supports large-scale, technologically advanced recovery of lithium, nickel, cobalt, manganese, and rare earths from end-of-life batteries, electronic waste, catalytic converters, permanent magnets, and industrial residues such as red-mud and fly-ash. In addition to CAPEX and sales-linked OPEX incentives, stronger measures are required to indigenise high-yield recycling technologies like hydrometallurgy and direct physical recycling. This can be supported by domestic R&D grants, technology partnerships, and pilot demonstration projects. On the supply side, improved collection systems through strengthened EPR enforcement, streamlined scrap import rules, and cluster-based recycling parks are needed to ensure predictable feedstock flows. On the demand side, integrating recyclers with downstream manufacturers through offtake facilitation, enabling participation in mineral exchanges for transparent price discovery, and allowing recycled-mineral credits under the Indian Carbon Market will anchor stable market demand. A reinforced recycling ecosystem will deliver cost-competitive secondary materials, reduce import dependence, and enable a scalable, low-emission critical mineral value chain.

6.5 Scaling Up Overseas Investment and Strategic Acquisitions

India should substantially enhance the scale and strategic intent of its overseas critical mineral investments to match the financial depth deployed by leading competitors. While initiatives such as KABIL have made important early moves, with investments like the $25 million Argentina venture, India must mobilise significantly larger capital pools through blended finance, sovereign-backed credit lines, and partnership models to compete with state-supported Chinese firms that routinely commit over $1 billion per project. Translating India's participation in platforms such as the Minerals Security Partnership and the Supply Chain Resilience Initiative into tangible cross-border acquisitions, long-term offtake agreements, joint processing ventures, and coordinated stockpiling mechanisms is essential to secure diversified supply at scale. Prioritising overseas assets that offer co-located beneficiation and refining capacity, combined with technology-transfer provisions, will accelerate India's capability-building far more efficiently than relying solely on domestic exploration and processing. A strengthened overseas investment strategy-anchored in financial competitiveness and multilateral cooperation will position India to reshape supply chains rather than adapt to existing ones.

6.6 Establishing an International Fund-of-Funds for Critical Minerals

India should spearhead the creation of an International Fund-of-Funds for Critical Minerals, designed to pool investments from mineral-rich countries, global processors, and multilateral partners such as the Mineral Security Partnership. This fund would strategically invest in exploration, acquisition, and critically-processing infrastructure within host countries like Australia, Brazil, Chile, and African nations. By enabling value addition closer to the source, the initiative would offer a transparent, rules-based alternative to China's mineral dominance, while securing India's upstream access and reinforcing its role as a global manufacturing and supply chain hub. This approach aligns with India's self-reliance goals and global efforts to build resilient, diversified mineral ecosystems.

6.7 Accelerating Alternative Technology Development

India's transition to a low-carbon economy is expected to substantially increase demand for critical minerals that underpin electric mobility, renewable energy systems, battery storage, and advanced manufacturing. According to the Scenarios Towards Viksit Bharat and Net Zero report by NITI Aayog (2026), cumulative demand for Critical Energy Transition Minerals could reach 169 million tonnes by 2070 under a Net Zero pathway, 51% higher than under current policy scenarios. This projected surge in mineral demand underscores the urgency of accelerating alternative technologies, improving material efficiency, and strengthening domestic innovation ecosystems.

To unlock the full potential of alternative technologies that reduce reliance on critical minerals, India should adopt a three-pronged strategy: establish national testing and certification hubs to validate emerging innovations, significantly boost public and private investment in R&D to accelerate breakthroughs, and create targeted incentives for commercial scalability, such as production-linked subsidies, pilot deployment programs, and industry-academia partnerships. This integrated approach will help bridge the gap between lab-scale promise and real-world adoption across EVs, energy storage, and industrial applications.

[31] A Study Report On - Scenarios Towards Viksit Bharat and Net Zero: An Overview (Vol. 1),NITI Aayog. (2026).

Notes

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