Policy Brief

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India's Rare Earths Strategy for Strategic Autonomy and Global Leverage

Abstract

Critical minerals form the backbone of modern technological advancement and the global energy transition. As India pursues its net-zero ambitions for 2070 and scales up its manufacturing capabilities, securing reliable access to these minerals has become a strategic imperative. This Policy Brief examines India's critical mineral landscape through a geopolitical lens, highlighting key vulnerabilities, opportunities, and pathways toward self-reliance in an increasingly weaponised global supply chain environment.

Introduction

According to India's Ministry of Mines (2023), critical minerals are those essential for economic development and national security. Limited availability or a high concentration of extraction and processing in few geographical regions can expose countries to supply chain vulnerabilities and disruptions.

India has identified 30 critical minerals through a three-stage assessment process that considers economic importance, supply risk, resource availability, and sectoral requirements across defence, agriculture, energy, pharmaceuticals, and telecommunications.

Critical minerals constitute a broader category of minerals deemed essential for modern technologies, national and regional security.

Rare earth minerals are a specific group of 17 elements with unique properties vital for advanced manufacturing. These minerals are termed ‘rare’ not due to scarcity but because economically viable and concentrated deposits difficult to find.

Rare Earth Elements (REEs) comprise 17 elements, divided into two categories:

a) Light Rare Earth Elements (LREEs): Essential for electric vehicle (EV) motors, wind turbines, and renewable energy applications. Key elements include Neodymium, Praseodymium, Lanthanum and Cerium

b) Heavy Rare Earth Elements (HREEs): Critical for high-performance applications including fighter jets and advanced defence systems apart from EVs and wind turbines requiring enhanced magnetic stability. Key elements include Dysprosium, Terbium, Yttrium and Gadolinium’

Historical Fact

India’s rare earth exports began even before independence, when radioactive material was accidently discovered in the beach sands of Kerala. In 1909, a German chemist, Herr Schomberg, noticed glittery substances stuck to coir ropes imported from India and established that it was monazite, a reddish-brown phosphate mineral. Monazite was a source of thorium, a slightly radioactive metal, used in making gas mantles in the era that predated electric bulbs. Subsequently, India started exporting beach sand and its extracts to Germany and the UK.

Homi J Bhabha, often called the father of the India’s nuclear programme, established Indian Rare Earths Ltd, (IREL’s predecessor), in 1950 to strengthen India’s energy security, recognising thorium’s potential as a fuel for nuclear reactors.

Rare Earth Magnets: The Strategic Asset

India’s focus on critical minerals gained momentum following its commitment to achieve net-zero emissions by 2070. In 2016, NITI Aayog introduced its first EV policy,

identifying rare earth market security as a key priority. In 2017, NITI Aayog member V.K. Saraswat called for greater investment and policy support to strengthen India's rare earth ecosystem. More recently, NITI Aayog member Arvind Virmanihas emphasised the need for a dual strategy that enhances domestic sourcing of rare earth minerals while deepening international partnerships in processing and metal production, thereby reducing reliance on China, the world's dominant supplier.

Rare earth magnets are the strongest permanent magnets commercially available. Their exceptional magnetic strength and resistance to demagnetisation make them indispensable in of applications, especially where weight and space are constraints. These magnets are made primarily produced using elements like neodymium, praseodymium, and dysprosium - materials that enable the high magnetic properties required in miniaturised and energy-efficient devices. The most widely used rare earth magnet is the neodymium-iron-boron (NdFeB) magnet.

NdFeB magnets represent the strongest type of commercial permanent magnets. Their compactness, high efficiency, and superior thermal resistance have driven their widespread adoption across sectors—from smartphones and EVs to wind turbines and precision-guided missiles. Over the past six to eight years due to their usage has expanded rapidly due to their favourable size-to-performance ratio and their advantages over traditional ferrite magnets.

Sectoral Requirements and Applications

Clean Energy Transition

- **Electric Vehicles**: Lithium, cobalt, nickel, graphite, rare earth magnets for motors
- **Wind Turbines**: Rare earth magnets (neodymium, dysprosium), copper
- **Solar Panels**: Silicon, tellurium, cadmium, silver
- **Energy Storage**: Lithium, vanadium, cobalt for advanced battery systems

Defence and Aerospace

- **Precision Weapons:** Rare earth magnets for guidance systems
- **Fighter Jets:** Titanium alloys, dysprosium and terbium for high-temperature stability
- **Radar Systems:** Gallium, germanium for semiconductors
- **Armor:** Tungsten, tantalum for penetrator rounds and protective plating

Advanced Manufacturing

- **Semiconductors:** Silicon, germanium, gallium, rare gases
- **Electronics:** Rare earth elements for displays, tantalum for capacitors
- **Industrial Machinery:** PGE for catalysts, molybdenum for steel alloys
- **Telecommunications:** Rare earths for fiber optics and network equipment

Emerging Technologies

- **Artificial Intelligence:** Advanced semiconductors requiring rare elements
- **Quantum Computing:** Specialised materials including rare earth compounds Biotechnology: Rare earth fluorescent compounds for imaging
- **Space Exploration:** Titanium, niobium for extreme environment applications

India's Resource Position: Strength amidst Challenges

Major REE deposits are concentrated in: Tamil Nadu (coastal beach sands); Andhra Pradesh (coastal areas); Odisha (coastal regions and Sukinda); Kerala (Chavara); Gujarat and Maharashtra (coastal areas).

Domestic Resources

India possesses an estimated 7.23 million tonnes of rare earth oxides, ranking third globally after China and Brazil. However, India's share of global production remains disproportionately low accounting for less than 10 percent of global reserves, but contributing under one percent to actual production.

Resource estimate indicates that India has 11.93 million tonnes of monazite in its beach sands, containing 55-65 percent rare earth oxides.

Source: *https://www.vedantalimited.com/public/uploads/16192/ET-Its-Elementary.pdf*

Critical Gap: Refining and Manufacturing

A Primus Partners report projects India's demand for rare earth magnets to exceed 7,000 tonnes by 2030, driven primarily by EV production. However, India currently lacks both the technological know-how and entrepreneurial base required for domestic magnet manufacturing.

Despite substantial reserves, India continues to face a critical bottleneck: as of September 2025, Indian Rare Earths Ltd (IREL) remains the country's only refiner of rare earth minerals.

India's critical minerals sector presents significant opportunities, but unlocking them requires strategic investment across the value chain. The country must build: advanced refining capacity, robust R&D infrastructure, large-scale manufacturing capabilities for rare earth magnets, effective technology transfer mechanisms, and a strong entrepreneurial ecosystem for rare earth value chains.

India's 30 Critical Minerals	
1.	Antimony
2.	Beryllium
3.	Bismuth
4.	Cadmium
5.	Cobalt
6.	Copper
7.	Gallium
8.	Germanium
9.	Graphite
10.	Hafnium
11.	Indium
12.	Lithium
13.	Molybdenum
14.	Niobium
15.	Nickel
16.	Platinum Group Elements (PGE)
17.	Phosphorous
18.	Potash
19.	Rare Earth Elements (REE)
20.	Rhenium
21.	Selenium
22.	Silicon
23.	Strontium
24.	Tantalum
25.	Tellurium
26.	Tin
27.	Titanium
28.	Tungsten
29.	Vanadium
30.	Zirconium

The complete value chain from oxide to finished magnet demands complex metallurgical processes, including sophisticated separation and purification technologies capable of producing high-purity individual elements.

Equally essential are modern quality control systems and testing infrastructure to meet international standards, particularly for defence and aerospace applications. Bridging the gap between laboratory-level innovation and commercial production also remains a key challenge.

To parallel China's deeply integrated rare earth ecosystem, comprising hundreds of specialised firms, India must nurture specialised entrepreneurs, expanded private sector participation beyond IREL, enhance research-industry linkages, and create a more dynamic investment environment for mineral processing ventures.

Across the value chain exploration, auctioning, mine development, ore processing, refining, and manufacturing, each stage requires distinct expertise, technology, and capital investments. Identifying and addressing these gaps present significant opportunities for targeted interventions.

While India has mapped primary resources, completing the assessment of secondary sources,urban ores such as e-waste and batteries, fly ash, red mud, and mine tailings, offers substantial potential for critical mineral recovery and advancing a circular economy.

Geopolitical Dimensions

At the 2025 BRICS summit in Brazil, Indian Prime Minister Modi articulated the strategic significance of this challenge: "*We need to work together to make supply chains for critical minerals and technology secure and reliable. It's important to ensure that no country uses these resources for its own selfish gain or as a weapon against others*".

This aligns with India’s External Affairs Minister S. Jaishankar’s broader warning terms "the weaponisation of everything"—the need to "de-risk our exposures and engagements" in an era of rising geopolitical volatility.

India’s flagship initiatives, such as the National Critical Mineral Mission (NCMM), the National Mission for Artificial Intelligence (IndiaAI Mission), and the India Semiconductor Mission (ISM) are rooted in the understanding that no emerging power can afford dependence on unreliable foreign suppliers for core industrial and technological fields.

China's Dominance and weaponisation of supply chains

China's overwhelming control of the rare earth value chain represents one of the most significant geopolitical vulnerabilities for India and other emerging economies:

- ~70 percent of global rare earth metals mining
- ~90 percent of global rare earth magnet production
- 85-90 percent of India's rare earth magnet import volumes
- 60-80 percent of India's rare earth magnet import values

This data, shared in a written reply to the Rajya Sabha on August 01, 2025, highlights India's acute dependence on a single external supplier for materials vital to defence, clean energy, electric mobility and advanced manufacturing.

China sources most of its raw materials from Myanmar, reinforcing its role as a global processing hub and giving it strategic leverage over international supply chains.

Import Dependency: A Vulnerability Assessment

India remains 100 percent import dependent for several critical minerals

essential for clean energy transition and advanced manufacturing:

Critical Mineral	Import Dependency	Major Import Sources (2020)
Lithium	100%	Chile, Russia, China, Ireland, Belgium
Cobalt	100%	China, Belgium, Netherlands, US, Japan
Nickel	100%	Sweden, China, Indonesia, Japan, Philippines
Vanadium	100%	Kuwait, Germany, South Africa, Brazil, Thailand
Niobium	100%	Brazil, Australia, Canada, South Africa, Indonesia
Germanium	100%	China, South Africa, Australia, France, US
Rhenium	100%	Russia, UK, Netherlands, South Africa, China
Beryllium	100%	Russia, UK, Netherlands, South Africa, China
Tantalum	100%	Australia, Indonesia, South Africa, Malaysia, US
Strontium	100%	China, US, Russia, Estonia, Slovenia

Source: Ministry of Mines, Government of India. (2023). Report of the Committee on Identification of Critical Minerals for India, June 2023, Table 1, p. 19

This dependency structure highlights significant concentration risks particularly with China as a dominant supplier, capable of disrupting India's industrial base, defence capabilities, and clean energy transition during geopolitical tensions.

Policy Initiatives: Building Domestic Capacity & Partnerships

National Critical Mineral Mission (NCMM)

The National Critical Mineral Mission is India's most ambitious domestic initiative to achieve self-reliance in critical minerals supply chain. Designed to discover indigenous sources for rare earth materials, the NCMM addresses vulnerabilities across the entire value chain, from exploration and auction, to mine operationalisation and foreign asset acquisition. Recognising the long gestation period for primary mining, the mission strategically prioritises secondary sources as an immediate pathway to domestic supply.

The Union Cabinet has approved an outlay of Rs 1,500 crore dedicated to extracting critical minerals from secondary sources over six years, from FY 2025-26 to FY 2030-31. This timeline aligns with India's industrial and clean energy transition goals, ensuring that critical mineral availability keeps pace with demand from EV production, renewable energy expansion, and electronics manufacturing.

Eligible feedstock includes e-waste, lithium-ion battery (LIB) scrap, and other scrap materials such as catalytic converters in end-of-life vehicles, collectively representing a substantial urban mining opportunity. The mission adopts an inclusive design by targeting both large, established recyclers and smaller, emerging players including start-ups, for whom one-third of the outlay has been earmarked. This dual approach ensures immediate scale while fostering innovation and entrepreneurship in the nascent critical minerals recycling sector.

Khanij Bidesh India Ltd (KABIL)

Established in 2019 as a joint venture of three central public sector enterprises; National Aluminium Company Ltd (NALCO), Hindustan Copper Ltd (HCL), and Mineral Exploration Corporation Ltd (MECL), KhanijBidesh India Ltd (KABIL) is India's strategic vehicle for securing overseas critical mineral assets. It operates on the principle that domestic resources alone cannot meet India's growing requirements, particularly for minerals with no proven reserves or where domestic extraction faces technical or environmental constraints.

KABIL actively scouts for overseas assets, prioritising on lithium and cobalt, both essential for battery technologies driving India's electric mobility transformation. Current engagements include projects under evaluation in Argentina's lithium triangle, Australia's mining hubs, and Chile's copper-lithium belt.

Beyond equity participation, KABIL seeks long-term offtake agreements, technology partnerships, and potential overseas processing facilities. This approach allows India to participate in global value chains while building expertise and relationships that can eventually support domestic processing capabilities. These efforts align closely with India's diplomatic missions and broader foreign policy objectives.

India's Multilayered International Engagement: From Bilateral to Minilateral Frameworks

India pursues critical minerals security through diverse international channels—bilateral agreements with Chile, Argentina, and Myanmar; KABIL's asset acquisition in South American and African mineral belts; and multilateral engagement through BRICS and the International Energy Agency. However, two partnerships merit detailed analysis for their strategic significance: the Quad Critical Minerals Initiative and the Mineral Security Partnership (MSP). These stand apart due to their unique combination of (a) direct access to alternative supply sources beyond China, (b) technology transfer mechanisms for processing and manufacturing, (c) alignment with democracies sharing India's strategic concerns, and (d) operational frameworks that translate commitment into tangible projects.

The Quad offers focused Indo-Pacific cooperation linking India to Australia's resources, Japan's materials technology, and US capital. The MSP provides the broadest network of 14 mining, processing, and technology-leading nations with binding ESG commitments. Together, these partnerships address both India's immediate supply diversification needs and its long-term goal of building domestic value-chain capabilities—objectives that bilateral deals or broader multilateral forums alone cannot fulfill.

Quad Critical Minerals Initiative

The Quad Critical Minerals Initiative, announced by India along with the US, Australia, and Japan, represents a strategic convergence of four major Indo-Pacific democracies aiming to reshape global critical mineral supply chains. The initiative intends to advance cooperation in exploration, processing, and recycling while explicitly reducing dependency on single-source suppliers, particularly China.

Australia, with its vast reserves of rare earths, lithium, and cobalt, is emerging as a reliable alternative supplier supported by stronggovernance and stable regulatory systems. In October 2025, the US President Trump and Australian Prime Minister Albanese signed an US$8.5bn critical minerals agreement, demonstrating tangible commitment.

For India, the Quad framework offers substantial benefits: access to Australian mineral resources, technology sharing for processing and beneficiation, joint R&D, and collective bargaining power in global markets. It also open pathways for Indian

participation in Australian mining projects and for Australian firms to operate in India, creating mutually reinforcing supply chain resilience.

Mineral Security Partnership (MSP)

India's accession to the Mineral Security Partnership (MSP) in June 2023 marked a major milestone in aligning with a coalition focused on responsible critical mineral supply chains. The MSP comprising Australia, Canada, EU, Finland, France, Germany, Italy, Japan, Norway, South Korea, Sweden, the UK and the US operates on three pillars:

- Strengthening supply chains through coordinated investment across exploration, extraction, and processing;
- Ensuring responsible production, based on high environmental, social, and governance (ESG) standards; and
- Catalysing public and private sector investments across the entire value chain.

For India, MSP membership provides access to global expertise -- Canadian mining expertise and lithium deposits, Australian rare earth and lithium resources, European processing technologies and recycling capabilities, Japanese advanced materials, and US finance and technology. It also facilitates data sharing, joint investment opportunities, and coordinated responses to supply disruptions.

These multilateral engagements complement India's domestic initiatives, creating a balanced strategy that blends self-reliance with strategic interdependence. Additionally, the Government of India has approved an incentive scheme with an outlay of Rs 7,280 crore to establish domestic capacity for manufacturing 6,000 tonnes of integrated rare earth magnets annually, aiming to break China’s dominance in this vital sector.

Strategic Engagement with Africa's Critical Mineral Wealth

There is a significant global scramble for critical mineral supply from Africa, with major powers competing intensely for access. India participates in this supply search at a smaller but growing scale, with concerted efforts underway to secure supply from the continent. This supply chain agenda appears to be a high priority in the portfolio of Indian missions across Africa. The strategic importance is reflected in numerous references found within various economic partnerships from China's Belt and Road Initiative to the US-backed Lobito Corridor, all designed to facilitate critical mineral trade and transit.

Africa's mineral wealth is extraordinary, holding approximately 30% of global reserves. The continent possesses vast deposits of cobalt, lithium, copper, manganese, graphite, and rare earth elements, all vital for green technologies (electric vehicles, batteries, wind turbines) and emerging AI infrastructure. Key supplier countries include the Democratic Republic of Congo for cobalt, Zambia for copper/cobalt/lithium, Zimbabwe for lithium, Guinea for bauxite, South Africa for manganese, and Mozambique/Tanzania for graphite.

Importantly, African nations increasingly aim to move beyond serving merely as raw material exporters toward developing local processing capabilities, viewing critical minerals as a pathway to broader industrialization and value capture within their own economies. This shift in African priorities adds complexity to India's engagement strategy, requiring partnerships that offer mutual benefits beyond simple resource extraction.

Way Forward: Suggestions & Policy Recommendations

India's path to critical mineral security requires a comprehensive and coordinated strategy across multiple fronts. The following recommendations provide a roadmap to achieve self-reliance while building resilient and secured global supply chains.

1. Establish Complete Domestic Value Chains

India must build comprehensive prioritise building complete domestic value chains with a target timeline of three-five years for achieving self-reliance in rare earth magnet production. This requires mapping the entire value chain, identifying technological gaps, establishing facilities for converting rare earth oxides into separated elements, and creating magnet manufacturing clusters with integrated supply chains.

A sectoral facilitation office under the Ministry of Mines, establishing (with private sector advisory representation) should support the establishment of integrated manufacturing clusters and related ancillary processes.

2. Financial Incentives Linked to Production

Production-Linked Incentive (PLI) schemes should target rare earth processing, refining, magnet manufacturing, advanced material development, and recycling technologies. Similar to the existing Rare Earth Permanent Magnet (REPM) initiative, all REPMs must include progressive localisation provisions to stimulate upstream development and prevent shallow, assembly-based activities.

3. Encourage Public-Private Partnerships (PPPs)

The government should support PPPs for establishing critical minerals processing facilities, magnet production clusters, R&D centres, and skill development institutions. Mechanisms such as long-term offtake agreements, credit guarantees, and initial tax holidays can de-risk private investment.

4. Technology Development and Transfer

A National R&D Mission should: accelerate technology transfer from CSIR and national research institutions; scale up pilot and lab-scale processes with industry partners; and develop indigenous to fill gaps that cannot be met through transfer or adaptation.

5. Incentivise Domestic Mining and Production

Reforms should streamline exploration licencing; fast-track strategic mineral clearances; encourage private sector exploration; and offer incentives for processing facilities. Preferential procurement, tax concessions, subsidised power, and research grants can improve viability while lowering environmental impact.

6. Secure International Supply Lines and Strengthen Global Partnerships

India must prioritise trade agreements with Chile, Peru, Myanmar and Australia, while negotiating long-term supply agreements with diversified sources, supporting KABIL's overseas asset acquisition, and leveraging bilateral relationships for technology transfer.

Strengthening partnerships with key countries is essential. Australia emerges as a critical alternative source given its vast reserves and recent US$8.5bn critical minerals agreement with the US, Myanmar offers potential for raw material sourcing particularly for rare earths, and the US provides technology transfer opportunities and joint investment frameworks through the Quad Critical Minerals Initiative.

The diversification strategy should aim to reduce China dependency from 85-90 percent to below 50 percent by 2035, establish multiple suppliers for each critical mineral across different geographies, create strategic reserves for high-risk minerals, and develop indigenous alternatives where technologically and economically possible. Integrating into resilient global supply chains through strategic partnerships ensures that India benefits from international best practices, shared technology platforms, and collective bargaining power while maintaining strategic autonomy in critical decision-making.

7. **Build Secondary Resource Capacity**

An Urban Mining Initiative should expand e-waste collection, enforce battery recycling mandates, support extraction technologies, and establish market linkages. Recovering minerals from fly ash, red mud, mine tailings, and metallurgical wastes will augment supply while promoting circularity.

8. **More innovation in the Centre of Excellence for Critical Minerals (CECM)**

The CECM should house advanced analytical and testing facilities, data analytics systems for deposit discovery, R&D labs for process development, and training centres to build skilled manpower.

9. **Develop Defence and Strategic Stockpiles**

India must create strategic reserves for minerals with 100 percent import dependence, maintain buffer stocks, and update reserve planning based on consumption trends. Stockpiling should complement rather than substitute domestic production efforts.

10. **Foster Innovation and Academia-Think Tank-Industry Ecosystem**

Support start-ups, incubation networks, mentorship programmes, and industry-sponsored academic research. Partnerships with IITs, IISc, and international institutions can build long-term human capital and innovation capacity.

Conclusion

India stands at a pivotal moment in its developmental trajectory. Its clean energy transition, advancement in defence technologies, and ambitions in high-tech manufacturing all hinge on secure access to critical minerals. Current dependence on China for 85–90% of rare earth minerals and full import reliance for almost ten critical minerals represents a strategic vulnerability that must be systematically addressed.

Achieving mineral security requires coordinated action across the value chain: technology development, global partnerships, and financial mechanisms that de-risk private investment. With an estimated 7.23 million tonnes of rare earth reserves, and strong political will, India has the resources to transform its dormant mineral base into a foundation for self-reliance.

As Prime Minister Modi has emphasised, critical minerals must not become tools of geopolitical coercion. India, must therefore, develop resilient supply chains, strengthen domestic capabilities, and build a robust mineral security architecture to support its emergence as a leading power in a multipolar world.

India's critical minerals strategy is fundamentally about 'strategic autonomy', the ability to take independent decisions in economic, technological, and security domains. In a world defined by supply chain weaponisation and geopolitical fragmentation, India's approach blends self-reliance with diversified sourcing and long-term capacity building.

In the short term, imports will continue; in the medium term, the diversification will reduce the risk; and in the long-term, self-sufficiency and allied sourcing will form the backbone of India's mineral security architecture.

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