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Strengthening India's Mineral Security: From Efforts to Action

Introduction

The ongoing twin transition (energy and digital transition) coupled with evolving geo-strategic contestations have reignited concerns regarding mineral scarcity. Growing digitisation of economies along with a global quest for energy transition has not only increased the demand for large volume raw materials such as copper and nickel but also for relatively niche minerals such as lithium, cobalt, tellurium, neodymium, REE, etc. which are critical for the production of clean energy systems and high-tech digital products. Demand for these minerals is expected to grow phenomenally in years to come as countries are poised to intensify their efforts for decarbonisation and digitalisation.

China has emerged as a pivotal player in global mineral supply chains. Leveraging extensive investments in domestic mining and processing along with proactive international acquisitions of mines in Africa, South America, and Asia, it has secured a dominant position in the global supply chains of key minerals critical for digital technologies and clean energy systems. This includes near-monopolies on mining and processing of REE, yttrium, gallium, tungsten and decisive control on mining and processing of cobalt, lithium etc. (Congressional Research Service, 2019).

In the wake of Covid pandemic coupled with ongoing geostrategic contestations, extremely concentrated global supply chain of minerals has become a matter of serious concern. Consequently, mineral security has emerged as an important policy objective globally. Keeping industrial and/or defense requirements in mind, most of the industrialised countries have identified minerals which are critical for them and have formulated comprehensive strategies to reduce their vulnerability to disruptions in the supply chain of these minerals. These strategies mostly include measures ranging from

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incentivizing domestic production, promoting R&D for recycling and exploring substitute for minerals deemed critical to exploring additional overseas resources.

India, facing rapidly increasing mineral demand driven by green energy targets and digitalisation, is similarly vulnerable due to its lack of self-sufficiency in several critical minerals. To address these challenges, this policy brief critically examines India's mineral security strategy and suggest measures to make it more effective.

Rush for Critical Minerals: Global Scenario

The concept of 'critical minerals' or 'strategic minerals' emerged after the 2010 when Sankaku boat incident disrupted global REE supply chain. Countries have since assessed their mineral security, identifying minerals at risk of supply disruption. Though there is no universal definition of critical or strategic minerals, economic importance and supply risk have been used as the twin criteria to identify critical minerals (Chadha & Sivamani, 2022). Using this twin criteria, European Union (EU) was first to finalise a list of critical raw material in 2011. Since then, several other countries including United Sates of America (USA), China, Japan, Australia, Canada have also published their lists of critical minerals which have striking similarities as well as differences. Developed countries by and large do not have energy minerals on their critical minerals list. In contrast, China has categorised six energy minerals as critical. Second, except Japan and China, other countries have not listed any precious metals such as gold, silver on their critical mineral list. Despite these differences, there are some striking similarities. There are five minerals, namely antimony, cobalt, lithium, REE and tungsten which are listed as critical minerals by all major economies (Su and Hu (2022). Notably, these minerals are essential inputs for most of the clean energy and high-tech systems. On top of that, global reserves of these minerals are highly concentrated. For example, estimated global reserves of cobalt are 7,600,000 metric tonnes and around 50 per cent of this is concentrated in Congo alone. Similarly, more than 41 per cent of known global lithium reserves are concentrated in Chile. Global reserves of other three most critical minerals namely, tungsten, antimony and REE are also highly concentrated as more than 50 per cent of their global reserves are concentrated in two or three countries. Chromium, fluorite, gallium, germanium, graphite, indium, magnesium, niobium, platinum group metals, tantalum, titanium and vanadium are other twelve minerals which are common in the critical mineral lists of all countries except China (Su and Hu (2022). Apart from these, aluminum, beryllium, bismuth, manganese, scandium, tin and zirconium have been listed as critical by at least four out of five developed economics.

Having finalised the critical minerals list, countries have formulated strategies to secure critical mineral supplies, focusing on supply chain diversification, developing substitutes, and promoting recycling. For example, the US has announced funding programmes under the 'Defense Production Act'

to support domestic critical mineral mining and processing. Additionally, it has introduced 'The Inflation Reduction Act' (IRA) to incentivises investment in local and allied mineral supply chains by offering subsidies for electric vehicles and batteries. It has also launched 'The United States Mineral Security Partnership' (MSP), which includes nations like India, Australia, Japan and collaborates with resource-rich countries such as Argentina, Congo, and Zambia to diversify supply chains and reduce dependency on dominant players. The European Union has enacted the 'Critical Raw Materials Act', that provides financial incentives for mining and processing projects within the EU to enhance self-sufficiency. Japan has implemented subsidies and financial support for rare earth projects in collaboration with Australia and other allies to ensure stable access to vital minerals.

Despite gaining momentum, developed countries initiatives for mineral security are still in initial state. At present, China has been leading the race for minerals. Given its unwavering focus on mineral sector since mid-1980s, it has not only developed world's largest mining and processing industry by optimizing domestic resource, but has also acquired stake in large number of mines abroad. Chinese firms have invested US$ 125 billion dollar in mining sector abroad during 2003 and 2017 to acquire stake in more than hundred mines (Ericson et al 2020). Chinese access to some of the most critical minerals can be

Table 1: Selected Countries Efforts for Ensuring Mineral Security

	United States	**European Union**	**Japan**
Term Used	**Critical minerals**	**Critical minerals**	**Rare metals.**
Key Considerations	1. Defense requirements 2. Economic security 3. Industrial competitiveness	1. Industrial competitiveness 2. Political commitment to climate neutrality	1. Industrial competitiveness.
Critical Minerals List	No. of Critical Mineral: **50**	No of Critical Mineral: **30**	No of Critical Mineral: **31**
Strategy	1. **Encouraging Domestic Production:** Regulatory reform, budgetary support, resource mapping. 2. **Promoting R&D for Developing Technology to**: find substitutes, recycling of minerals, efficient separation and processing, sea mining etc. 3. **Securing stake in mines overseas:** providing loan guarantees for assets acquisition, financial assistance 4. **International Cooperation:** Mineral Security Partnerships, agreements with resource rich countries		

Source: Author's compilation from the policy documents of concerned countries.

gauged from the fact that 15 out of the 19 cobalt-producing mines in Congo, which accounts for around half of the global cobalt reserve, are either owned or financed by Chinese companies (Searcey, Forsythe, & Lipton, 2021). Similarly, Chinese companies, the Jinchuan Group and the China-Africa Development Fund, have acquired 45 per cent stakes in Wesizwe Platinum which have access to substantial reserves of platinum and palladium reserves, essential inputs for electrical vehicles (Reuters, 2010). Lithium is another key mineral used in high power batteries. Although, Australia, Chile, and Argentina are key miners and extractors of lithium, China has established monopoly over processing of the lithium and its companies have made strategic investments in upstream production overseas. Chinese company Tianqi Lithium Co. has 51 per cent stakes in Tianqi Lithium Energy Australia which owns the Kwinana plant in Western Australia (Lithium, n.d.).

Evolution of Indian Mineral Sector and Dependence on Imports

India's mineral sector, endowed with vast reserves of iron ore, bauxite, chromite, limestone, and REE, has experienced remarkable growth since independence, both in terms of production volume and economic contribution. Currently, India produces 87 minerals and have well established value chain from upstream extraction to downstream processing of energy and several metallic, and non-metallic minerals (table 2). Over time, mineral production value has soared from a modest INR 7 crore in 1947 to an impressive INR 1,54,323 crore in

Table 2: Mapping Indian Mineral Value Chains

	Crude Oil and Gas	**Coal and Coke**	**Metallic minerals**	**Non-Metallic mineral (Fertiliser)**	**Rare Earth**
Leading Public Sector Players in Value Chain	1.BPCL 2.HPCL 3.IOCL 4.GAIL 5.ONGCL	6.Coal India 7.SAIL 8.RINL 9.NTPC	10. HCL* 11. NALCO*	12. HFCL 13. NFL 14. FACT 15. FCIL 16. BVFCL 17. FAGMIL	18. IREL* 19. KMML*
Value chain	In place				Missing
Overseas Efforts	ONGC Videsh	Nil	KABIL: JV of NALCO, HCL and MECL		
Controlling ministry	MoP&NG	MoC	MoM *MoS	MoCF	DoAE

Source: Author's compilation.

2021 (Indian Mineral Year book 2022). This growth has been supported by a strong presence of Central Public Sector Enterprises (CPSEs) across the mineral value chain. Companies such as Oil and Natural Gas Corporation (ONGC), Gas Authority of India (GAIL), and Indian Oil Corporation (IOCL) dominate crude oil and gas production, while Coal India and National Thermal Power Corporation (NTPC) lead in coal. For metallic minerals, National Aluminum Company Ltd. (NALCO) and Hindustan Copper Ltd (HCL) are pivotal players, and rare earth minerals are primarily managed by Indian Rare Earth Ltd. (IREL) and Kerala Minerals and Metals Ltd. (KMML).

Despite its strengths, India's mineral dependency remains a challenge, particularly for clean energy and advanced technological sectors. While the country is self-reliant in resources like iron, aluminum, and bauxite, it imports 60 per cent of its manganese and remains fully dependent on imports for coke and certain non-metallic minerals such as fluorspar and magnesite (Table 3). Additionally, India is fully dependent on imports for minerals like germanium, heavy rare earth elements, beryllium, rhenium, tantalum, niobium, cobalt, lithium and strontium etc., many of which are indispensable for high-tech and clean energy applications.[1] Moreover, despite having significant reserve and a head-start in extraction, india has not

1 Import figures for some of these minerals such as rare earth element, cobalt, lithium is very low because these minerals are largely being imported in form of derivates such as, semiconductors, battery cell, solar panel etc.

Table 3: India's Import Dependence for selected minerals

Mineral Type	Mineral Name	Import as % of Consumption
Fuel Minerals	Coal	25
	Coke	100
	LNG	35
	Petroleum	85
Metallic Minerals	Bauxite	10
	Chromite	3
	Copper	18
	Manganese	60
Non-Metallic Minerals	Limestone	7
	Magnesite	80
	Wollastonite	17
	Fluorspar	100
Other Non-Metallic Minerals	Graphite	57
	Kyanite	25
	Siliceous	34
	Vermiculite	16

Source: Calculated from Indian Mineral Year Book 2021-22.

been able to fully develop domestic value chain of light rare earth elements.

Indian Efforts for Minerals Security

India, though a bit late, began efforts to ensure mineral security in 2019 with the establishment of Khanij Bidesh India Ltd. (KABIL). This joint venture, comprising National Aluminum Company Ltd. (NALCO), Hindustan Copper Ltd. (HCL), and Mineral Exploration Company Ltd. (MECL), marked a significant step towards securing mineral resources abroad. Since its inception, KABIL has actively pursued international partnerships, including agreements with Argentine public sector entities like JEMSE, CAMYEN, and YPF to explore lithium and other essential minerals. It has also been exploring joint investment opportunities in Chile, Bolivia, and Australia, focusing on securing minerals such as lithium and cobalt, which are vital for clean energy technologies and advanced manufacturing. India's efforts to ensure mineral security gained further momentum with the finalisation of its list of critical minerals in 2023, which identifies 30 key resources essential for industries like defense, electronics, renewable energy, telecommunications, and transportation. This list includes 17 rare earth elements (REEs), six platinum-group elements (PGE), and other crucial minerals such as lithium, cobalt, nickel, and germanium (Ministry of Mines 2023). Building on this, Finance Minister Mrs. Nirmala Sitharaman announced 'Critical Mineral Mission' in 2024 with budgetary provision of Rs 1500 crore for research & and creation of national stockpiling.

Way Forward

India has taken steps to ensure mineral security during last five years. However, despite these steps, India is still far away from developing a comprehensive mineral security strategy. Following measures are required to make India's mineral security effective.

Establish a Dedicated Fund for Acquiring Mineral Assets Overseas

Despite being endowed with rich mineral resource, India is not self-sufficient in several fuel and non-fuel minerals. It has limited or no reserves of crude oil, coke, cobalt, lithium, niobium, strontium, manganese, molybdenum, indium, neodymium, graphite, vanadium, nickel etc. Thus, securing mineral assets abroad is vital for India's mineral security. India enjoys cordial relations with most of the mineral rich countries and KABIL has been making efforts to acquire minerals assets in some of these countries. However, KABIL currently lacks the financial capacity to assume the risks associated with overseas acquisitions. To address this gap, the Indian government should consider creating a dedicated fund to support KABIL and other firms engaged in overseas mineral acquisitions. The fund should not only cover the purchase of mineral assets but also include infrastructure development for transporting minerals

back to India. Additionally, India should explore leveraging development assistance programmes, similar to China's approach, to support Indian firms mineral acquisition projects abroad.

Develop Missing Domestic Value Chains

In addition to financial limitations, gaps in domestic value chains of cobalt, lithium, and rare earth elements presents another significant challenge for India. The value chain encompasses extraction, refining, processing, downstream manufacturing, and recycling. For cobalt and lithium, India remains fully dependent on imports, with no significant domestic mining or refining infrastructure. In case of REE, although India has some capacity in upstream mining and ore processing, refining and separation capabilities remain absent. Furthermore, India lacks the capacity to produce advanced derivatives of cobalt, lithium, and rare earths, such as battery cathode materials, high-performance alloys, and permanent magnets etc.

Without domestic refining, processing capabilities and downstream manufacturing, mineral resources acquisitions abroad will yield limited benefits. Therefore, India must urgently invest in developing refining and processing capacity while promoting the domestic downstream manufacturing. In budget 2024-25, India earmarked INR 1000 to develop technologies for refining, processing, and recycling of critical minerals. However, the amount allocated is insufficient. The complexity and scale of the technological advancements needed, especially for rare earth elements and e-waste recycling, demand significantly higher investments. To effectively address these challenges and reduce dependence on foreign supply chains, India needs to substantially increase funding for technology development / acquisition and focus on long-term, large-scale initiatives. In addition, fiscal incentives should be provided to promote the domestic production of advance derivates such as battery cathodes, alloys, and permanent magnets etc. It will not only reduce reliance on imports but also ensure the offtake of minerals that KABIL intends to procure in the coming years.

Remove Regulatory Hurdles to Optimizing Domestic Resource Utilisation

India is a mineral-rich country and has resources of several minerals. However, less than 10 per cent of Indian land mass has been geo-scientifically surveyed for an assessment of underlying minerals (Gupta *et al,* 2016). Long delays in regulatory clearances and social resistance have prevented investment in mineral sector. Efforts should be made to address these concerns to fully exploit the domestic mineral potential. India has considerable reserves of Light Rare Earth Elements which have not been utilised due to passive government attitude. REE exploration and processing is fraught with financial, technological and environmental challenges and therefore needs government support in terms of clear policy and financial handholding in the initial phase of development. However, in spite of recognizing the importance of REE, Indian government is

yet to devise a clear policy or road map for the development of REE sector. Instead of having a separate policy for REE, government clubbed REE with atomic minerals which ensured state monopoly and kept the foreign and private domestic investors away, leading to a stagnant REE sector. India should urgently formulate a clear policy for REE sector with support for technology upgradation/ acquisition and incentives such as viability gap finding. Moreover, it should amend Atomic Mineral Concession Act (2016) which has reserved all beach Sand Mines deposits containing more than 0.75 per cent Monazite (source of REE) for government owned companies (Vashisht 2021). Additionally, comprehensive geoscientific surveys should be conducted to identify new mineral resources, and targeted funding should be allocated for exploration efforts, particularly for underutilised minerals such as Light Rare Earth Elements.

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