TAKSHASHILA BLUE PAPER : A RARE EARTHS STRATEGY FOR INDIA

TAKSHASHILA INSTITUTION

This Blue Paper is the result of a Roundtable Discussion held on 17th February 2021, on the Discussion Document: *A Rare Earths Strategy for India*

Takshashila Blue Paper
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ABOUT THE DISCUSSION DOCUMENT

This segment addresses the following aspects of the Discussion Document:

— Summary of the proposals of the document

— The challenges and opportunities for India in the rare earths sector

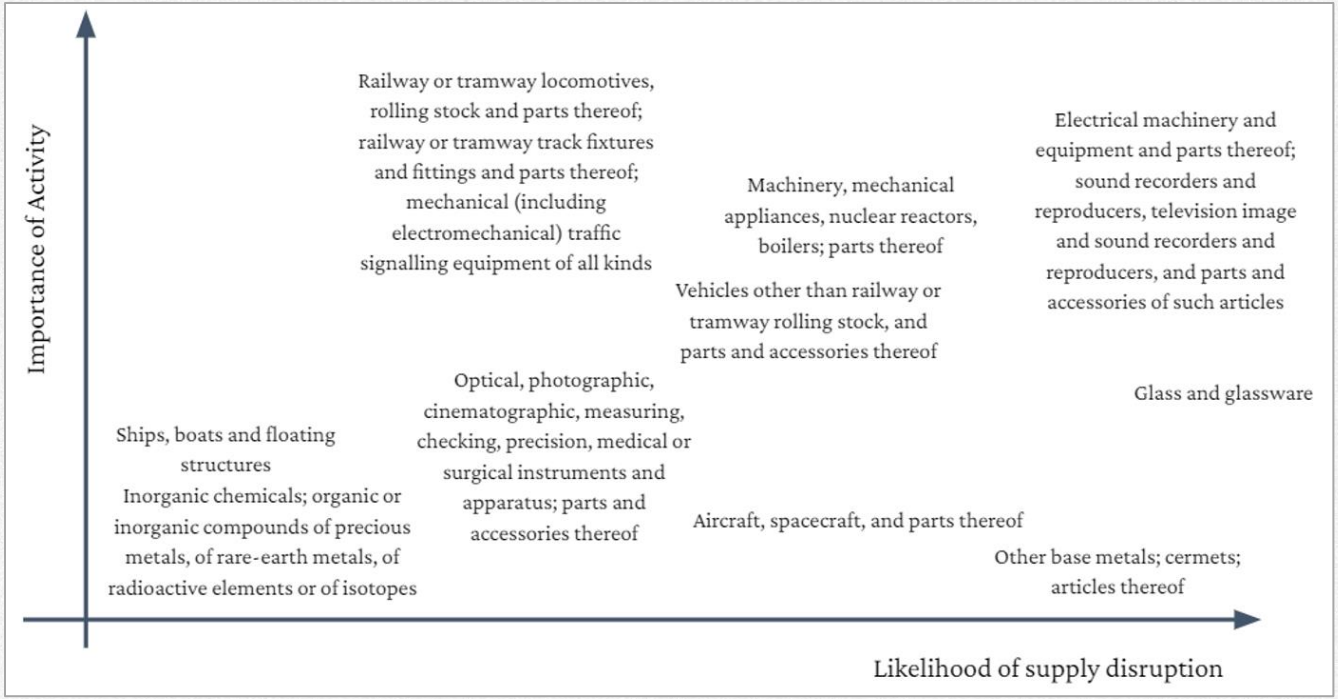
Discussion Document Overview

Post-pandemic geopolitical and economic trends offer a precious opportunity for India to emerge as a rare earths supplier for the world. Below is a brief overview of the challenges faced by the sector in India and the solutions proposed by our Discussion Document.

Challenge	Proposed Solution
The Department of Atomic Energy, which holds responsibility for REE extraction in India, lacks incentives to build production capacity.	Create a new Department for Rare Earths focussed on the sector.
The government has other investment priorities over REE development	Allow private sector companies to participate in processing of rare earth elements.
Upstream processing requires high capital investment and offers limited return on investment due to low prices of the end product.	Offer Viability Gap Funding to businesses in upstream processing to help them set up operations.
Downstream processing faces the challenges of uncoordinated supply chains and logistics.	Provide enabling infrastructure close to ports Implement Ease of Doing Business Measures Create a whitelist of international suppliers for businesses in downstream processing.
There exists a risk of supply shock due to China's monopoly over the REE sector.	Build a rare earths reserve along with partners such as the US, Australia, and Japan.

The Need for a Strategy

Rare earth elements (REEs) and their derivatives contribute an estimated value of $200 billion to the Indian economy every year. China controls nearly 90% of the world's REE mining and refinement capacity and has a record of using trade as a coercive tool in international diplomacy. This poses a significant threat to Indian interests in the coming decades.

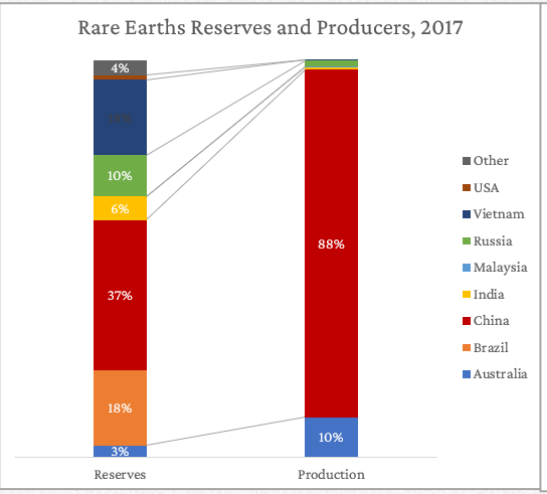


Risk of supply disruptions to Indian imports that use rare earths. This figure categorises rare earth applications by importance of activity and the likelihood of supply disruption. The importance of an activity is determined by its share in India's Gross Domestic Product (GDP) of the country. The likelihood of supply disruption depends upon the concentration of exporters, India's changing relations with the exporting countries, and availability of appropriate substitutes. The data for this analysis was obtained from the WTO.

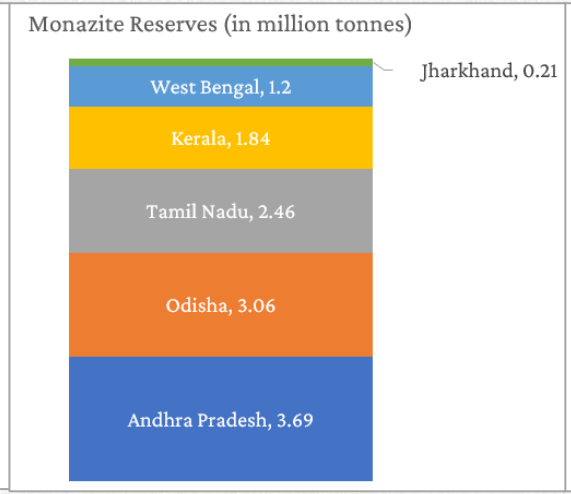
The Opportunity

India's reserves of rare earth oxides, nearly 6.9 million tonnes, are the fifth largest in the world. The largest feasible deposits for LREEs in India are to be found in beach sands (monazite). Monazite deposits are located primarily in the coastal states of West Bengal, Kerala, Tamil Nadu, Odisha, and Andhra Pradesh.

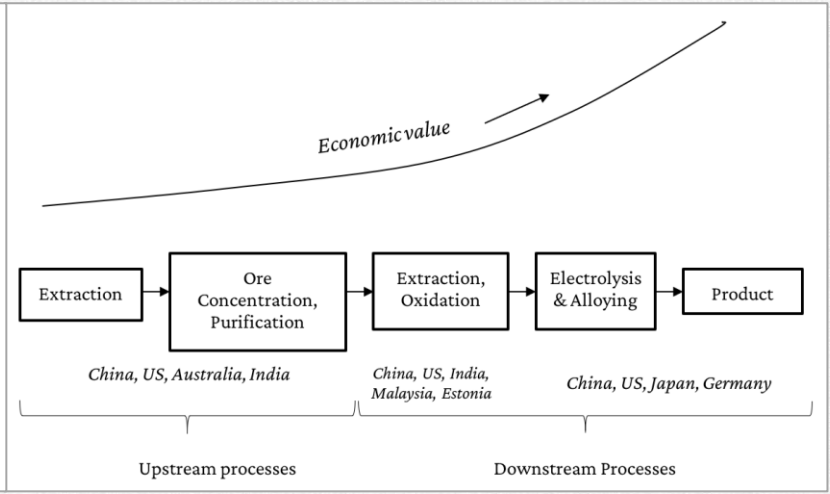
Some of these are already being exploited in limited capacities – but India is primarily a low-value material provider to countries which specialise in more lucrative downstream processing activities.



Percentage of global reserves versus production by country, based on data from the US Geological Survey.



Reserves of monazite sand by state in India. Data from the Indian Bureau of Mines.



The REE production process and value chain.

The Challenges

Process diagram for the extraction of REEs.

1. **The Costs:** The process of obtaining rare earth metals in a pure form from ore have both high up-front costs and high running costs. Of particular concern are the environmental side effects. Rare earths are also extremely energy intensive to extract from their ores: production of heavy rare earth oxides consumes almost 20 times more primary energy as compared to steel (per unit mass).

2. **Environmental Effects:** Toxic and radioactive waste can be released during the mining and extraction process. This is of particular concern with monazite beach sand, the primary mineral containing rare earths in India, which contains thorium.

3. **Bottlenecks in Production:** In India today, the government holds an effective monopoly over beach sand minerals which contain lighter rare earth elements. This has held India back from emerging as a major supplier due to difficulties in expanding capacity and securing investment.

4. **Global Competition:** India lags far behind suppliers such as Australia and China in terms of rare earth extraction and refining capacity. Producing rare earths in India will incur significant costs with no guarantee of recovering the investment in an extremely competitive global market.

A framework for assessing India's needs

Lighter REEs in general have high commercial potential and are available in relative abundance in India, due to their occurrence in monazite. A sustainable supply of LREEs can be developed by reforming India's rare earth policy to take better advantage of its reserves, increasing their availability in the medium term.

				Availability in India		
Atomic No.	Element	Strategic Potential	Commercial Potential	Short Term	Medium Term	Where are they found?
57	Lanthanum	Medium	High	Medium	High	Monazite Beach Sand
58	Cerium	Low	High	Medium	High	Monazite Beach Sand
59	Praseodymium	Low	High	Low	Medium	Deposits needing open pit mines
60	Neodymium	Very high	High	Medium	High	Monazite Beach Sand
61	Samarium	High	High	Low	Medium	Deposits needing open pit mines
63	Europium	Low	Medium	Low	Medium	Deposits needing open pit mines
64	Gadolinium	Low	Medium	Low	Medium	Monazite Beach sand, hydrothermal veins
65	Terbium	Medium	Low	Low	Low	NA
66	Dysprosium	Medium	Medium	Low	Medium	Hydrothermal veins
67	Holmium	Low	Low	Low	Low	NA
68	Erbium	Low	Low	Low	Low	Hydrothermal veins
69	Thulium	Low	Low	Low	Low	NA
70	Ytterbium	High	Low	Low	Low	NA
71	Lutetium	Medium	Low	Low	Low	NA
21	Scandium	Low	Low	Low	Low	NA
39	Yttrium	Low	High	Low	Medium	Deposits needing open pit mines

ROUNDTABLE DISCUSSION POINTS

The Roundtable was chaired by Mr. Narayan Ramachandran, co-founder and Fellow at the Takshashila Institution.

List of participants in the Roundtable:

- *Dr. Abhilash, Principal Scientist, National Metallurgical Laboratory*
- *Mr. Amit Bhandari, Fellow, Energy & Environment Studies Programme, Gateway House*
- *Mr. Anubhav Sachdeva, Legislative Assistant to Dr. Shashi Tharoor, MP*
- *Dr. V Balaram, Chief Scientist & Head, Geochemistry Division, National Geophysical Research Institute*
- *Dr. LV Krishnan, Former Director, Safety Research and Health Physics Group, IGCAR, Kalpakkam*
- *Mr. Niladri Bhattacharjee, Partner and Lead, Metals and Mining, KPMG in India*
- *Mr. Rahul Mazumdar, Assistant General Manager, EXIM Bank of India*
- *Mr. R Saravanabhavan, Deputy Advisor (Minerals), NITI Aayog*
- *Ms. Trisha Ray, Associate Fellow, Observer Research Foundation*
- *Dr. Yamuna Singh, Former Head, Mineralogy, Petrology and Geochronology at Atomic Minerals Directorate For Exploration And Research*

On Policy Reorientation & Private Sector Participation

Discussion Point #1: The proposed Department of Rare Earths

The proposal for a new department focussed on rare earths was debated at length. The expert group eventually agreed that it would be better to reprioritise the agenda of the Department of Atomic Energy (DAE) rather than create a new department altogether. This could help achieve similar outcomes, especially if new rules are implemented to facilitate public-private partnerships in this sector. This would also help effectively use the expertise that the DAE has built up on rare earths over the years.

Discussion Point #2: The role of the private sector

Indian companies are predominantly single mineral companies, in comparison to global giants such as Lynas, which focus on multiple minerals. They could be incentivised through clearer and more open policies to participate in rare earth exploration and extraction, especially in the allotment of leases for mining activities.

On the Environmental Challenges

Discussion Point #3: The radioactive byproducts

Scientists in the panel noted that the risk of radioactivity is often overstated: public fear is disproportionate to the actual risk. No adverse health effects have been found in communities living near monazite extraction sites. A proper science-based communication strategy can help allay fears. Furthermore, pollution control boards need to be vigilant and insist on proper chemical processes to isolate toxic byproducts. Radioactive materials can be dealt with by the DAE.

Discussion Point #4: Sustainability and the involvement of communities

In some cases, extensive mining activities have disrupted livelihoods, such as those of local fishermen. A balance needs to be found, and communities need to be able to benefit from them. The risk of disruption to highly capital-intensive activities will otherwise disincentivise international companies from setting up facilities in India otherwise.

On the Internationalisation of India's Rare Earth Supply Chains

Discussion Point #5: Investing Abroad

One approach that has worked for India in the past has been to have purely financial stakes in large companies abroad, creating a better supplied market overall. However, the manageable environmental consequences and the general global interest in building rare earth extraction capacity outside of China offers an opportunity that India could take advantage of. The Quad, in particular, could be partners for India in this space – but India should take care to bring its entrepreneurs and private sector enterprises on board instead of working only on a government-to-government level.

Discussion Point #6: Potential International Partners

So far, the Quad has tended to focus on military-to-military engagement, though there are some encouraging signs of academic collaboration in the technology space, and Australia and the US have signed bilateral agreements in the rare earths space. There is potential for a Quad-level dialogue on a critical minerals strategy, but continuous long-term engagement is needed. Middle Eastern countries have considerable interest in building up mineral based revenues and could be a source of capital, but are more interested in brownfield than greenfield facilities. Discussions with Canada might prove fruitful.

Do share further comments/thoughts here.

/end

FURTHER READING

- Anirudh Kanisetti, Aditya Pareek, Narayan Ramachandran. *A Rare Earths Strategy for India.* Takshashila Discussion Document 2020-16. December 2020. https://takshashila.org.in/a-rare-earths-strategy-for-india/

- Anirudh Kanisetti. “OPINION: Here's how India can end Chinese dominance in rare earths”. *Business Insider*. February 13, 2021. https://www.businessinsider.in/policy/economy/news/heres-how-india-can-end-chinese-dominance-in-rare-earths/articleshow/80883001.cms