



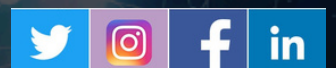
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RARE EARTH ELEMENTS; THE ACHILLES' HEEL OF INTERNATIONAL GEOPOLITICS

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**Rare Earth Elements;
The Achilles' Heel of International
Geopolitics**



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Introduction

Rare earth elements (REEs) have gained traction in international discourse with the push by the newly elected President of the US for a deal with Ukraine and overt expression of desire to acquire Greenland for exploitations and mining of rare earths. In the midst of a trade war with the US, China has threatened to restrict supply of REEs jeopardizing its global supply chain. REEs are seventeen lesser-known elements which when mixed with other metals can create unique materials with wide spread applications. That's why in the scientific community these are also referred to as "Vitamins" and "Spice" of modern economy. (John Hua Fan 2023) Their products are critical in manufacturing of semi-conductors, magnets, air crafts, electric vehicles, hard discs, LED screens, wind turbines and many other applications. Initially US dominated the global market of REEs which was conceded to China in last three decades. Since then, China has not hesitated to use its monopoly in the field of

REEs to expand its strategic-economic nexus due to its increased demand and tighter supply.

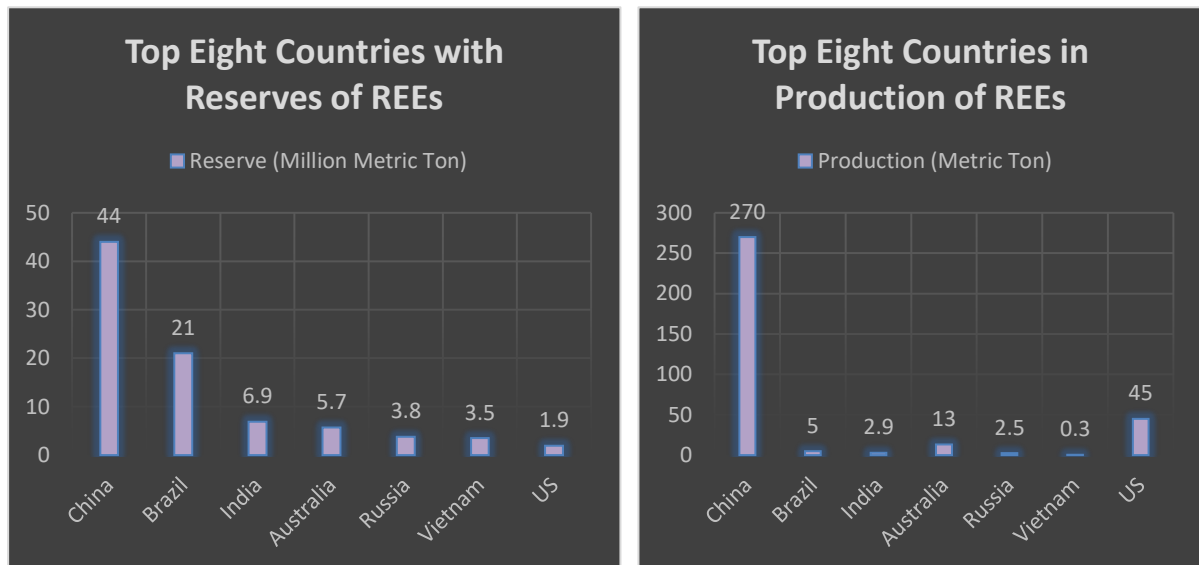
Complexity of REEs Production

The 15 Lanthanides on the periodic table (La-Lu), plus Scandium (Sc) and Yttrium (Y) are categorised as REEs. As the name suggests, REEs are rare to find with limited known storage across the world. Their extraction and refining process are extremely cumbersome, requires high-tech specialist infrastructure and involves handling of hazardous byproducts. Let's see the complexities involved with REEs.

- All the 15 Lanthanides display similar chemical behaviour. Hence, use of traditional methods makes it very difficult to separate them from each other.
- Most REE deposits are scattered and found in very low concentrations. Sometimes the Rare Earth Oxide (REO) percentage below 10 and mixed with other gangue minerals. To extract a particular quantity of element a large number of ores are required to be processed, which makes it economically unviable.
- As the separation of these similar elements is challenging, the methods like "Ion Exchange" and "Solvent Extraction" are applied. These chemical processes are complex and expensive.
- The extraction process yields large amount of toxic waste which may lead to soil and water contamination. Some REEs are found associated with radioactive elements as well. For every ton of rare earth produced, the mining process yields 13kg of dust, 9,600-12,000 cubic meters of waste gas, 75 cubic meters of wastewater, and one ton of radioactive residue. (Nayar 2021) Handling and disposal of such hazardous waste add to the production cost and environmental concerns.
- The entire process involves high energy requirements adding to the cost and environment issues.

- The supply chain of REEs involving extraction, processing and shipment is complicated and requires sophisticated equipment enhancing its cost and complexity.

Apart of the difficulties linked to the processing of REEs the availability of these elements is itself a major issue. Having large reserves does not guarantee high production yield due to the reasons discussed above. Here is the latest data on REEs of top eight countries in the world. (Cordier 2025) and (Pistilli 2025)



It is evident from the chart above that China has an unassailable lead in both reserves and production. Brazil having the second largest and half of Chinese reserves does not contribute even a fraction compared to China. US despite having a fraction of the reserves is the second highest producer globally. China, by virtue of its technological prowess is unequivocally dominating the global supply chain having nobody anywhere close to it.

Behind China's REE Empire

"The Middle East has oil; China has rare earths." This was famously stated by Chinese Premier Deng Xiaoping during his visit to Baotou, Inner Mongolia, one of China's biggest rare earth mines in 1992. China accounted for 69% of global REE production in 2023. (Seth, Mine the Tech Gap: Why China's Rare Earth

Dominance Persists 2024) This is not a coincidence, but due to the systematic evolution of Chinese ecosystem around REEs once they identified its true potential. China is the global leader in REEs mining, extraction, processing, distribution and the only country with the end-to-end production capability. China has an effective monopoly over processing major heavy rare earths – Dysprosium (Dy) and Terbium (Tb), and Light Rare Earths – Neodymium (Nd) and Praseodymium (Pr). Here is why.

- **Reserves** – China holds the largest REE reserves (44 million MT, 90% of global reserves) and yields the highest share of global production (69%). Bayan Obo field in Inner Mongolia is the largest rare earth deposits in the world. China has banned mining by any foreign company on its soil. They can only process in a joint venture with a Chinese company after approval of the state. (Philip Andrews 2023)
- **R&D** – China has more than 25000 rare earth patents surpassing US patents accounting for about 10000 between 1950 to 2018. This equips China with monopoly of exclusive rights over most REE products.
- **Technology** – The *Solvent Extraction* technology used to refine REEs originated in the US, but environmental concerns and other regulatory restrictions made its application untenable in US. However, the Chinese technicians have mastered this art over decades and applied domestically. Western world simply does not have the expertise to achieve similar results.
- **State Support** - In June 2024, China notified rare earths as state resources and formed new regulations on mining, smelting, and trade. Further, China recently banned export on technology related to mining, processing, and manufacturing magnets. (Seth, Mine the Tech Gap: Why China's Rare Earth Dominance Persists 2024) State owned enterprises like China Rare Earth Group Co. Ltd. has enhanced the production efficiency at competitive pricing.
- **Liberal Environmental Regulations** – Over the decades Chinese mining companies have benefited from lenient regulations for handling and disposal of hazardous byproducts from REE plants. Remote

locations of mines and sparse population around the processing units have encouraged liberal environmental regulations. However, in last two decades China has tightened its safety parameters with stricter norms.

The Geo Politics of Chinese Global Dominance

This is an established fact that REEs are critical for multiple futuristic industries and defense productions. For instance, to produce a stealth multirole fighter Lockheed Martin F-35 Lightning II it takes 417kg, a missile destroyer Burke DDG-51 takes 2,359 kg and a nuclear powered submarine SSN-774 Virginia, takes as many 4,173 kg of rare earth are needed. (Richiello 2021) Due to its large reserves, mastered extraction technology, low labour cost and liberal environmental regulations China has an unassailable lead in production of the same and dominates the global market today. Most of the developed world rely on China for meeting their defence and green technology requirements. REEs in China have been declared as state assets and foreign participation in their mining has been restricted. China's entry into WTO in 2001 made its REE exports more favourable for rest of the world. China is capable of moderating the scales of production, global prices and supply chain all across the world. It can destabilize any country's critical industries at its will using this ability as a tool and this phenomenon empowers China with an ultimate leverage like none other.

In 2010, Japan detained the Captain of a Chinese ship for alleged intrusion into its territorial waters. China suspended all REE exports to Japan in retaliation. China's rare earth policies, including export tariffs, quotas and regulatory requirements, were perceived as distortion of free trade and discrimination against foreign businesses. In 2012, US, Japan and EU went to WTO for a formal dispute settlement on these issues which was vehemently defended by China. (Yiying Zhang 2014) As the imbalance between the global demand and Chinese supply continue to increase, China enjoys stronger negotiating position at the international high table.

While China is looking at increasing its economic trade, importers are eyeing at a secure supply chain. When there occurs a conflict of interest, the trade dispute attains a geo political character. As the trade war between US and China under the present Trump administration escalates, China has threatened to cease exports of rare earths to US jeopardizing its massive defence and green industry. Evidently China is using its REE leverage as a diplomatic weapon.

India's Position

India has the third largest (6.9 million MT) reserves and fifth largest annual yield (2.9 MT) of REEs in the world. Most of India's REE mines are located along coastal areas and sandy beaches of Indian peninsula in Kerala, Tamilnadu, Odisha, Maharashtra etc. Indian Rare Earth Limited (IREL), a PSU holds the effective monopoly over REE production in India. Very few private companies have the approval of the government to explore REEs in order to prevent illegal mining of such precious minerals. Despite of its vast deposits, India has not been able to achieve its potential of production and contributes only a fraction globally. India lacks the technical expertise in all four stages i.e. mining, processing, refining and magnet production. Also, handling toxic waste, environmental clearances, high energy requirements and private industry alienation are major impediments in India's way.

The joint venture between IREL and Japan's Toyota Tsusho Corporation in the state of Andhra Pradesh is a significant mineral separation and refining facility. Other facilities like alloy and magnet making are almost non-existent. India imports 60% of its REE requirements from China. (Seth, Nayan 2024) India needs to build its domestic capacity with support of international collaborations to participate in global productions and secure its own supply chain. Infusion of private capital and technology is imperative to build an ecosystem for all stages of production of REE.

QUAD holds potential to become the mitigation to India's REE challenge. In Oct 2024, India announced a major agreement – critical minerals supply chain cooperation with the US. The two sides committed to “expand and diversify”

supply chains and benefit from each other's strengths. This highlights India as a potential key partner in the efforts worldwide led by US to diversify away from China's dominance and India's quest for technology transfers. The India-US collaboration on Critical and Emerging Technology (iCET) is an attempt in this direction in which both countries are exploring critical mineral diversification efforts. Australia, not only holds large REE reserves, but also technical edge over India in large scale production. India and Australia already have bilateral cooperation on critical minerals which can be extended to rare earths. Furthermore, India can partner with Japan Organization for Metals and Energy Security (JOGMEC) for sharing high end technology and experience in the field of REEs. India is already part of the 15-member group known as the Minerals Security Partnership, an informal association of nations to manage divergence efforts for mineral dependency. Finally, the government has to prioritize its efforts, promote private industry and invest in R&D for niche technology to achieve self-reliance.

Global Efforts for Diversification & Self-Reliance

Rare earths are vital and integral part of modern technology and its demand is going rise multifold in times to come. All global powers have started to acknowledge importance of its secure supply chains and diversification from China due to strategic reasons and geo political uncertainties. Here is what some countries are doing to safeguard their national interests from which India can take a cue.

- **US** – Biden administration enacted Energy Act 2020, Infrastructure and Jobs Act 2021 and invoked Defence Production Act 1950 in 2021 to ensure a stable supply of REEs and other critical minerals for both economic and national security reasons. US has also focused on enhancing its strategic reserves in view of geopolitical risks and possible supply chain disruptions. The American government and its private sector are also investing heavily in R&D in recycling technologies. (Boruta 2025)

- **Canada** - As per Canadian Critical Minerals Strategy 2022, Canada is striving to further strengthen its global position by exploiting its large natural resources and emphasizing on partnerships with other countries in order to reduce global dependence on China. It is focusing on sustainable mining with highest environmental safety norms.
- **Japan** – Chinese coercion in 2010 happened to be a turning point for Japan's approach to REEs as Japan is not as resource rich. It invested JPY 100 billion with a multi prong strategy to reduce use of rare earth, develop alternate technology, create recycle facilities, maintain adequate reserves and partner with other resourceful nations like Australia and Vietnam. By doing so Japan has reduced its imports from China from 90% to 58% in a decade. (Boruta 2025)
- **Australia** – With large REE reserves to its advantage Australia is focusing on scale up its processing capability in an eco-friendly manner. Its Critical Mineral Strategy 2023 eludes upon technological innovation and mineral extraction efficiency. Lynas Rare Earths Ltd, Australia is the largest REE company outside China.
- **European Union** – Unlike the countries above, Europe doesn't have significant REE reserves, though Greenland offers hope. EU has acknowledged the implications of its entire dependency on imports particularly from China and identified elements critical for its industries, the latest list being published in 2023. EU Action Plan on Critical Raw Materials 2020 has proposed a range of measures, including investment in the extraction of raw materials within the EU, the development of technologies for recycling and waste management, and the strengthening of strategic partnerships with other countries. (Boruta 2025)

Conclusion

The fact that REEs are lifeline of the present and future of technology is undisputed. Also, China today dominates the prices and global supply chain which make the entire world dependent on it. An ambitious China rising as a challenger to the powers of the West inherits the ability to disrupt the flow at will. Such strategic leverage is being exploited by China as a diplomatic

weapon for coercion as well. The western world has recognized this malice and trying to undertake number of initiatives in R&D, upscaling of production, recycling, alternative technology and international collaboration. India needs to rise up to the occasion to protect its strategic interests by indigenous production, securing and diversifying its supply chain in an increasingly uncertain world. Till then China will continue to hold the knife to the *Achilles' Heel* of international geopolitics.

DISCLAIMER

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References

- Boruta, Raigirdas. 2025. "Rare earths; Seeking West's Strategic Response to Chinese Dominance." *Geopolitics and Security Study Centre*.
- Cordier, Daniel J. 2025. *Mineral Commodity Summaries*. U.S. Geological Survey.
- John Hua Fan, Akihiro Amura, Eduardo Roca. 2023. "Geopolitics and Rare earth Metals." *European Journal of Political Economy*.
- Nayar, Jaya. 2021. "Not So "Green" Technology: The Complicated Legacy of Rare Earth Mining." *Harvard International Review*, 12 Aug.
- Philip Andrews, Anders Hove. 2023. "China's rare earths dominance and policy responses ." *The Oxford Institute for Energy Studies*.
- Pistilli, Melissa. 2025. "Rare Earths Reserves: Top 8 Countries." *Investing News Network*.
- Richiello, Angelo. 2021. "The geopolitics of rare earths: how to counter China's dominance." *Aspenia Online*.

Seth, Nayan. 2024. "Mine the Tech Gap: Why China's Rare Earth Dominance Persists." *New Security Beat*.

Seth, Nayan. 2024. "Rare Earths, Rare Opportunity: India's Potential in Easing China's Chokehold." *South Asian Voices*.

Yiying Zhang, Guoyi Han and Marie Jürisoo. 2014. "The geopolitics of China's rare earths: a glimpse of things." *Stockholm Environment Institute*.