# Rare Earth Export Controls in April 2025 - Impacts on Semiconductor and Automotive Industries

## AltaScient LLC

The export controls announced in April 2025 by China on seven rare earth elements (REEs) can have significant impacts on multiple sectors, including defense, automotive, semiconductors, and electronics. This is mainly due to the sourcing concentration in China for multiple parts of the supply chain, namely, the mining, processing, and refining of these elements.

In this article, we aim to assess the current market positioning for REEs, major applications in semiconductors, key companies and their performance, global trade influence and impacts, and sector impacts from Chinese export controls. Based on these, risks are assessed, and mitigation strategies for the short, mid, and long-term are evaluated.

**This is part of the ongoing, larger scale, assessment for critical minerals at AltaScient risk analytics SaaS platforms.**

*Image Reference: iStock by Getty Images*

## I. Export Controls (EC): Rare Earth Elements (REEs) and Critical Minerals

The export restrictions are not surprising, considering China's strategic positioning in this area since the 1990s-2000s and the progression in controls over the last several years. While there have been several actions since 2006, a notable one occurred when China halted REE exports to Japan following a maritime dispute in 2010, causing global prices for neodymium and dysprosium to reportedly surge by over 100%. Our analysis below points to a steady escalation after a relatively quiet period, starting in 2018, during which China has gradually tightened control through new licensing regimes, export laws, and targeted bans. The coverage has included REEs, gallium, and germanium. These measures have the potential to further disrupt global supply chains, impacting industries across Asia, Europe, and North America—particularly in defense, electric vehicles, and semiconductor industries.

**2018–2020: U.S.-China Trade Tensions Escalate**

- **2018**: The U.S. enacts the Export Control Reform Act, enhancing the government's ability to control exports of critical technologies and materials.
- **2020**: China passes a comprehensive Export Control Law, allowing broader control over "dual-use" items - particularly REEs, gallium, and germanium.

**2023 - 2024: Global Response**

- **2023**: The European Union proposes the Critical Raw Materials Act to secure a sustainable supply of critical materials, reducing dependency on external sources (10% local sourcing, 15% recycling by 2030).
- **April 2024**: China imposes non-automatic licensing requirements on seven medium/heavy REEs and rare earth magnets. While not a ban, the bureaucratic hurdles caused immediate disruptions for U.S. defense contractors. By mid-2024, delays in licensing approvals led to a temporary pause in exports, squeezing suppliers of components for F-35 jets and submarine propulsion systems.
- **December 2024**: China bans exports of gallium, germanium, antimony, and superhard materials to the U.S., citing national security and tightened controls on graphite. These materials are crucial for semiconductors and photovoltaics.
- **2024**: The U.S. announces a 25% tariff on Chinese REE magnets, effective in 2026, aiming to bolster domestic production.

**April 4, 2025: China's Expanded Export Controls**

- In response to U.S. tariffs, China announced export restrictions on seven REEs: samarium, gadolinium, terbium, dysprosium, lutetium, scandium, and yttrium - along with their alloys, oxides, and compounds.
- Exporters are now required to obtain licenses, a process that can take up to 45 days, affecting global supply chains.
- These materials are essential components in data center storage systems, networking equipment, and semiconductors, and could significantly impact tech giants including Dell Technologies, HP, Apple, and IBM, along with semiconductor leaders such as Intel, Samsung, and TSMC.
- Impacted sectors include electric vehicles, wind turbines, defense, and AI hardware.

## II. Why are Rare Earths Crucial?

### Demand

The demand for REEs is expected to grow significantly, driven by their use in clean energy technologies (like wind turbines and electric vehicles), electronics, and defense applications. Artificial intelligence (AI) is also driving the demand for semiconductors that require REEs and other critical minerals.

### Uses of REEs

1. The largest global use of REEs is in the manufacture of permanent magnets, accounting for 44% of total demand in 2022. Praseodymium and neodymium, used in wind turbines and EVs, are high demand.
2. They are key components in many electronic devices, clean technologies and alternative energy systems (wind turbines, fuel cells, rechargeable batteries, electric vehicles), LCD screens, LEDs, lasers, fluorescent lighting, catalytic converters, optical glass, polishing powders for semiconductors, permanent magnets.

Figure 1 is a summary of REE applications and broader impacts on critical sectors. This was further expanded with an assessment of each REE's role in these sectors, including semiconductors and automotive.

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|---|---|---|
| Defense | - REEs in fighter jets (e.g., F-35 uses 900+ lbs)<br>- Missiles, submarines, drones, radar systems | - Disruptions in defense tech development<br>- Delays from EC licensing<br>- Limited REE refining domestically<br>- Prior EC targeting U.S. defense firms |
| Technology | - REEs essential for smartphones, HDDs, PCs<br>- Gallium, Germanium for semiconductors, LEDs, fiber optics | - Supply shortages, price volatility<br>- Ongoing bans on Gallium & Germanium<br>- Diversification difficult due to limited global sources |
| Automotive | - Rare earth magnets in EV motors<br>- Graphite in lithium-ion batteries | - Graphite EC + China's dominance = battery supply risk<br>- Threats to global EV production scalability |
| Semiconductors | - Gallium & Germanium for high-performance chips (AI, defense tech) | - Price hikes, reduced exports<br>- Lack of non-China sourcing<br>- 2025 REE EC risks similar to Gallium/Germanium bans |
| Renewable Energy | - REEs in high-efficiency wind turbine magnets | - Deployment delays in wind energy<br>- Supply chain instability for green tech |

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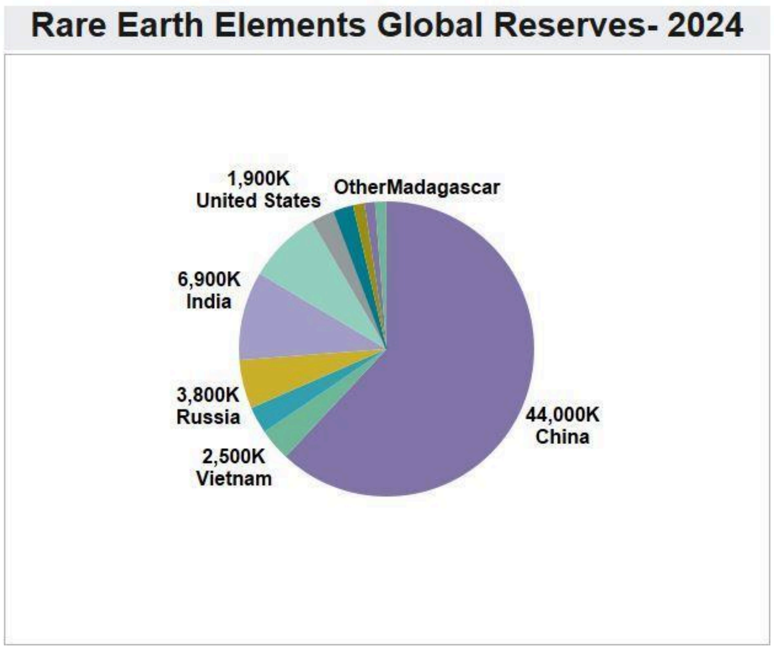
**Fig 1: Rare Earth Elements (REEs) Export Control (EC) Impact on Global Industries**

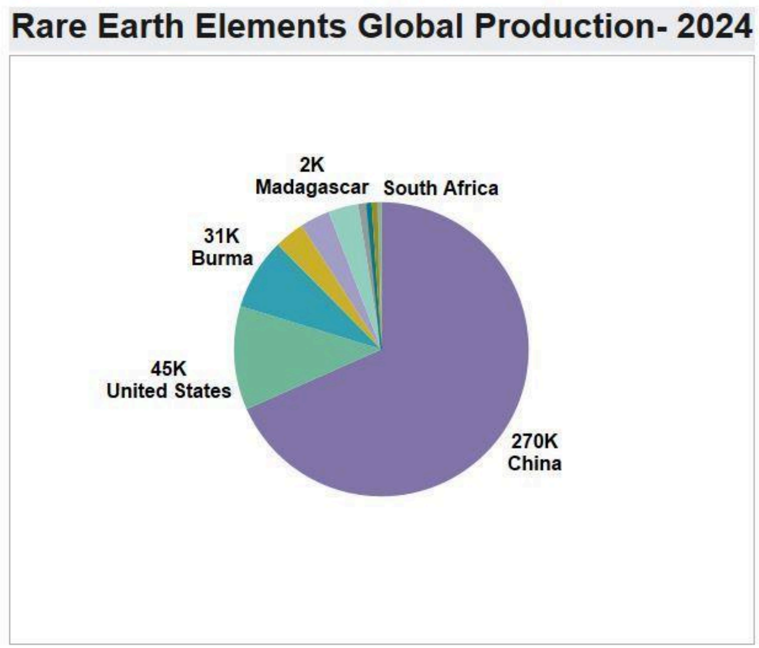
References: AltaScient Analytics, WSJ, Reuters, CSIS, Other

## III. A Global Look at REE Production and Reserves (REO Equivalent Tons)

- China is the dominant player in both the mining and critical refining of rare earth elements.
- The U.S. and Australia are increasing their mining production and developing separation and refining capabilities to reduce reliance.
- Many countries with significant reserves, like Brazil, currently have low production capacity but have the potential to become larger players.
- Data on separation and refining is less readily available and often concentrated in China.

**Fig 2: REE Global Production and Reserves**



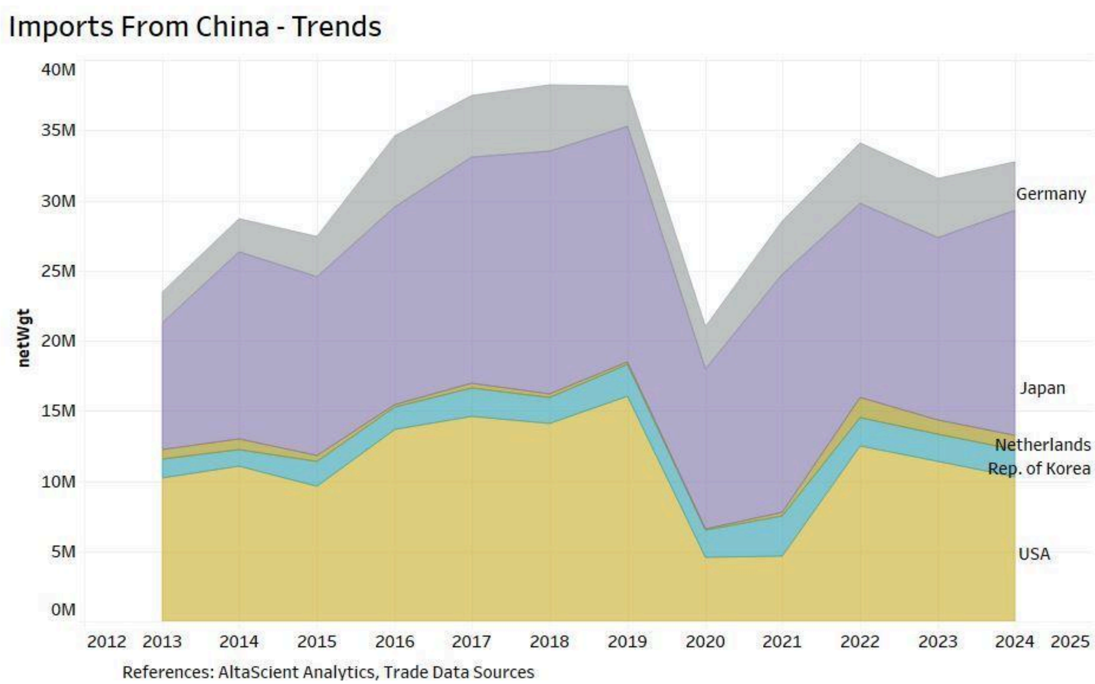




References: AltaScient Analytics, Investing News Network Feb 2025, Natural Resources Canada

# IV. Global Trade of REEs - Import Trends

Considering the production concentration in China for rare earths, it is not a surprise that a substantial portion of imports come from China. **Export controls such as the one announced in April 2025 will impact all countries. This can be extrapolated to countries involved in relevant parts of the semiconductor supply chain including Japan, South Korea, Netherlands, Germany and the US.**

Import reliance is high for Japan and the US. The progression of REE imports, assessed from 2013-2024 here, suggests Japan is increasingly a higher-level importer than the US. Japan increased imports slightly during 2023-2024 while the U.S. has been showing a declining trend.




**Imports from China** to the US reduced drastically during the 2020-2021 period, post-covid, but picked up after that. During 2022-2024 quantities increased along with pricing. In 2024 as announcements on export controls started, imports indicated an overall slight decline as well.

Japan while building self-reliance on REEs during the last decade, still has high import reliance for these elements.

Delays with the new export controls announced for rare earth elements (REEs) in April 2025 can reduce overall trade in Q3 and even Q4 2025, causing delays in various parts of the semiconductor supply chain and production.

**Fig 3: Global Imports Trends from China**

## V. Applications for REEs in Semiconductors

REEs play a critical role in the development and performance of modern semiconductor technologies. These elements, due to their unique chemical and magnetic properties, are integral to the various stages of semiconductor manufacturing and the functionality of advanced electronic systems. These rare earths are vital in several semiconductor products, for instance, as a dopant for integration into chips for product enhancement and for applications in semiconductors powering AI systems.

Elements such as **cerium (Ce)** are widely used in chemical-mechanical planarization (CMP), a key process for polishing semiconductor wafers to achieve the necessary surface quality for device fabrication. Meanwhile, **neodymium (Nd)** and **praseodymium (Pr)** are essential for manufacturing powerful magnets used in semiconductor equipment, ensuring efficient and precise production processes.

Several REEs—including **gadolinium (Gd), lanthanum (La), and lutetium (Lu)** - enhance logic and memory performance by forming high-performance oxide layers. These lanthanide-based oxides are employed across various semiconductor processes to improve overall device functionality. Similarly, **europium (Eu)** improves the performance of indium phosphide when used in doping, contributing to better display technologies in electronic devices.

In the context of cutting-edge applications, elements like **scandium (Sc)** and **yttrium (Y)** are indispensable. Scandium is vital for advanced chips that support AI systems, while yttrium is key in gallium nitride (GaN) enhancement, crucial for high-power and high-frequency semiconductor devices. **Dysprosium (Dy)**, **terbium (Tb), and samarium (Sm)** also serve important roles, particularly in high-temperature environments and within chip structures, further broadening the applicability of REEs in next-generation technologies.

**Semiconductor companies will face the impact** of export controls in multiple fabrication, toolmaking, and ATP (Assembly, Testing and Packaging) locations/countries. These can include imports from China to Japan, South Korea, Netherlands, Germany, Malaysia and the US.

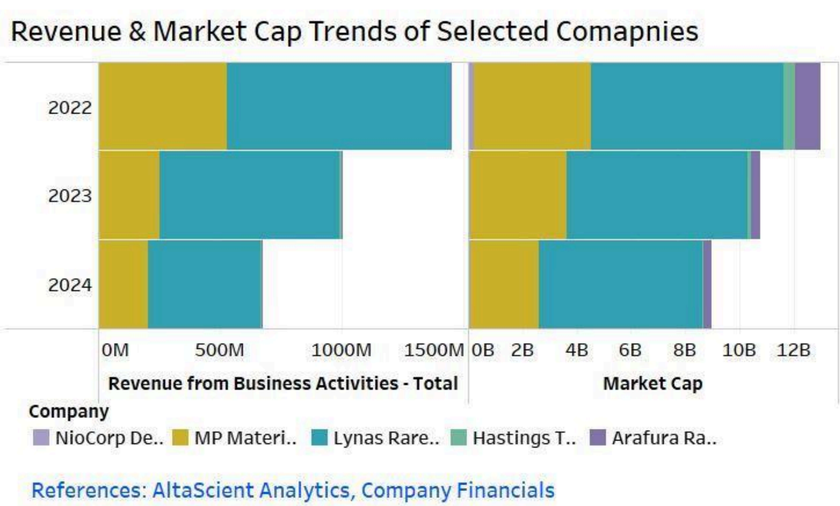
**It will be vital to secure the sourcing with Tier 1 suppliers. In addition, exploring collaborations with Tier-2 or upstream suppliers may become essential for companies aiming to avoid operational or research disruptions and erosion of competitive edge.**

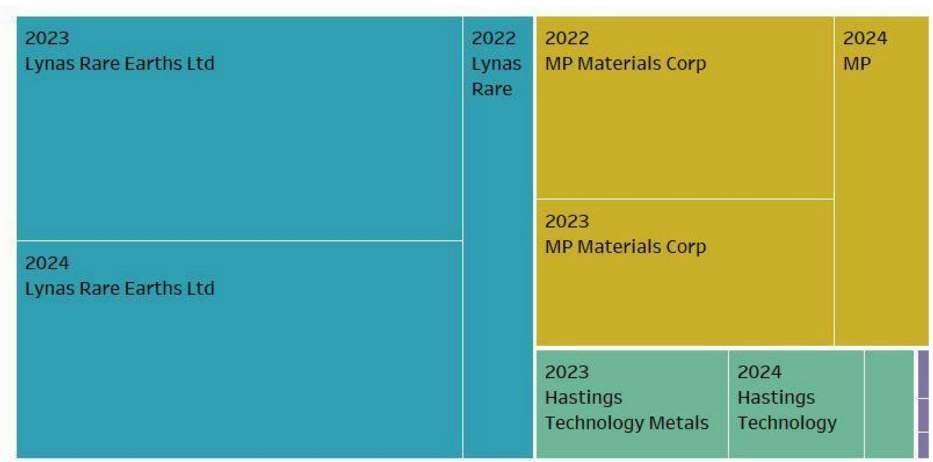
## VI. Value chain companies – Financial Performance

**The value chain is concentrated from a supplier perspective** at the mineral reserves, mining, and refining areas. The key players in mining and processing are located in China, with China Rare Earth and China Northern Rare Earth having a market share of over 90%. Some of the major players outside China are MP Materials, Lynas Rare Earths, Nio Corp Developments, Arafura Resources, and Hastings Technology Metals, located in Australia and the US. However, companies based in China have a near-monopoly in midstream operations for refining and separation.

An assessment of key financial indicators for select US and Australian companies indicated a declining trend in market cap during 2022-2024. Revenue from business activities has declined for Lynas. A similar, but lower impact, is seen for MP Materials as well. For both of these major players capital expenditure declined from 2023 to 2024. Customers in the defense-automotive-semiconductor sectors will need to track these developments and take measures to support suppliers to enable production expansion and to reduce regional supply concentration. In addition, smaller but key players such as Nio Corp, Hastings Technology Metals and Arafura were analyzed.

**Fig 4 & 5: Financial Performance and Capex of Key Players in the US and Australia**



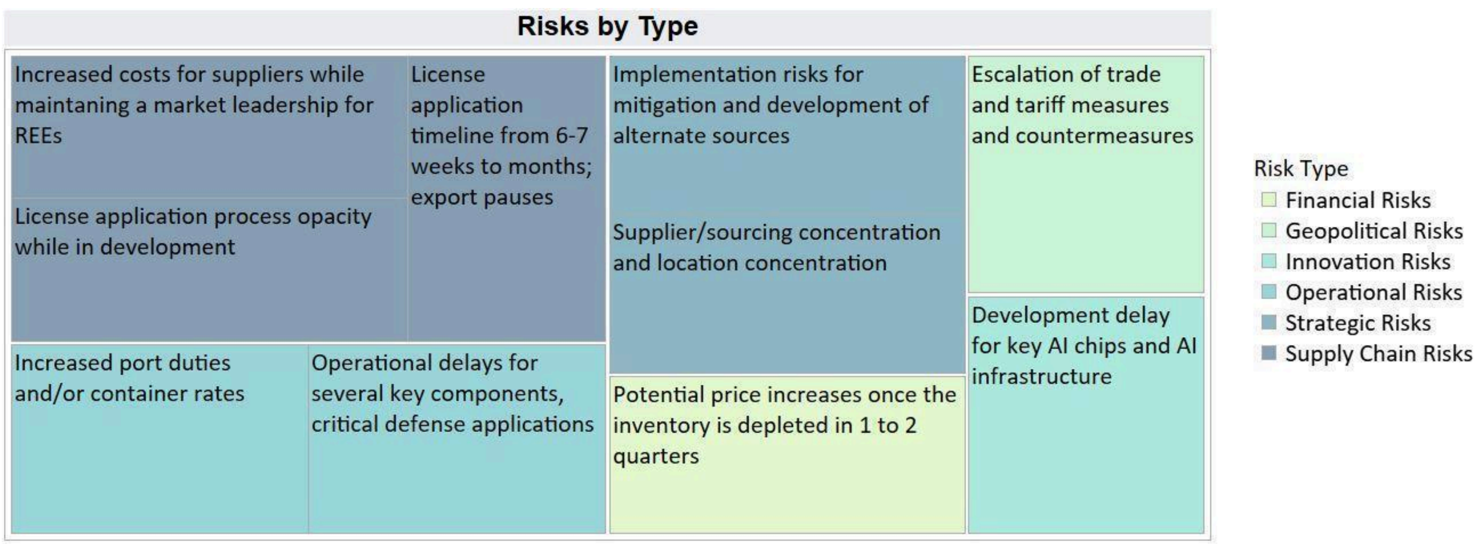



## VII. Risk Assessment

**We anticipate multiple risks emerging out of the evolving export control implementation, including operational, supply chain, geopolitical and innovation risks. All of these will directly contribute to financial risks.** Strategic risks, which exist, indicate high levels of supply and location concentration and no immediate resolution to shift or diversify this. This also raises the strategy basis for future efforts and collaborations, with its own execution risks.

Short-term and mid-term supply chain risks should be anticipated during the implementation phase of the new licensing requirements. If inventory levels are not sufficient to address production requirements, then operational disruption and delivery delays are possible. In addition, logistics delays and port congestion are possible. As seen in previous commodity price increases post export restrictions, companies should anticipate price increases for REEs. Additionally, the unavailability of REEs can cause delays in new technology deployment such as AI chips and infrastructure. **These will have a potential impact on Company Financials in Q3 and Q4 2025. Alternate sourcing in the short term is limited.**

**Fig 6: Assessment by Categories of Risk**




References: AltaScient Analytics

## VIII. Risk Mitigation Strategies - AltaScient Analysis

Mitigation strategies for short/mid and long-term are crucial to reducing concentration risks and potential supply crunches for critical sectors, as well as innovation. The content below was developed with varying timelines and strategies in mind. For details on each, contact AltaScient.

**Fig 7: Risk Mitigation**

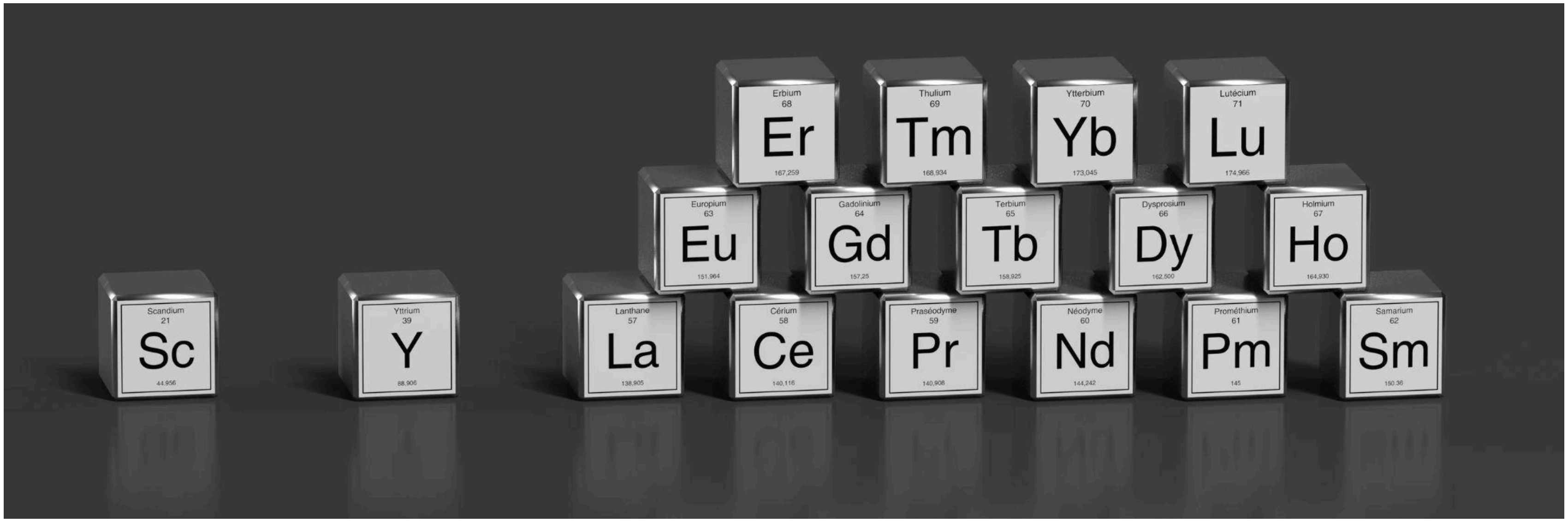

References: AltaScient Analytics

## IX. Conclusions

Companies in the semiconductor, automotive and defense value chains will have to develop and manage a **multi-pronged strategy** with different timelines in mind to stay competitive. Monitoring market and geopolitical changes, such as export controls against the backdrop of a 90% sourcing and supply chain concentration, is the first step. Allocating a budget to manage sufficient inventory may avoid future significant expenses or severe operational impacts. In this case, this has been an evolving development of restrictions and of sourcing concentration. As noted in this report, multiple aspects of existing and emerging risks will have to be continuously monitored and assessed.

**Scenario planning exercises should be undertaken, with buy-in from C-Suite and the Board, to identify multiple futures and options. In addition to the above steps, mitigation plans can include collaboration with upstream partners and some level of captive capacity.** Making these supply chain discussions part of an enterprise risk management (ERM) initiative is also imperative.

**AltaScient's SaaS Platform for Risk Analytics** monitors the indicators discussed in this report, and much more, related to critical minerals and semiconductors. Contact us at inform@altascient.com for more information and to initiate secure, ongoing access.



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## Prepared By:


**AltaScient LLC**
**Atlanta, GA**
**https://www.altascient.com/**

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