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China's dominance in rare earth markets: A geopolitical trap for Europe?

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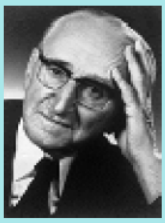

Ralph M. Wrobel

China's Dominance in Rare Earth Markets: A Geopolitical Trap for Europe?

Diskurs 2025 - 12

China's Dominance in Rare Earth Markets:

A Geopolitical Trap for Europe?

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Abstract

Rare earth elements (REEs) are critical for Europe's economic competitiveness, green transition, and national security. Yet the EU remains heavily dependent on China for their supply, particularly in refining and processing. This paper examines Europe's vulnerability to supply disruptions and geopolitical leverage stemming from China's market dominance. Rising demand for REEs in renewable energy, electric vehicles, and defence technologies exacerbates this dependence, while environmental and regulatory constraints hinder European extraction and processing. Case studies, including the 2010 Senkaku crisis and 2024–25 Chinese export restrictions, illustrate how REEs can be used as strategic tools of coercion. The paper evaluates Europe's policy responses, highlighting the Critical Raw Materials Act (CRMA), domestic processing projects, recycling initiatives, and international partnerships aimed at supply diversification. While progress is evident, challenges remain: recycling is nascent, domestic capacity is limited, and EU research programs are bureaucratic and slow. Overall, Europe faces a "geopolitical trap," requiring urgent action to secure REE supply and technological resilience.

Keywords

Rare earth elements (REEs), China, Europe, geopolitics, supply chain security, strategic autonomy

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China’s Dominance in Rare Earth Markets:

A Geopolitical Trap for Europe?

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1. Introduction

Rare earth elements (REEs) have emerged as one of the most critical resources for the twenty-first century, underpinning technologies that are central to Europe’s economic competitiveness and geopolitical resilience. From wind turbines and electric vehicle batteries to advanced defence systems and digital infrastructure, Europe’s green and digital transitions, as well as its security architecture, depend heavily on stable access to these minerals. Yet the global supply chain is overwhelmingly dominated by China, which not only accounts for the majority of global rare earth mining but, more importantly, controls the refining and processing stages that transform raw materials into usable components. This concentration of power gives Beijing a structural advantage that extends far beyond economics, offering the potential to deploy REEs a tool of geopolitical influence, as is just demonstrated in China’s export halts 2024 and 2025. (Shamim 2025) For Europe, this raises pressing questions about vulnerability to supply disruptions, coercion, and strategic dependency at a time when relations between China and the West are increasingly defined by competition and mistrust.

Against this backdrop, the central research question of this paper is: How does China’s dominance in rare earth markets affect Europe’s geopolitical and economic security and how can the EU escape from this? Additionally, it is a main question if the EU's industrial policy approach (Critical Raw Materials Act 2024) is sufficient to reduce the dependency? Addressing these questions requires first an analysis of market structures, the European demand of REEs, the supply by China as dominating producer and refiner and the current supply expansion because of China’s monopoly position. Then, in a second chapter the geopolitical dimensions of rare earth markets will be discussed by analysing Europe’s dependency and vulnerability answering the question if REE markets are a geopolitical trap for Europe. In the end, the European industrial policy response, the Critical Raw Materials Act 2024 and its results, are to be examined in addressing the question whether the EU can escape this trap through this industrial policy approach.

2. Current Rare Earth Markets

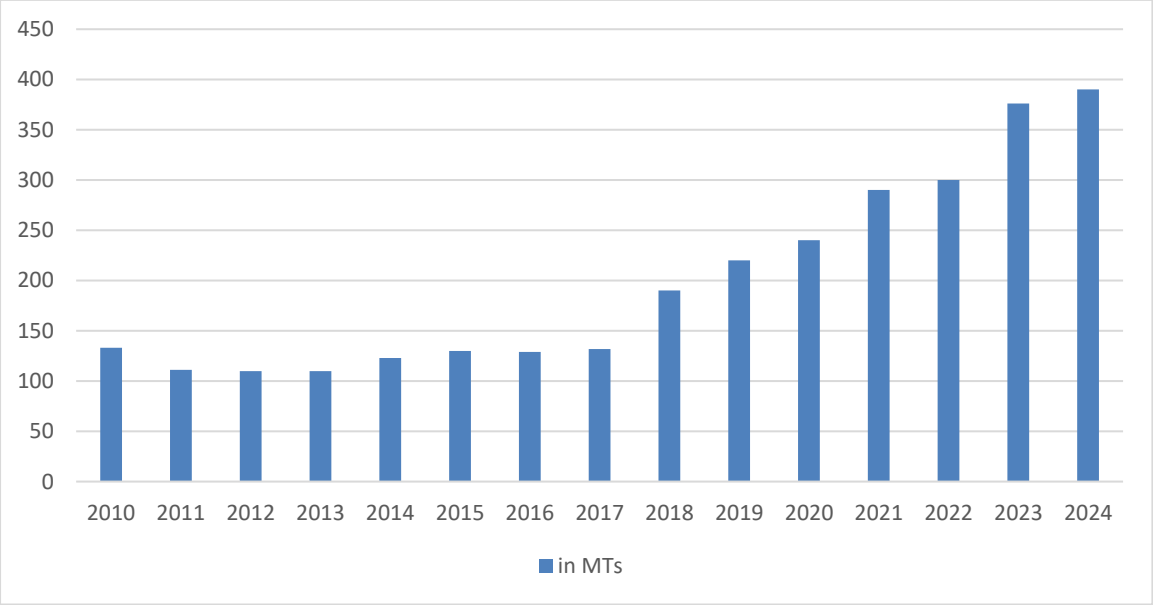
2.1 Demand: The Importance of Rare Earth Elements for Europe

REEs are a group of 17 chemically similar metallic elements consisting of the 15 lanthanides, along with scandium and yttrium, which often occur in the same ore deposits and exhibit comparable chemical properties. Light rare earth elements (LREEs), lanthanum, cerium, praseodymium, neodymium, and samarium, correspond to atomic numbers 57 to 62 and are more abundant than their heavier counterparts. Heavy rare earth elements (HREEs), comprising atomic numbers 64 to 71 along with yttrium (39), occur less frequently and are primarily employed in advanced high-tech applications. (Hynek 2023, 15) Despite their name, REEs are relatively abundant in the earth's crust, but economically viable concentrations are scarce, and their extraction and processing are technically complex and environmentally challenging. These elements are indispensable for modern technologies: they are key components in permanent magnets used in wind turbines and electric vehicles, phosphors in lighting and displays, catalysts in petroleum refining, and advanced defence applications. (Humphries 2013, 2) For instance, in solar energy technologies, specific REEs, notably neodymium and dysprosium, are used to produce high-performance magnets that are essential for solar panel tracking systems. These systems allow panels to adjust their orientation according to the sun's movement throughout the day, thereby maximizing energy capture. Similarly, in the wind energy sector, the production of permanent magnets for modern wind turbine generators depends heavily on REEs, particularly neodymium, praseodymium, and dysprosium. The inclusion of these elements significantly improves both the efficiency and overall performance of wind turbines. (Mariev / Blueschke 2025, 2) And, the magnetic properties of neodymium and praseodymium play a vital role in the production of electric vehicle motors. (Hynek 2023, 20) As a report of the International Energy Agency (2021) stated: "*A typical electric car requires six times the mineral inputs of a conventional car, and an onshore wind plant requires nine times more mineral resources than a gas-fired plant.*" (IEA 2021, 5) REEs are also critical for advanced defence applications, such as precision-guided munitions, radar systems, and secure communication technologies. For instance, neodymium is vital for producing strong magnets used in missile guidance systems, while europium is a critical component in the red phosphors found in night vision goggles. (Hynek 2023, 23) At all, the strategic importance of REEs lies in their role as critical enablers of both the green transition and high-tech innovation, which makes supply security a major concern for economies heavily reliant on imports.

As a result, in the last decade, demand for REEs rose continuously. Figure 1 shows a clear upward trend in global REEs mine production from 2010 to 2024, reflecting a rising demand

for these critical materials. While between 2010 and 2017, production remained relatively stable, fluctuating between 110,000 and 132,000 metric tons (MTs) of rare earth oxides, starting in 2018, production began to rise sharply, reaching 190,000 MTs, an increase of more than 40% compared to 2017. This growth accelerated in the following years. By 2023, global production surged to 376,000 MTs, with projections for 2024 reaching 390,000 MTs. (see fig. 1) The sustained increase from 2018 onward indicates growing demand driven by the expansion of high-tech industries, which all rely heavily on REEs. Overall, the data highlights both the rising strategic importance of REEs and the significant expansion of mining to meet global demand.

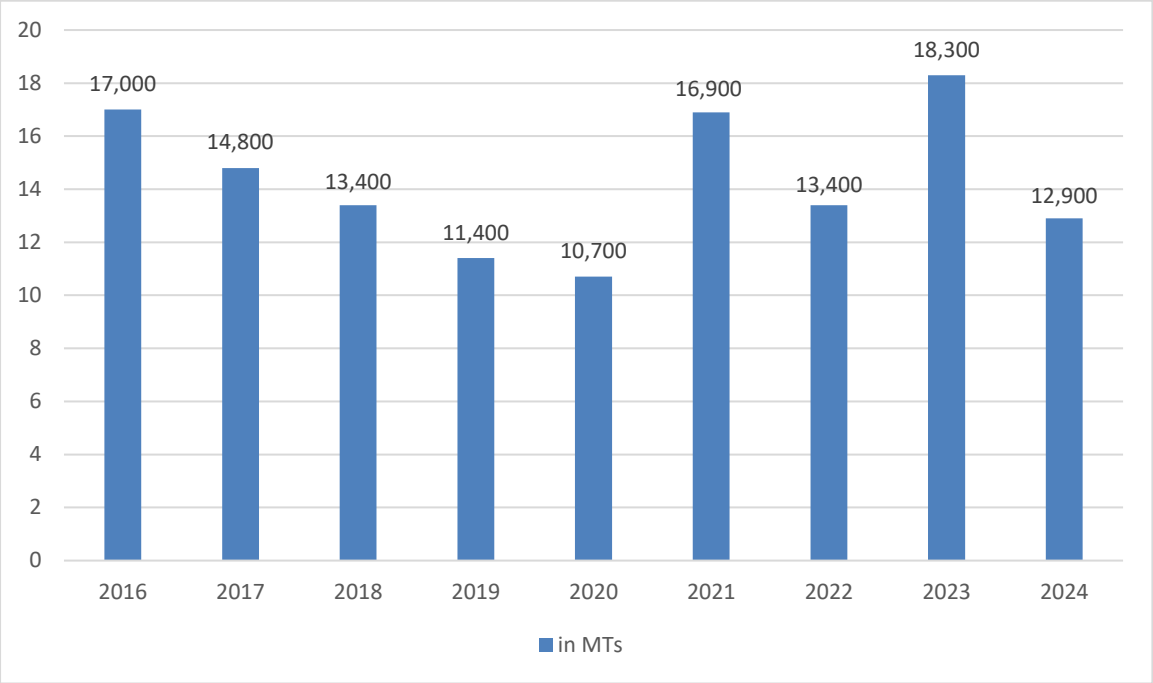
Fig. 1: Mine production of REEs worldwide from 2010 to 2024



Source of data: Statista (2025a).

As figure 2 shows, the direct European demand for REEs is only a small part of the world demand: in 2024, with 12,900 MTs about 3.3%. Additionally, it must be mentioned that, from 2016 to 2024, EU imports of REEs were highly volatile. Imports fell from 17,000 MTs in 2016 to a low of 10,700 MTs in 2020, then rebounded sharply to 18,300 MTs in 2023. The decline from 2016 to 2020 reflects consecutive drops, likely influenced by market and supply disruptions, including the COVID-19 pandemic. Recovery from 2021 onward, culminating in the 2023 peak, suggests rising demand. Overall, while cyclical, imports show an upward trend after 2020, highlighting the EU's growing reliance on REEs critical for modern technology.

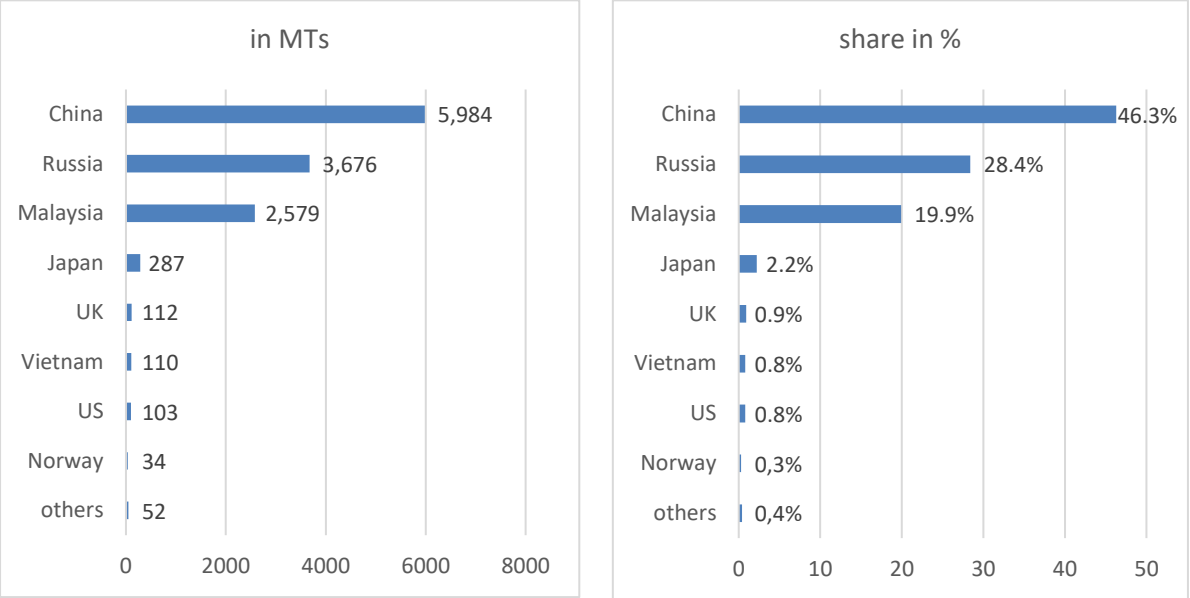
Fig. 2: Import of Rare Earth Elements into the EU 2016 - 2023



Source: Finsterbusch et al. (2025).

According to the latest Eurostat data, nearly half of the European Union's REE imports in 2024 originated from China. Russia was the second-largest supplier, accounting for about 29%, followed by Malaysia at roughly 20%. (Statista 2025b) Despite Malaysia not being a major producer of REEs, it plays a significant role in the global supply chain due to its advanced processing capabilities. The country serves as a critical hub for refining and separating REEs, which are then exported to various markets, including the European Union. This strategic position has been further solidified by Malaysia's policy to prohibit the export of unprocessed REEs, aiming to encourage domestic value-added processing and attract foreign investment in downstream industries. (Aziman et al. 2023) Almost all REEs refined at Malaysia's Lynas Advanced Materials Plant come from Lynas's Mount Weld deposit in Western Australia, are shipped to Malaysia as lanthanide concentrate for further cracking, solvent extraction and separation. (Lynas 2024)

Fig. 3a & b: Imports of REEs into the European Union in 2024, by country (in MTs respective in %)



Source of data: Statista (2025b).

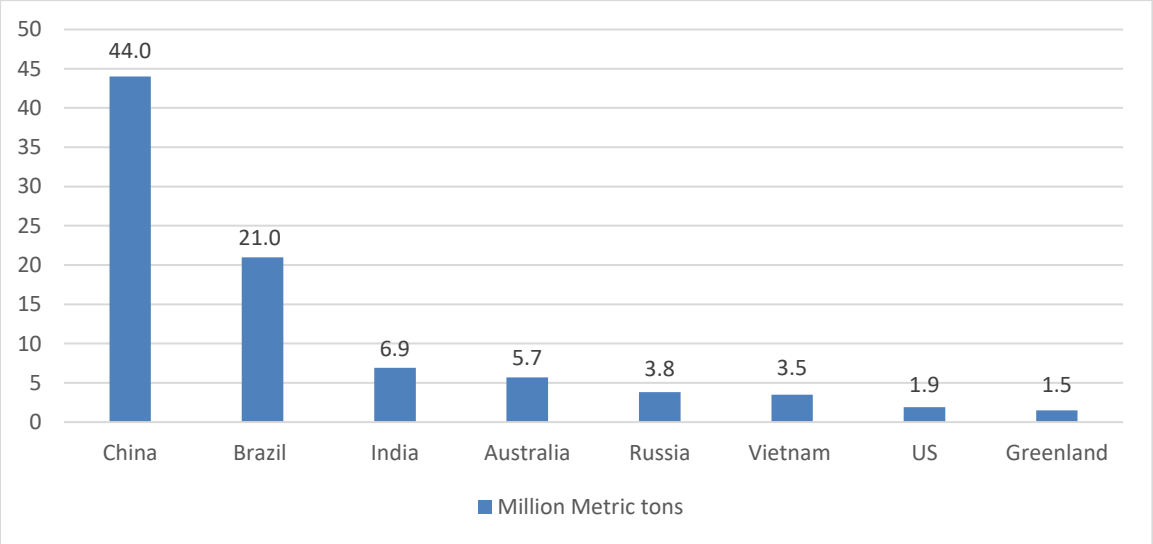
However, the aggregated data capture only part of Europe's dependency. The use of REEs in wind turbines illustrates this limitation: In 2024, 43% of Neodymium and Praseodymium came from China, but 69% was refined there. Dysprosium and Terbium were extracted by 84% in China and processed by 100% in that country. As a result, the European Commission evaluates the supply risk as high respective very high. (Carrara et al. 2025, 22 – 25)

Additionally, it must be highlighted that the origin of REEs imported by the EU are very undiversified. With China and Russia two autocratic states are dominating, massively. Only the third-largest share, the REEs from Malaysia, are originating in a Western country, Australia. (see fig. 3a & b) Additionally, if one takes in consideration that over 80% of large European firms are not more than three intermediaries, often U.S. tech firms making products with Chinese REEs, away from Chinese REE producers Europe's dependency on Chinese REEs rises to 70%. (Banin et al. 2025) In line with the objectives of the Paris Agreement, and as outlined in the International Energy Agency's Sustainable Development Scenario, global mineral demand is expected to shift dramatically in the near future, too. Over the next two decades, clean energy technologies are projected to account for more than 40% of total demand for copper and REEs, 60–70% for nickel and cobalt, and nearly 90% for lithium (EIA, 2021). Therefore, the demand for raw materials like REEs etc. will rise enormously in the future.

2.2 Supply: China's Dominance in the Rare Earth Market

The already described picture is not surprising because China holds the world's largest rare earth reserves, estimated at 44 million MTs. The country was also by far the leading producer in 2024, turning out 270,000 MTs. Even with its dominant position, China has been working to maintain and expand its REE stockpiles. After warning in 2012 that reserves were dwindling, the government announced in 2016 plans to build up both commercial and national reserves. For years, authorities have also cracked down on illegal and environmentally damaging mining operations, shutting non-compliant facilities and restricting production and exports. While such limits once constrained supply, Beijing has gradually eased them in recent years, repeatedly raising mining quotas. China's stronghold over both reserves and production has created global tensions before. In 2010, export cuts triggered a sharp price surge, spurring countries worldwide to seek alternative sources. The competition with the United States has only intensified. In December 2023, China escalated the standoff by banning the export of technology used to manufacture rare earth magnets, for instance. (Pistilli 2025)

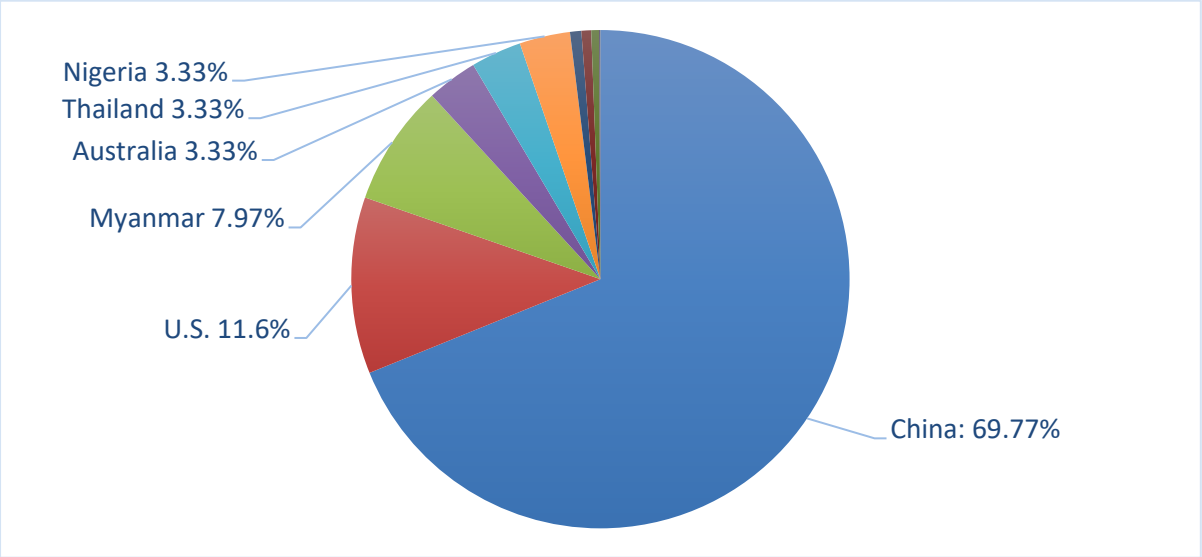
Fig. 4: Rare earths reserves (2024), in million MT.



Source of data: Statista (2025c).

The 2024 data on rare earth reserves (fig. 4) show that China is followed by Brazil with 21 million MTs. Other notable reserves include India (6.9), Australia (5.7), Russia (3.8), and Vietnam (3.5) million MTs. The United States (1.9) and Greenland (1.5) have comparatively smaller reserves. This distribution highlights China's dominant position in global rare earth resources, while other countries hold significantly smaller but still important shares.

Fig. 5: Distribution of rare earths production worldwide as of 2024, by country (in %)



Source of data: Statista (2025d).

As figure 5 shows, in 2024 China overwhelmingly leads global production, accounting for nearly 70% of the total REEs. The United States is the second-largest producer at 11.6%, followed by Myanmar at 7.97%. Australia, Thailand, and Nigeria each contribute 3.33%, making them minor but notable producers. Additionally, India, Russia, and Madagascar produce less than 1% each. Also, Vietnam and Brazil are very minor contributors. (Statista 2025c) Additionally, it must be highlighted that China has secured a central role in the mining, and especially the processing, of the subgroup of ten HREEs, for which China's share exceeds 90 percent for some elements and there are virtually no alternative suppliers. (Astheimer et al. 2025) And, it must be considered that strategic dependencies frequently exist in intermediate goods, rather than solely in upstream raw materials. (Klimek et al. 2025, 13)

2.3 Supply Expansion: Current Reactions to China's Dominance

Contestable monopolies, particularly the Chinese-dominated supply chain for REEs, create significant market and strategic risks for other countries and companies – but also set strong incentives. To tackle these challenges, numerous countries are seeking alternative sources of REEs. Efforts include investing in new mines and advanced mining technologies, as well as promoting the recycling and recovery of REEs from discarded electronic devices. In addition, some nations are exploring ways to lessen their reliance on REEs by designing weapon systems and electronic devices that incorporate substitute materials. Examples from all over the world can be found where other actors, private enterprises as well as states, are creating

alternatives to China's dominance by investing in REE mining and refining. These include primarily democratic countries, but also some that cooperate with China within the framework of the BRICS.

Although Brazil, the country with the second largest reserves of REEs worldwide, was not a significant REE producer in 2024, that is set to change. Early in the year, Serra Verde launched Phase 1 commercial production at its Pela Ema deposit in Goiás state. By 2026, the company aims to ramp up output to 5,000 MT of rare earth oxide per year. (Pistilli 2025) At the moment Australia is the leading Non-Chinese producer of REEs. Lynas Rare Earths is the foremost player outside China, operating the Mt Weld mine in Western Australia alongside its separation plant in Malaysia. The company currently produces 5,000–6,000 tonnes of neodym-praseodym (NdPr) oxide annually and is expanding into the United States with a new facility focused on both light and heavy rare earth separation. Other Australian projects are also advancing: Iluka Resources is developing the country's first fully integrated refinery at Eneabba, designed for 17,500 tonnes per year, while Arafura's Nolans project is targeting 4,440 tonnes of NdPr oxide annually by 2025. Together, these efforts are positioning Australia as the world's second-largest refining hub after China. (Rare Earth Exchanges 2025)

Also, India holds rare earth reserves of 6.9 million MTs and produced 2,900 MTs in 2024, consistent with output levels from recent years. The country possesses nearly 35 percent of the world's beach and sand mineral deposits, a major source of REEs. In December 2022, India's Department of Atomic Energy provided a detailed overview of the nation's REE production and refining capacity. By late 2023, the government was reportedly developing policies and legislation to support REE research and development, aiming to capitalize on its substantial reserves. In October 2024, Indian engineering and procurement firm Trafalgar announced plans to establish the country's first facility for producing rare earth metals, alloys, and magnets. (Pistilli 2025)

Although the United States possesses REE deposits within its territory, it has seen a sharp decline in domestic production and become heavily reliant on imports from China. By 2020, as much as 80% of U.S. REEs imports originated from China. (Hynek 2023, 15) Therefore, now the U.S. are restoring REE capacity. The U.S. firm MP Materials has revived production at the Mountain Pass mine, outputting 1,300 tonnes of NdPr oxide in 2024. Its new magnet facility in Fort Worth, Texas, is set to supply 1,000 tonnes of neodymium–iron–boron (NdFeB) magnets annually, sourced entirely from U.S.' REEs. The company's portfolio, however, does not include HREEs. Meanwhile, energy fuels, through its White Mesa Mill in Utah, is producing mixed REE carbonates along with limited volumes of NdPr oxide. A strategic partnership with POSCO International is aimed at building a Korea-linked REE supply chain independent of China. (Rare Earth Exchanges 2025)

But all these measures are not enough to reduce China's dominant position in the REE markets in the short or middle run. Finding alternatives remains challenging for several reasons. Beyond China's dominance and its extensive foreign policy networks, such investments are highly costly, and establishing an entirely new infrastructure is both resource-intensive and technologically complex. Consequently, it is unrealistic to expect any state to establish its own infrastructure in the short term and effectively challenge China's monopoly. (Hynek 2023, 19) Therefore, China's dominance in rare earth refining and magnet production remains formidable, yet mounting competition is emerging.

3. The Geopolitical Dimensions of Rare Earth Markets

3.1 Reasons for Europe's Dependency and Vulnerability

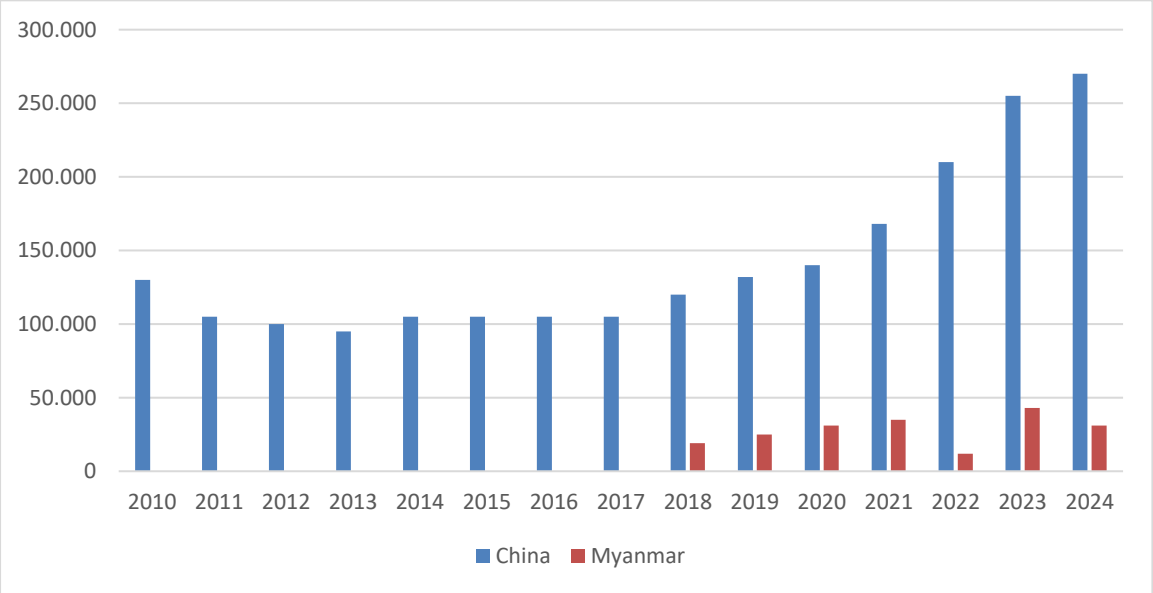
In addition to China's vast natural deposits of rare earth elements, there are three main factors that drive Europe's dependence on Chinese REEs. First, China created a near-monopoly position by active economic policy measures, second, Europe's approach to fight the climate change by a transition to renewable energy sources is continuously increasing the need for, and thus the demand for, REEs in Europe, and third, Europe as well as other Western countries refrained from processing REEs due to the environmental impact of this process.

For a long time, China's dominance in the field of REEs has been attributed to its vast domestic deposits and has been continuously expanded. Already in the 1990s, Deng Xiaoping famously remarked: "*There is oil in the Middle East; there is rare earth in China*" (Biedermann 2014, 276), highlighting Beijing's view of REEs as strategic commodities. Before China's rise, the U.S was the dominant producer and distributor of REEs but lost this position, largely due to regulatory restrictions on radioactive by-products. As Western production declined in the 1980s, China capitalized by investing heavily in exploration and development, ultimately establishing the world's largest REE mine in its northern regions. China's approach was driven not only by economic goals but also by political imperatives. Already in 2011, the Chinese government restructured the REE sector, consolidating more than 100 firms into six state-owned enterprises (SOEs) and providing direct funding to national research laboratories focused on REE smelting and separation. That brought REE production in China under political control of the Communist Party. In the following years, low labour costs and lax environmental regulations enabled Chinese producers to undercut global competitors, making it economically unfeasible for firms outside China to compete. In 2022, three large mining conglomerates and two research institutes merged into the China Rare Earth Group, a monopolist – or at least market dominating enterprise – in the worldwide REE markets. Under the direct supervision of the State Council, the newly formed SOE is expected to strengthen China's ability to set prices

for critical REEs, a move that could generate disruptions across the supply chain. (Fan et al. 2023, 1-2) REEs are also highlighted in China's "*Made in China 2025*" strategy, where the sector is identified as a strategic priority for advancing technology, strengthening security, and supporting national defence. (Hynek 2023, 19)

While the West continues to impose significant bureaucratic obstacles on the extraction and processing of REEs, Beijing has removed all such barriers. And while the West scaled back its infrastructure over three decades, Beijing approved extraction, construction, and operational permits within weeks. From the initial application to the commissioning of new facilities, the process took at most two years. (Finsterbusch et al. 2025) As a result, between 2010 and 2024, the production data of REEs (fig. 6) clearly illustrates China's growing importance in the REE world market. During this period, China more than doubled its output, from 130,000 MTs in 2010 to 270,000 MTs in 2024, maintaining a dominant position in the global market. Especially from 2018 onward, China's production has increased sharply.

Fig. 6: Rare earths mine production in China 2010-2024 / Myanmar 2018-2024 (in MT)



Source of date: Statista (2025e) and (2025f).

But also, the European dependency on REEs from China is pressing because Europe, in its pursuit of reducing greenhouse gas emissions and advancing the transition to renewable energy, confronts a pivotal challenge at the intersection of climate policy, clean energy development, and the supply of REEs. Central to Europe's climate strategy is the ambitious "European Green Deal", a framework designed to achieve carbon neutrality by 2050. This transition to a

low-carbon economy depends heavily on the renewable energy sector, which in turn relies on the trade of critical materials like minerals imported from resource-rich countries outside Europe, mainly REEs from China. Especially, the pivotal role of REEs in the production of clean energy technologies, particularly solar panels and wind turbines, cannot be overstated. Their unique properties, including high magnetic strength, exceptional conductivity, and resistance to corrosion, make them indispensable components in the fabrication of these advanced energy systems. (Mariev / Blueschke 2025, 1)

Additionally, REEs are also vital to national security, as they are indispensable in the production of specialized alloys used in weapon systems. REEs underpin technologies across all branches of the military, including the air force, ground forces, and the navy. (Hynek 2023, 16) For instance, the Center for Strategic and International Studies (CSIS) notes that REEs, especially dysprosium and terbium, play a critical role in manufacturing key components for advanced U.S. defence systems. (Shamim 2025) But, more than 90 percent of refined dysprosium and terbium is produced in China. (Astheimer et al. 2025) For this reason, they are also of strategic importance in Europe's current military buildup in response to the threat from Russia.

However, it is also the environmentally harmful production of REEs that has so far prevented Europe and other Western states from carrying out refining themselves and from diversifying their sources of raw materials accordingly. The high costs, complex regulations, and strict environmental standards make REE refinery and production economically and technically unattractive for European countries. A very good example for the ecological problems concerning REE separation is the Lynas Advanced Materials Plant in Malaysia. In 2023, there has been a partial shutdown respective suspension of many operations at Lynas's Malaysia facility, though not a complete closure. The company was shutting down most operations, except for its Mixed Rare Earth Carbonate processing plant, for upgrades, license issues, and regulatory compliance. (Fong 2023) The cracking and leaching operations, which are more of the upstream, waste-generating part of the process, were under particular pressure. There were regulatory conditions (licensing, radioactive waste concerns) that affected whether they can continue operating. But Lynas responded to the demands of the Malaysian regulatory authorities. As a result, Malaysia has extended Lynas's operating licence until March 2026. This includes permission to continue cracking and leaching activities in Malaysia, with new conditions: radioactive content in the waste (Water Leach Purification or WLP residue) must be kept under 1 becquerel per gram (1 Bq/g). Additionally, Lynas must also extract thorium (a naturally occurring radioactive element) from either the incoming feedstock or from its waste. (Ayzzat 2023)

But also, China itself is continuously avoiding the environmental pollution by refining REEs in the own country. For decades, the Chinese province of Jiangxi was the world's main source

of heavy REEs, but mining caused severe environmental damage, polluting water and land. Under Xi Jinping, China began tightening environmental standards and cracking down on illegal mining. As a result, much of the extraction has shifted to Myanmar, where thousands of Chinese workers now operate mines under poor environmental conditions. (see fig. 6) While China enforces stricter environmental rules at home, Myanmar does not, and mining along the shared border has severely scarred the landscape. (Pistilli 2025) In this manner, China continues to dominate the global supply chain because it controls the processing and refining stages, even if extraction increasingly happens abroad. While Myanmar now supplies a rising share of the world's HREEs, the mining industry there is tied to armed groups, worsening the ongoing civil conflict and raising concerns that REE revenues are financing war. For Europe and the U.S., this creates a dilemma: breaking China's dominance means relying on politically unstable and environmentally destructive mining in Myanmar, where Chinese companies already hold most of the concessions. Meanwhile, China seeks to reduce its own dependence on Myanmar by investing in alternative sources, such as Laos, but without solving the environmental problems inherent to REE mining. (Theile 2025)

The combination of all three reasons, China's near-monopoly position, the rising demand for REEs because of the transition to renewable energy sources in Europe and the environmental impact of the refining process of REEs, has steadily increased Europe's dependence on Chinese REEs. Overall, China not only controls the majority of global production, but the limited and unstable output from alternative sources makes Europe increasingly reliant on Chinese supplies, heightening the risk of supply disruptions or geopolitical constraints.

3.2 Rare Earth Markets as Geopolitical Trap for Europe?

On the one hand, the transformation of the European industries, housing and mobility to renewable energy sources shall not only fight climate change but also reduce the European dependency on fossil energy resources from abroad, mainly Russia and the Middle East. But on the other hand, exactly this transformation creates a new, perhaps much more dangerous, dependency on REEs from China. The risks are becoming obvious while analysing the Senkaku Crisis 2010 as well as the halt of REEs exports by China in 2024/25. Also, prospects for a coming Taiwan Crisis are concerning.

Case Study 1: "Senkaku Crisis" 2010:

The "Senkaku Crisis" 2010 is a very early example for REEs as a strategic instrument of Chinese foreign policy. The Senkaku Islands, a group of five uninhabited islands and three islets

in the East China Sea, are administered by Japan but claimed by China and Taiwan. They hold significant economic value due to rich fishing grounds and potential oil and gas deposits, as well as geostrategic importance for controlling the East China Sea. The 2010 Senkaku crisis began when a Chinese trawler refused to leave Japanese territorial waters, eventually ramming two Japanese Coast Guard vessels. Japan detained the 15-man crew and captain, prompting China to escalate with rhetorical threats, popular protests, the arrest of Japanese nationals, and an unofficial REE embargo. China's short-term goal was the release of the captain, while long-term aims likely included demonstrating its economic leverage as a coercive tool. The Japanese government faced domestic criticism for releasing the captain without indictment, and protests arose over both China's actions and perceived Japanese weakness. The crisis ended by late November 2010 with restored diplomatic dialogue and de-escalation. (Economic Leverage n.d.)

Case Study 2: China's Export Halts 2024/25:

Also, in response to escalating trade tensions, particularly with the U.S., China imposed export controls on several critical materials. In December 2024 China halted exports of gallium, germanium, antimony, and imposed stricter reviews on graphite, citing national security concerns. And in April 2025, export restrictions were extended to seven REEs, samarium, gadolinium, terbium, dysprosium, lutetium, scandium, and yttrium, affecting industries globally. This decision caused a supply shock: Shipment of REE magnets dropped by approximately 75% within one month in comparison to the year before, forcing some car producers to pause production. (Banin et al. 2025) From the introduction of the restrictions to summer 2025, dysprosium oxide prices have risen by 27%, terbium oxide prices have increased by 19%, and neodymium-praseodymium alloy prices have climbed 15% in anticipation of further regulatory measures. (Murphy 2025)

In October 2025, the situation between China and the U.S. escalated again: In Announcement No. 61 of 2025, China declared it would expand export controls to include five additional REEs, olmium, erbium, thulium, europium, and ytterbium, on top of the seven metals already restricted since April. With these new additions, China imposed export restrictions on 12 of the 17 REEs. The government also announced new controls on the export of specialized technological equipment used in refining REEs. Most of these measures should take effect on December 1, 2025. Under the new rules, foreign companies should be required to obtain special approval from Beijing to export rare-earth magnets and certain semiconductor materials containing at least 0.1 percent HREEs from China. As part of the licensing process, foreign com-

panies should be required to disclose the intended purpose of the products they seek to produce with Chinese-sourced REEs. China hasn't yet pulled the trigger on export restrictions, but it's reminding Washington that it could. First, this must be recognised as a signal that Beijing is prepared to leverage its dominance in the REE supply chain as a strategic tool. (Shamim 2025) But second, there visible consequence would follow: Beijing was focusing particularly on the military. Under the new regulations, from December 1, 2025, companies with any links to foreign armed forces, including those of the U.S. and the EU, should generally no longer be granted export licenses. The Chinese Ministry of Commerce also made it clear that applications to use REEs for military purposes shall be automatically rejected. In effect, the policy was designed to block any direct or indirect contribution of Chinese-origin REEs or related technologies to foreign defence supply chains. (Astheimer et al. 2025) Surprisingly, on 30 October 2025, China has consented to postpone the implementation of its latest round of REE export controls for one year under an agreement reached between Presidents Donald Trump and Xi Jinping. However, previous restrictions on critical minerals that have disrupted global trade are still in effect. (Jackson 2025)

What are the results for Europe? Already more than 10 years ago, Valerio Grasso (2013) warned that global reliance on Chinese REE supplies was becoming a serious concern, particularly in relation to national security. He stressed that supply chain vulnerabilities could undermine the U.S.' strategic and defence planning. REEs are essential for most critical infrastructure, and with ongoing technological progress, this dependence is only deepening. Amid escalating geopolitical tensions and uncertainties linked to China's growing influence, the country's dominance in REE has become increasingly concerning.

A future scenario: a possible war over Taiwan

What does that mean for Europe's geopolitical dependency in the long run? For instance, Europe faces a complex balancing act regarding Taiwan. On one hand, all EU countries support Taiwan's democratic system and are interested in its continued independence as a symbol of liberal values and as a strategic partner in technology, semiconductors, and innovation. Taiwan is a critical hub for advanced microchips, which are essential for European industries ranging from automotive to defence, making its stability a matter of economic and technological interest. On the other hand, Europe is heavily dependent on China for trade, investment, and access to global supply chains. Especially, the here analysed European dependency on Chinese REEs is crucial here. At least, since 2022 when U.S. politician Nancy Pelosi, at the time the Speaker of the House of Representatives, visited Taiwan the global conflict for Taiwan

became obvious. Also, China's approach to the Russian war in Ukraine raises questions about China's willingness to remain a peaceful geopolitical player in the future. (Hynek 2023, 14)

In a crisis concerning Taiwan, China could impose export restrictions or embargoes on REEs to the U.S., Japan, or Europe in retaliation for their involvement in defending Taiwan. The "Senkaku Crisis" in 2010 as well as the Chinese REEs export restrictions 2024/25 can be considered as precedent cases showing China's willingness to weaponize REEs supply. But also, Chinese price manipulation, e.g. by tightening export quotas or imposing tariffs, could drive up global REE prices. Further, prioritizing friendly or neutral states is an opportunity for China to use its dominance in REE markets against Europe and the West. For instance, China could continue supplying REEs to states that remain neutral in the conflict while cutting off adversaries. This would create diplomatic incentives for countries (e.g., in Southeast Asia or Africa) to avoid aligning with the U.S. or EU, fragmenting international support for Taiwan. As alternative, a targeted denial of high-value REEs may be a possible strategy for China. Not all REEs are equal — neodymium, dysprosium, and terbium are critical for high-performance magnets used in fighter jets, naval propulsion, and missiles. China could selectively restrict these "choke point" materials rather than applying a blanket ban, maximizing strategic pressure while limiting global backlash. Or, China could simply disrupt the supply chain via informal controls, e.g. by slowing down customs clearances, delay export licenses, or apply "environmental inspections" to constrain supply indirectly. As a result, it must be highlighted that the dependence on Chinese REEs will limit Europe's willingness to take strong political or military stances in support of Taiwan, as antagonizing China could disrupt economic ties and strategic supply chains. Therefore, Europe's dependency on REEs from China can be described as serious "geopolitical trap".

4. Europe's Responses to China's Dominance

4.1 The Critical Raw Materials Act 2024 – an Overview

The European Union's Critical Raw Materials Act (CRMA), which entered into force on May 23, 2024, is a key legislative initiative – following the basic ideas of industrial policy – designed to strengthen Europe's strategic autonomy and supply resilience in critical and strategic raw materials such as lithium, cobalt, nickel, copper, and REEs. The Act aims to ensure that the EU can secure, process, and recycle sufficient quantities of these materials within its borders, reducing overdependence on external suppliers such as China. The regulation sets binding benchmarks to be achieved by 2030, targeting a more diversified and circular raw materials economy. Specifically, at least 10% of the EU's annual consumption of strategic raw materials

should come from domestic extraction, 40% from EU-based processing, and 25% from recycling. Furthermore, the EU must ensure that no more than 65% of any strategic raw material is sourced from a single non-EU country. These goals are intended to create a more resilient and environmentally responsible supply chain across Europe. (European Commission 2024a)

To meet these objectives, the CRMA introduces a suite of regulatory and policy measures. It streamlines permitting procedures for critical raw material projects: extraction projects should receive permits within 27 months, and processing or recycling projects within 15 months. The Act also establishes the concept of "Strategic Projects," which may receive fast-track approval, financial support, and priority recognition at both national and EU levels. Each EU Member State is required to designate a single national contact point to coordinate raw material project approvals, ensuring consistency and administrative efficiency. Member States must also develop national exploration programmes to map domestic raw material potential, strengthening geological knowledge across the EU. In parallel, the Act requires risk monitoring and stress testing of supply chains for strategic technologies, such as batteries, renewable energy equipment, hydrogen technologies, and semiconductors, to anticipate and mitigate potential disruptions. A major focus of the CRMA is on the circular economy and sustainable use of resources. Recycling and recovery of raw materials from waste streams, such as end-of-life vehicles, wind turbine components, and electronic waste, are to be scaled up. The Act emphasizes the creation of closed-loop recycling systems and the development of environmentally sound recovery technologies. On the external front, the CRMA promotes international diversification through strategic partnerships with resource-rich countries in Africa, Latin America, and beyond. These partnerships aim to secure stable, transparent, and sustainable supplies of raw materials while fostering mutual development benefits and high environmental and social standards. Because it is an EU regulation, the CRMA applies directly and uniformly across all Member States without needing national transposition. (European Commission 2024a)

By building reserves from multiple sources, countries can lessen their reliance on a single supplier, especially China. Such stockpiles serve as a buffer against supply disruptions or geopolitical tensions, helping to maintain a stable supply for critical industries. (Hynek 2023, 25) Therefore, the CRMA includes provisions for the coordination of strategic stocks of critical and strategic raw materials as part of the EU's supply-risk preparedness framework. The Act mandates the newly established European Critical Raw Materials Board to oversee and coordinate these stockpiles at the EU level, ensuring better crisis response and resilience of supply chains. (European Commission 2024a) However, the regulation does not specify minimum reserve levels or require Member States to maintain mandatory national stockpiles. Instead, it focuses on monitoring, risk assessment, and coordination mechanisms rather than quantitative storage obligations.

But at all, Europe's industrial policy remains largely reactive. While the EU has published a strategy paper with the CRMA, implementation has been limited. Many political and economic actors continue to rely on China's eventual cooperation rather than pursuing autonomous supply solutions. In contrast, the U.S. are much more active. Since the Biden administration, the U.S. have reoriented its raw material policy, seeking to regain control over extraction and processing to reduce dependence on China. Under Donald Trump, this strategy has intensified: new partnerships with resource-rich states such as Australia, Malaysia, and India are announced almost weekly, alongside domestic mining projects. Washington increasingly invests directly in companies, making resource security a matter of highest national priority. (Astheimer / Záboji 2025) In contrast, Europe still had done a few first steps into the right direction.

4.2 Strategic projects, development of domestic extraction and processing projects

Fortunately, countries like EU member Sweden and EU associated partner Norway have exploitable deposits of REEs. For instance, Norra Kärr in southern Sweden is rich in heavy REEs like ytterbium, terbium, and dysprosium. Since 2024, mining lease application and EU Strategic Project application is underway. (Leading Edge Materials 2024) But the bureaucratic process takes time. On 6 June 2024, Rare Earths Norway (REN) announced that its Fen Carbonatite Complex hosts the largest REE deposit in continental Europe. The Maiden Mineral Resource Estimate reports 559 million MTs at 1.57% Total Rare Earth Oxides (TREO), including 1.5 million MTs of magnet-related REEs. REN plans a 2024 drilling campaign and a pilot processing facility in Nome municipality to test new technologies and train staff. Supported by European EIT RawMaterials, ERMA, and Innovation Norway, the project could see a NOK 10 billion investment by 2030, supplying up to 10% of Europe's REE demand, supporting EU Critical Raw Materials Act goals. (Rare Earths Norway AS 2024) But it will still take some time before these projects are fully operational and can supply REEs on a continuous basis.

Even though no major deposits of REEs can be found in the EU at the moment, it is becoming increasingly necessary to at least carry out refining and processing within the union. The company Silmet in Estonia represents a first step in this direction. Neo Performance Materials (NPM) operates the Silmet plant in Estonia, currently the EU's only commercial REE separation facility. The company also opened a 2,000-ton-per-year magnet plant in Narva, strengthening EU capacity and forging transatlantic links through partnerships with U.S. producers. (Rare Earth Exchanges 2025) In 2023, the owner of NPM Silmet, Neo Performance Materials Inc. from Canada, has announced a significant update to its manufacturing strategy at its rare

metals facility in Sillamäe, Estonia. The company will discontinue the energy-intensive hydrometallurgical processing of niobium- and tantalum-bearing ores. Instead, it will source niobium and tantalum from higher-value oxides and recycled materials. Neo has already completed successful testing of these inputs and secured multiple sourcing agreements, ensuring continuity of supply. (Neo 2023) Surprisingly, Silmet is still not a “Strategic Project” of the EU. (European Commission 2025)

Additional facilities will follow soon: In 2025, Belgium-based chemical company Solvay has inaugurated a new production line at its La Rochelle facility in France to process REEs for permanent magnets. The investment in France upgrades an existing facility, making it the largest plant outside China capable of fully separating all REEs. (Solvay 2025) Solvay Italia appears in the official list of Strategic Projects recognized under the CRMA dates 25 March 2025. As a result, Solvay benefits from increased political priority and greater visibility for financing opportunities but a concrete support for the plant in La Rochelle is not visible. (European Commission 2025)

In other European countries the activities are much less. According to the German Mineral Resources Agency in Berlin, the Federal Republic plays no significant role in the world in the mining, refining, processing, or trading of REEs. As the state-owned agency wrote in its “Raw Materials Information” 2025, there have been no noteworthy efforts in the country for the commercial processing of rare earth ores or minerals for the past three and a half decades. (Finsterbusch et al. 2025) While the extraction of REEs in Europe, the EU and its allied neighbouring countries, progresses at a low level, concrete steps have at least been taken toward processing REEs within the EU. The implementation of EU procedures, offering faster permits to European enterprises may help to accelerate this process. However, so far, only a single facility is capable of processing REEs, Silmet in Estonia. Therefore, the EU still faces a long way to go before this can meaningfully reduce its dependence on China. The industrial policy approach of the EU takes too much time and lacks flexibility.

4.3 Diversification through strategic partnerships and stockpiles

To reduce supply risks and dependency, the EU has to identify alternative suppliers, as countries such as the U.S., Australia, Brazil, and several African nations possess significant REE deposits that can be mined and processed. Mainly, in Brazil and Australia new REE mines are already developed. Then, the EU can develop strategic partnerships through trade agreements and joint ventures to ensure long-term and stable access to these resources. Finally, building up strategic reserves or stockpiles of critical rare earth elements would provide a buffer against short-term supply disruptions, enhancing overall resilience of the supply chain.

For instance, in 2024 the EU signed an MoU with Australia to cooperate on sustainable critical and strategic minerals. The agreement covers the full value chain, including exploration, extraction, processing, refining, recycling, and managing extractive waste. (Delegation of the European Union to Australia 2024) And, in December 2024, the EU officially endorsed a roadmap with the DR of Congo focused on raw materials. This partnership aims to build a more sustainable and resilient value chain from extraction to processing to recycling. (European Commission 2024b) Additionally, the European Commission has selected 13 strategic projects in third countries, including four in Africa, as part of its initiative to diversify the supply of critical raw materials for European industry. In Malawi, the chosen Songwe Hill Rare Earths Project, developed by Mkango Resources Limited, focuses on extracting REEs used in high-performance magnets. In South Africa, the Zandkopsdrift Project, led by Frontier Rare Earths Limited, aims to produce REEs and manganese for battery manufacturing. (NovaNews 2025) Also these agreements represent a first step, but the path toward independence from Chinese REEs is still a long way off. Furthermore, it should be emphasized that broader free trade agreements (FTAs) with countries rich in REEs would provide a better alternative, fostering more open and equitable trade between these countries and the EU.

Also, in the case of stockpiles, the EU's activities are not enough. While the CRMA lays the groundwork for stockpiles in REEs through its provisions on supply risk preparedness and mitigation, as of October 2025, the European Union has not yet established operational stockpiles of REEs under the Critical Raw Materials Act. As a result, at the moment there are private initiatives, only: A notable example is Strategic Metals Invest in Frankfurt, where the company is reportedly stockpiling strategic metals, including REEs, stored in a World War II-era vault with armed security. (Carbon Markets 2025) However, Strategic Metals Invest does not hold EU Strategic Project status, nor does the company receive any direct funding measures. Also, the German defence company Rheinmetall has meanwhile built up a five-year stockpile for all "critical items like REEs". Equally important for the company's strategy is diversifying its suppliers. (Finsterbusch et al. 2025)

Despite these private efforts, Europe still lacks comprehensive infrastructure for large-scale REE stockpiling. A comprehensive and coordinated approach, potentially involving public-private partnerships, will be essential to establish a robust and resilient REE supply chain in Europe. It is incomprehensible why the EU has so far failed to support the joint creation—or at least the concrete promotion of national initiatives—for the establishment of strategic reserves in REEs. This is particularly surprising since the establishment of European stockpiles would not lead to any price distortions in the markets for REEs, and would therefore represent a completely market-based solution.

4.4 Recycling

Furthermore, EU countries should prioritize the development of recycling programmes. Worldwide, the reuse and recovery of products containing REEs remain relatively limited, leaving much of the potential within existing products and waste streams largely untapped. (Hynek 2023, 25) Therefore, one major focus of the CRMA is on the circular economy and sustainable use of resources. In the last years, the EU has approved numerous strategic projects under the CRMA, focusing on REE recycling. (1) Pilot Plants: Establishing facilities to demonstrate and scale up recycling technologies. (2) Innovation Funding: Providing financial support for start-ups and SMEs working on recycling solutions. (3) Public-Private Partnerships: Encouraging collaboration to accelerate the development and deployment of recycling technologies. Several projects to recycle several raw materials were started in cooperation with German EIT RawMaterials, part of the European Institute of Innovation and Technology (EIT), for instance. These projects, recognized as technically feasible, sustainable, and timely, aim to secure the EU's access to critical raw materials essential for the economy and green transition. (EIT RawMaterials 2025) But the process of recycling REEs in the EU is still in its infancy.

Only one case seems to be successful in Europe in the short run: French Carester, financially supported by the French government as well as by Japan's state-owned resource agency Jogmec and the private company Iwatani is erecting a new plant in Lacq (Pyrénées-Atlantiques). The plant is scheduled for completion in mid-2026, with commercial operations beginning in early 2027. Carester aims to recycle 2,000 MTs of magnets and refine 5,000 MTs of mining concentrates annually, establishing Europe's first large-scale REE recycling facility and the largest Western producer of heavy REEs. The planned annual output, 600 tonnes of dysprosium and terbium oxides accounts for around 15% of global production. (Caremag 2025) At least, the Caremag facility (a Carester subsidiary) is listed in the Commission's annex as one of the Strategic Projects and has already received major financing commitments (e.g., reported investments/guarantees). The project is cited in official EU communications and industry reports as an important step toward strengthening REE recycling and processing capacity in Europe. (European Commission 2025) Also, the French company Magreesource has ambitious plans. Since December 2024, it has operated a small pilot plant for REE recycling in the Isère department, with an annual capacity of 50 tonnes. (Astheimer / Záboji 2025) These projects show how fast flexible market solutions can be found while the European bureaucracy is often not a substantial form of support.

4.4 Technology-neutral approaches and innovation

Also, investing in research and development, particularly in recycling and alternative technologies, can decrease dependence on specific REEs while promoting long-term sustainability and security. Necessary for technological substitution of REEs is more investment in R&D to replace REEs with more abundant materials in magnets, batteries, and electronics. In concrete, research into new magnetic materials, battery chemistries, and lightweight alloys that do not rely on REEs must be supported. Also, advanced recycling technologies could increase efficiency and economic feasibility of extracting REEs from waste streams. A good but unique example for innovation is German BMW. Developers at the German car producer have succeeded in producing some of the large electric motors in their cars entirely without REEs. Thanks to a new design principle, magnets in the current generation of the Bavarian battery cars' motors are replaced by magnetic fields, making the REEs unnecessary. However, these magnet-free electric motors are more expensive. And, like all other car manufacturers, BMW still requires REEs for all the smaller electric motors in its vehicles. (Finsterbusch et al. 2025) But the example shows that innovation is possible and will reduce the dependency on China.

To support research aimed at substituting or recycling REEs, the EU provides strong framework conditions, though there are some practical challenges. Funding and research programmes are, for instance: (1) Horizon Europe: The EU's flagship research and innovation programme funds projects targeting REE recycling, substitution, and sustainable extraction. (European Commission 2022) (2) EIT RawMaterials: The institute supports projects that develop alternative materials, recycling technologies, and circular economy solutions. (EIT RawMaterials 2025) (3) European Raw Materials Alliance (ERMA): The alliance provides coordination, funding, and networking opportunities for research and innovation in critical raw materials. (ERMA n.d.) But all of these industrial policy research programmes are to be considered very bureaucratic, complex, and slow. Support for small start-ups is too limited, and innovation within SMEs is hardly supported. But, the industry must reduce its dependence as quickly as possible by substituting the by China controlled REE products. Instead of bureaucratic industrial policy approaches broad tax incentives would support these efforts much faster and more effective. (Astheimer et al. 2025) Therefore, while the EU programmes are targeted, their effectiveness in the short run must be questioned.

5. Conclusion

Europe's dependence on Chinese REEs represents a multifaceted strategic vulnerability with significant economic, technological, and geopolitical implications. REEs are indispensable for

the green and digital transitions, as well as advanced defence capabilities, yet China's dominance in mining, refining, and processing gives it substantial leverage over global supply chains. Historical precedents, such as the 2010 Senkaku Crisis and the recent 2024/25 export restrictions, demonstrate China's willingness to use REEs as instruments of economic coercion and geopolitical influence. Europe's transition to renewable energy and high-tech industries further amplifies its reliance on these critical materials, creating what can be described as a "geopolitical trap."

In response, the European Union has taken concrete steps to diversify supply and build resilience. The Critical Raw Materials Act (CRMA) establishes binding targets for domestic extraction, processing, and recycling, alongside mechanisms for strategic partnerships, risk monitoring, and support for innovation. Initiatives in Sweden, Norway, Estonia, France, and beyond illustrate efforts to develop domestic and allied REE capacity, while pilot projects and recycling programmes aim to gradually close the loop on circular use of critical materials. Nonetheless, these measures are still in their early stages. Domestic extraction and processing remain limited, recycling infrastructure is nascent, and technological substitution faces both technical and bureaucratic hurdles. At all, the CRMA can be seen as cornerstone of the EU's Green Deal Industrial Plan and the broader European strategy for economic sovereignty. But with its numerical targets and the definition of Strategic Projects, the CRMA is a typical example of European industrial policy. However, it also includes elements that promote market-oriented developments, such as shortened approval procedures. On the other hand, it is bureaucratic and slow and lacks a broad regulatory framework that encourages technology-neutral approaches and innovation.

Therefore, in the short run diplomacy will be crucial for the EU. Their representatives will need to try to appease Beijing. This is not entirely hopeless, since China depends on maintaining access to important European export markets for its automobiles and machinery, particularly amid its trade disputes with the U.S. At the same time, it must support domestic raw material producers, who are now left with unsold stock. Perhaps the strongest argument: Beijing has no interest in allowing the rest of the world to develop real alternatives, which would blunt its leverage. On the other hand, there must be concern that a potential rapprochement between U.S. President Trump and Chinese President Xi could reverse recent progress. If China resumes deliveries, the pressure on stakeholders will ease, and the issue could once again fade from Europe's agenda.

Therefore, Europe's long-term security and strategic autonomy will depend on a combination of approaches: expanding domestic and allied production, establishing European stockpiles, accelerating recycling and circular economy solutions, and supporting innovation to reduce dependence on critical Chinese-controlled REEs. While the EU's legislative framework lays

somehow solid foundation, the effectiveness of these industrial policies will ultimately hinge on rapid implementation, streamlined support for SMEs and start-ups, and pragmatic industrial policy that complements regulatory ambitions. Additionally, a more flexible and market-oriented way of support for the affected industries by tax incentives and other favourable economic conditions for innovation would be more effective. Without sustained action, Europe will continue to face significant exposure to supply disruptions and geopolitical leverage, reinforcing the urgency of a coordinated and multifaceted response. In short, the EU is moving in the right direction, but the journey toward genuine strategic autonomy in REEs remains long and complex.

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