A rare opportunity: What are the chances for reducing rare earth dependence?

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Despite a provisional agreement, the trade conflict between the US and China continues to simmer. The bone of contention remains China's dominance of the rare earths market, which has evolved into a **means of exerting geopolitical pressure** in retaliation for the tariff increases and in the negotiations – and not for the first time in history. Once again, the high dependence of many countries is turning out to be a vulnerability.

The EU is also dependent on raw materials imported from non-EU countries for 100% of its rare earths and 99% of processed goods.[1] **China's dominance of the entire value chain** for permanent magnets and other future technologies that contain rare earths is symptomatic of the weak point – the single point of failure – and the serious consequences for industry and national security that could result from a disruption of Chinese supplies. **Germany's high manufacturing share makes it particularly vulnerable**. At the same time, in 2024 the share of direct imports of certain rare earths products from China was above the EU average, at around 62%. **Nearly 90% of Germany's imports** of permanent magnets came **directly from China**. Meanwhile, German industry may potentially also play a role in further processing.

In this paper, we shine a spotlight on the future. **Will Germany and the EU remain vulnerable in the medium term?** Besides the high geographical concentration, price volatility poses a challenge for long-term investment – despite rapidly growing demand. In the medium term, this means continuing high vulnerability to supply shocks. According to estimates by the IEA, China will remain the most important player in 2030 as well, with a share of half of global extraction and three quarters of rare earths processing. Cautious trends towards greater diversification are already underway but whether the EU can benefit from them is unclear. The EU imported a net volume of only 244 tonnes of important raw magnet rare earths in 2024 and its demand for them could grow to 6,000 tonnes by 2030. Total demand for rare earths is many times greater.

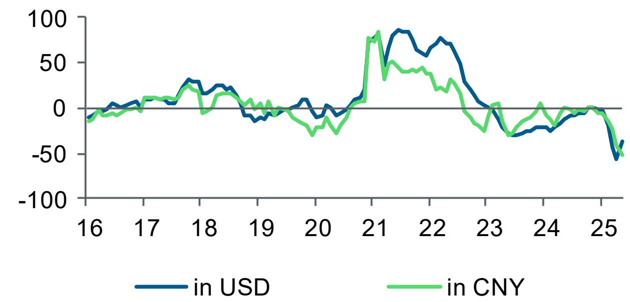
For new producers, the road is rocky but not impassable. According to various analyses, up to 13 kilotonnes of annual production capacity for permanent magnets could be developed in Europe by 2030. **De-risking potential** may result from technical innovation – and transnational partnerships. The EU and the German Federal Government have planned measures that must be expanded quickly in order to effectively reduce dependencies along the value chain. Businesses must also diversify their sources. These measures must now be implemented while striking a balance between acute crisis intervention and strategic planning.

In geopolitics, dependencies are easily instrumentalised

Since the beginning of the year, the trend towards growing protectionism in global trade has further accelerated. While the tariff conflict between the US and China is subject to fluctuations, the exchange of blows has expanded to cover non-tariff measures. Both the threats and the bargaining chips centre around access to rare earths, over which China possesses great market power. The export restrictions imposed by China in retaliation for the reciprocal tariffs in April 2025 were officially frozen in the Geneva talks in May 2025 and extended in August. But the issuance of export licence approvals stalled nonetheless. The resulting bottlenecks have likely given businesses downstream of the supply chain – automobile manufacturers, aviation and aerospace firms, semiconductor manufacturers and defence suppliers – a taste of their vulnerability in the supply of the coveted minerals. In the context of the framework agreement signed in June 2025, China and the US agreed on speeding up deliveries. However, the most recent developments show that exports from China remain restrictive, particularly for uses in the defence sector.

Figure 1: Trade disputes are weighing on China's exports of permanent magnets

Per cent year-over-year change (3-month moving average)



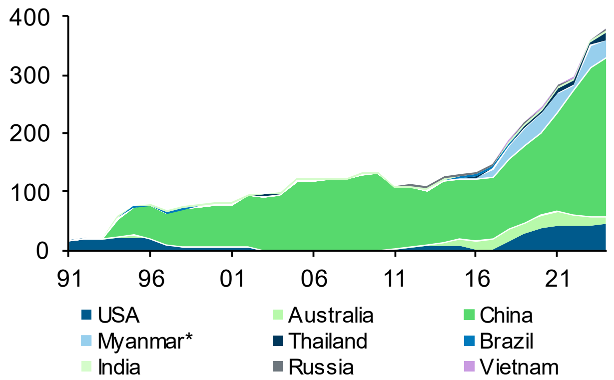
HS8505 permanent magnets and articles intended as magnets, from rare earths.

Source: China General Administration of Customs (GAC), KfW Research.

The consequences of a potential undersupply of minerals from the group of rare earths[2] are severe. The production of permanent magnets used in electric vehicles, wind turbines, industrial motors and robotics accounts for around one quarter of global consumption of rare earths. But conventional combustion engines, light bulbs, laser devices and medical equipment also use rare earths. According to a study by KfW, 22% of gross value added in manufacturing in Germany involves goods containing rare earths.[3]

Figure 2: Mining output over time

Mining output in thousands of metric tonnes of rare earth oxides



Note: Without yttrium and scandium. *Data for Myanmar only from 2013 onwards.

Source: U.S. Geological Survey, British Geological Survey, KfW Research.

High concentration along the value chain

China's dominance of the entire value chain for permanent magnets and other technologies of the future that contain rare earths is well known. The **value chain** is highly concentrated, with China's documented mining production accounting for nearly 70% of global output in 2024 (Figure 2). China also owns mines in Myanmar in addition to undocumented production. China's share of global rare earth metal refining operations sits at 92%. The country also leads in the further stages of the value chain, in metallurgy, the production of components and finished products.

Germany is dependent on imports for 100% of its rare earth requirements. Germany imports 90% of the permanent magnets that are essential for wind generators and other applications from China – one of the most significant dependencies of the wind energy supply chain.[4] EU suppliers of components, for their part, often source rare earths from China.

At the same time, rare earth deposits can be found practically all over the world. The most common element, cerium, is more abundant in the Earth's crust than copper. But extraction and processing are highly specialised procedures associated with considerable environmental risks:

- **Complex extraction and separation process:** Many rare earths are found in deposits where they are not the primary metal. When they are mined, they are heavily diluted and extracted as part of larger quantities of ore in order to meet demand. Separation processes are then needed to isolate the individual rare earths from the ores.
- **Environmental impacts:** Rare earths are extracted by digging vast open pits in the ground, which can put heavy pressure on the environment and ecosystems. Where the extraction is inadequately regulated, it can leave behind wastewater ponds filled with acids, heavy metals and radioactive material.
- **Water- and waste-intensive production:** Processing the raw ore into a form that is suitable for the production of magnets and other products requires large quantities of water and potentially toxic chemicals and results in considerable amounts of waste.

China's pathway to a magnet superpower

In the 1990s, Japan and the US were the most important producers of magnets. But already in 1992, China's reformer Deng Xiaoping recognised that 'The Middle East has oil, China has rare earths.' An automotive subsidiary responsible for magnet production was bought out by two Chinese groups in 1997.[5] In Japan, China first established itself as a supplier of purified rare earths. When China imposed a ban on the exportation of rare earth products to Japan in the territorial dispute over the Senkaku / Diaoyu islands, Japanese businesses were pressured to shift part of their magnet production to China in order to obtain access to Chinese markets. In this way, China gained access to missing technologies in the early 2010s. Japan's coping strategy for reducing its dependence on China for rare earths through a combination of diversification of production (reshoring as well as offshoring, for example to Vietnam), strategic stockpiling and innovation in alternative materials offers a blueprint for risk mitigation even today.

In the past ten years, China has consolidated its position as the world's leading supplier of permanent magnets. Between 2012 and 2023, China's share of global exports of metal-based permanent magnets grew from 52 to 63%.[6] According to market studies, China's own magnet consumption will grow to 170,000 tonnes and meet 40% of global demand by 2030.[7] Moreover, it must be borne in mind that China itself needs to act as a net importer of unprocessed rare earths – oxides and carbonates – in order to meet downstream industries' growing demand for these raw materials. The mines in Myanmar account for the largest share of these imports.[8] This strategic orientation is also reflected in the rise of Chinese mergers and acquisitions (M&A) outside China.[9]

Protectionism, geopolitics and price volatility are weighing on supply chains

According to the OECD, export restrictions on critical raw materials have increased significantly overall – not just in number but also in scope.[10] For rare earths, for example, they also comprise refined products. Today, more than half of all energy-relevant critical raw materials are subject to at least one form of export restriction. China has banned the export of technologies related to the extraction and separation of rare earths since December 2023.

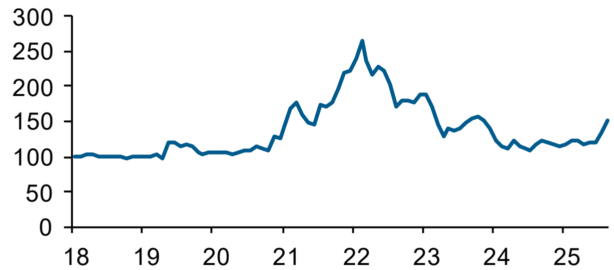
In the US-China trade dispute, access to rare earths remains a contentious issue despite a preliminary agreement. In April 2025, in response to Trump's tariff policy, China imposed export controls on seven rare earths but these were recently suspended again in the wake of the framework negotiations with the US.[11] The impact of the restrictions was immediately felt. In May 2025, China's exports of permanent magnets fell by 76% in US dollars compared with the previous year (Figure 1).[12] Numerous car manufacturers were forced to suspend the production of individual electric vehicle models or parts or issued warnings that production stoppages might be imminent. In Germany and the EU, the delay in the issuance of export licences caused friction in the production process.[13]

In addition, China maintains a quota on rare earths production and thus regulates market supply. In 2024 and the years before, it expanded the production quota by a double-digit percentage, partly in order to offset losses in Myanmar. But it intends to set a more restrictive quota in 2025. It has also escalated its control of tracking systems. Risks and bottlenecks can also originate outside of China. An exacerbation of the political conflict in Myanmar, which accounts for 8% of global mining output and is the largest supplier of ores after China, could further tighten supply.

China's ability to set prices remains a major challenge. Rare earths are not traded on transparent commodity exchanges but in less regulated over-the-counter markets via brokers and trading platforms.[14] Indexes via Asian Metal or Shanghai Metals Market, which publish reference prices daily, are often used but tend to reflect Chinese industrial policy and not market momentum. China can influence price volatility when it needs to. Depraiter et al. (2025) highlighted the interplay between global geopolitical tensions and the expansion of rare earths shipments from China, for example in order to maintain its market dominance. That makes it difficult to ensure the economic viability of long-term projects and prevents private actors from undertaking the high investments required to open up new plants. Other critical minerals – such as lithium – are currently facing a similar problem, as their prices have fallen as a result of the sharp increase in supply. After lithium, 14 rare earths experienced the sharpest price drops in 2024 (Figure 3).

Figure 3: Price volatility slows investment momentum

Index (Jan 2018=100); mean prices of rare earth oxides, metals and alloys, issued by the Shanghai capitals market.



Source: Bloomberg, KfW Research.

Overcapacity or supply gap? Outlook for supply and demand

Rare earths mining output has grown at an average annual rate of 10% between 2021 and 2024. Processing also increased sharply, with Chinese production accounting for 96% of the growth. The supply of rare earths exceeded demand. The EU Commission voiced concern over excess capacity of rare earths. This is noteworthy as demand for rare earths used in the production of magnets tripled between 2015 and 2024.[15] According to estimates, the **market for permanent magnets based on rare earths** is set to grow rapidly – from approx. USD 8 billion in 2024 to USD 13.5 billion by the end of the decade, with average annual growth rates of 10.5%.[16] With a view to the more distant future up until 2040, it is estimated that global consumption of neodymium iron boron (NdFeB) magnets – the most common type of permanent magnets – will grow fivefold to more than USD 44 billion (by an average 8.7% per year). This is all the more relevant given the market value of the downstream industry, such as automotive engineering. According to some forecasters, robotics and similar areas are set to drive demand growth at disproportional rates in the future.[17]

Not all rare earth metals are the same. The simultaneous extraction of ores from which individual rare earth metals are subsequently isolated determines the production of the metals for which demand is highest. That is why the more common rare earths have difficulty finding a market while others are in short supply. Besides, there are differences between the elements because of their application. For example, demand for neodymium is associated with the overall growth of the market for magnets, while demand for dysprosium is mainly geared to enhancing the strength and high-temperature resistance of magnets.

No diversification in sight? Yes, but ...

Owing to China's very strong market dominance in the production and processing of rare earths, the supply situation is set to remain tense over the medium term. The geographical concentration has intensified since 2020. But there is a ray of light on the horizon. According to an analysis by the IEA, the geographical concentration of production will tend to ease by 2023 – unlike with some other critical minerals such as copper, nickel and cobalt.[18] Besides rare earths, lithium and graphite mining operations are also likely to diversify more strongly due to changes in their supply.

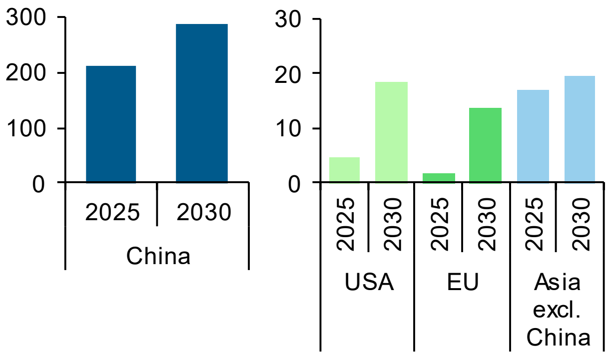
Especially in extraction, it is expected that Australia will be able to further expand its market share over the next ten years while China will lose just under 10% of the market. In processing, Malaysia and the US will play a more prominent role in the future. Australia and the US will join the race with a handful of corporations that operate global refineries. They will start from a low base with shares of refinery output of 1% (USA) and 4% (Australia) in 2024. On the basis of IEA forecasts, in five years the supply of rare earths from countries outside China will thus be able to account for around half the mining output and one fourth of processing. But the reverse also applies: Despite gains by other countries, China's dominance in refining will remain largely untouched at 70%. According to the IEA, without China as the largest supplier, **only just under 40% of demand could be met by 2035**.[19] This will also result in high vulnerability to supply shocks in the medium term.

In the medium term, the IEA predicts much greater diversification in production capacity for magnets – in the further stages of the value chain –, particularly as a result of capacity expansion in the US and the EU. The capacities for the production of

NdFeB magnets are likely to be expanded massively here in the next five years, with annual growth rates averaging 50% in the EU (Figure 4). This was announced by producers, including in Estonia, Slovenia, France and Germany. Thus, non-Chinese capacity in the EU, US and Asia could more than double by 2030 and then account for around 18% of China's expected production capacity. It should be noted that this outlook refers to a stage of the value chain and thus reduces only part of the supply risks.

Figure 4: Doubling of capacity outside China – forecast production of NdFeB permanent magnets

In kilotonnes per year



Source: IEA (2025).

The rocky road for other players

Given China's monopoly position coupled with the high strategic importance of rare earths, many countries have recently adopted measures aimed at strengthening the domestic supply chain and reducing excessive dependence on China. Some are drawing on the experiences of past years and restarting their idle production while others are developing new sites (see box). Australia, Brazil, Vietnam and other countries have abundant rare earth resources while Europe, Malaysia and the United States are investing in separation plants.

New strategic partnerships

At the same time, Germany and the EU are looking to enter into new raw material partnerships. With a view to rare earths, Canada and Australia stand out in particular. Commission President von der Leyen recently floated the idea of a 'Metals Club' of the G7 countries.[20] However, individual interests and needs as well as – in some countries – difficulties in complying with ESG standards often stand in the way of broad import diversification. The table in the annex summarises the current position and potential of alternative mining countries and lists the countries that should play a greater role in processing in the future. (→ Table on page 8)

Research partnerships offer a good starting point.[21] The Australian Critical Minerals Research and Development Hub, for example, is developing initiatives for international cooperation that involve industry and universities. Japan has a Center for Rare Earths Research and a joint initiative with Vietnam that aims to improve the extraction and processing of rare earths.[22] The high financial expenditure involved means that co-financing arrangements may also need to be considered. Examples of other partnerships include that of the EU and Taiwan.[23]

Reversing the recent trend – how global actors plan to be players in rare earths again:

Several decades ago, **France** was a major actor in the separation of rare earths.[24] Its significance dropped after the plant of Belgium-based Solvay was forced to limit operations to specific applications in 1992. Supported by the French investment fund, the company restarted activities in the area of separation and purification of rare earth oxides for magnets at the end of 2022. It wants to meet 30% of Europe's demand for processed REE by 2030.

The US has relaunched the historic Mountain Pass mine in California and financed the future opening of a separation plant. Environmental damage and lawsuits had stopped activities there in 1997.[25] The placing of large orders through the Department of Energy and the Department of Defense to build up strategic stocks was a way to get around the shortage of private players. A strategic partnership with the US Department of Defence to establish a new magnet production plant was announced in July 2025 with the aim of creating an independent supply chain which will involve substantial funding and price guarantees.[26]

India has the world's third-largest rare earths reserves even though the country contributes less than 1% of global production. Only one state-owned enterprise has so far been involved in their extraction, mainly for export to Japan. The government is now planning to open up exploration for private players and pursuing a multi-pronged strategy comprising financial incentives, public-private partnerships and procurement from other countries.

A rare opportunity for research and development!

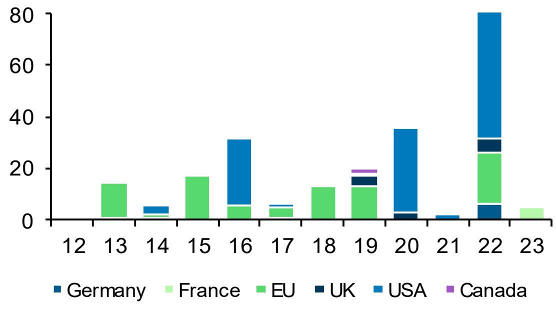
The challenges involved in diversifying imports highlight other aspects for reducing dependencies all the more strongly. Research and development of alternative technologies, alternative processes and recycling potential are deemed to be key starting points. Many of these already exist. The most obvious approach is to **reduce the consumption** of rare earths through technological innovation. Indeed, magnets are rare earths can be dispensed with for specific applications, although this usually means a loss of performance.

The main object of research is the **development of alternative materials** in which material properties can be achieved without or with fewer rare earths. For permanent magnets, research focuses on replacing neodymium and dysprosium, for example with iron alloys. Potential substitutes are also being researched for catalytic converters and luminescent materials.[27] Also of importance is to **continue developing process technologies**. New technologies in mining, refining and recycling offer great potential for diversifying suppliers. The further development of technologies for extracting rare earths from ionic adsorption clay deposits, such as those situated in China, for example, can reduce capital intensity and the volume of waste generated. Accordingly, production opportunities would present themselves in countries such as Australia, Brazil and Uganda.[28] With a view to more resource-friendly extraction as a precondition for opening up new mining areas, innovating less environmentally damaging processes could be a game changer.[29]

Recycling rare earths remains a costly affair, both in terms of energy consumption and business expenditure, since a particular degree of purity is required for the production of magnets. Just a few years ago, the recycling quota at the end of useful life was a very low <1%. Today, studies assume a much higher potential.[30] Researchers at the Ecole Polytechnique in Paris are working on the development of products that use recycled materials without the required high degree of purity. Other approaches aim to extend the life cycle of magnets.[31] The EU has also invested in the recycling of end-of-life permanent magnets for around 10 years now (Figure 5).[32]

Figure 5: EU and member states invested more than EUR 100 million in projects to recycle permanent magnets

In EUR million



Source: Koese et. al (2025).

De-risking by 2030?

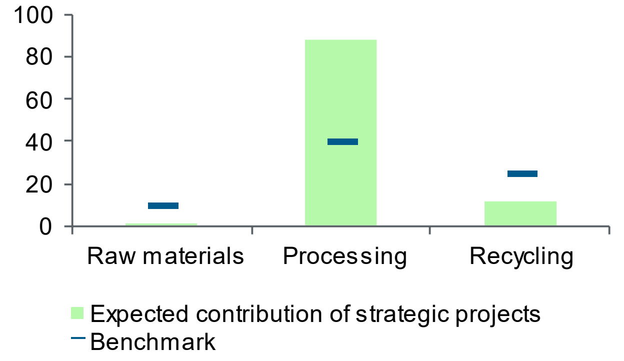
One of the main aims of approaches being adopted at EU and federal level to place access to rare earths on a more secure footing is **crisis management**. In response to China's export restrictions of April 2025, the EU introduced a new IT tool that compiles, prioritises and forwards urgent licensing requests to Chinese authorities on a bilateral basis.[33] Beyond this, however, the following is clear: The EU needs rare earths for its transition to an economy that is aligned with climate change and for a competitive global position in technologies of the future. And this cannot be achieved without structurally lower dependencies.

The focus now is primarily on the defence sector. While the US is investing funds to drive forward the development of an autonomous mine-to-magnet supply chain, the raw materials requirements of the defence sector in Germany and Europe are increasingly competing with the already high demand from climate and digital technologies. Thus, NATO at the end of 2024 published its own list of raw materials which underscores, among other things, the criticality of rare earths.[34]

The EU has chosen a 'de-risking' approach. Instead of ending business relationships, it focuses on reducing weaknesses by diversifying supply chains and developing strategic partnerships. The **Critical Raw Materials Act** (CRMA) that came into force in 2024 stipulates specific targets. For critical and strategic raw materials, at least 10% of the EU's annual consumption for extraction and at least 40% of its annual consumption for processing is to come from domestic capacities, no more than 65% of annual consumption is to be imported from a third country and 25% is to be sourced from recycled materials by 2030.[35]

Figure 6: Targets of the CRMA by 2030 and expected contribution of strategic projects

In per cent of annual Union consumption



Source: EU Commission (2025).

How realistic are these targets for rare earths?

The high geographical concentration of the mine-to-magnet supply chain calls for a broader approach. In order to break up the current monopolistic situation, it is important to promote **businesses and projects at every stage of the value chain** and in this way to enhance competition. Resources are theoretically available in Europe, for example in Sweden and Norway, but expanding extraction takes time and political will. In a recent evaluation of the strategic projects involving rare earths, the EU Commission expects progress to be achieved mainly in processing (Figure 6).[36] Here, the strategic projects are likely to be able to meet almost 90% of Union consumption from domestic production by 2030 – significantly more than the 40% target. In mining and recycling, that goal is far away. So it is foreseeable that the dependence cannot be reduced to a low level at all stages.

With respect to **import diversification**, there has been no reason to sound the all-clear in recent years. In 2024, the EU imported 90% of five of 14 traded unwrought raw materials and alloys from rare earths directly from China based on import weight, as revealed by our analysis of data from Eurostat. For eight of these traded products, China is by far the largest supplier. Overall, China accounts for 43% of imports of the 14 products from outside the EU, followed by Russia (28%) and Malaysia (20%). It should be noted that the goal of reducing import dependency on a single trading partner to below 65% refers to every stage of the supply chain, which is why the approx. 90% in the case of rare earths rather represents a guideline for the status quo than the 43%, which, for example, includes certain metal compounds. In 2024, the latter quota even rose by six percentage points on the previous year.

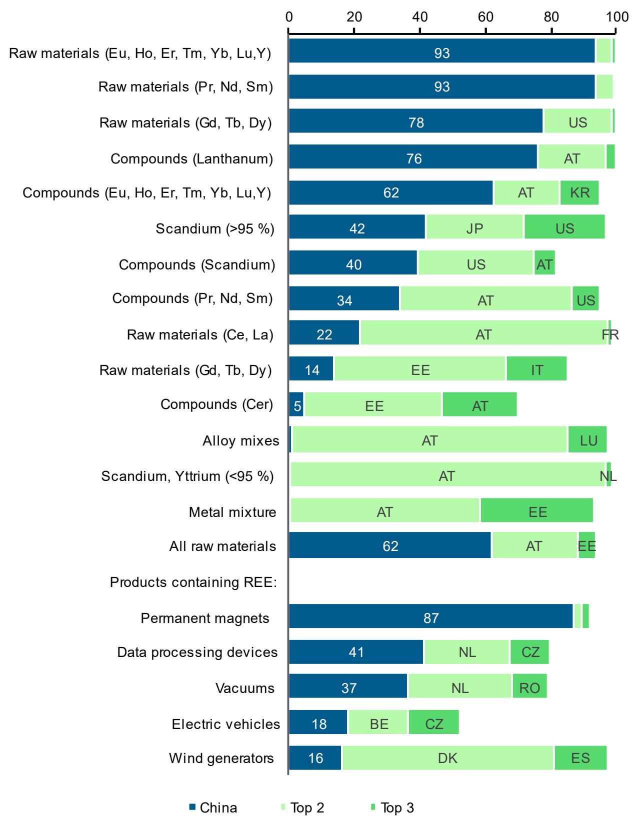
With respect to Germany, the trade data do not paint a more optimistic picture. On the contrary: **the combination of a lack of domestic rare earths deposits and a comparatively large industrial sector** makes Germany particularly reliant on supplies from abroad. With respect to the 14 trading products of rare earths, China accounted for 62% of Germany's direct imports in 2024 and as much as 97% of all its imports from outside the EU (Figure 7). Hardly surprisingly, China's share of unprocessed raw materials is particularly high. EU countries play a larger role as suppliers for the import of specific compounds as well as scandium. Austria, France, Estonia and Italy have significant shares of individual products. None of these countries has a domestic rare earths production. The figures reflect the integration within the value chain. One of the few rare earth products in which a significant drop of China's share can be observed over the years is >95% purity scandium. Some 30% of imports now come directly from Japan and one quarter from the US. Germany's dependence on finished products containing rare earths also remains high. Almost 90% of permanent magnets were imported directly from China in 2024.

Adaptation creates costs – and requires compromises

Between 2008 and 2019, the EU invested some EUR 370 million in research and innovation of research areas such as metallurgy, magnets and fibre optics associated with rare earths.[37] Under the EU Horizon 2020 Initiative, EUR 5.7 million was allocated for REProMag, bringing together European partners for a more research-efficient production. The project REEsilience received EUR 12 million in EU support funds.[38] While there are more and more examples of major private investment in the processing of rare earths and, specifically, the magnet value chain around the world, the private sector in Europe is still exercising restraint. [39]

Figure 7: China's share of Germany's rare earths imports

In per cent of total imports in 2024 (based on quantities)



AT=Austria; BE=Belgium; DK=Denmark; CZ=Czech Republic, EE=Estonia; ES= Spain; FR=France; IT=Italy; JP=Japan; LU=Luxembourg; NL=Netherlands; RO = Romania; US=United States

Source: Eurostat, COMEX, KfW Research.

The European Raw Materials Alliance (ERMA), founded in 2020, identified 14 investment projects across Europe that deepen the magnet value chain at different stages. The total investment volume is EUR 1.7 billion.[40] Commissioned by the EU, the alliance predicted in 2021 that if these projects were realised, the production of magnets in Europe could be ramped up from 500 tonnes per year in 2019 to 7,000 tonnes by 2030. That would enable **the EU to meet around 20% of its demand for rare earths magnets** compared with 3% at the beginning of the observation period. In addition, the ERMA expects more than 5,000 jobs to be created. In a more recent analysis, the IEA even went a step further, predicting that the EU could potentially produce around 13 kilotonnes for permanent magnets annually based on the capacities of individual producers (Figure 4).[41]

Four years after this first assessment, another important step has now been taken but there are major gaps in implementation. Although the passage of the **Critical Raw Materials Act** has given the development the necessary momentum, there is still a long way to go before all milestones are achieved even after the identified projects have fully materialised.[42] The geopolitical complexity of the upstream production and supply chain illustrates that the issue must be addressed comprehensively and, above all, collectively in order to effectively reduce the strong one-sided dependencies. Price interventions are another sensitive issue. How rare earths obtained from newly developed extraction sites can be viable in such a price-sensitive market is still unclear. State support mechanisms range from models of contracts for difference, in which the government pays the difference when the price drops below a certain level, to having the government act as the ultimate offtaker.[43]

Can we break out of the dependence? A cautious conclusion

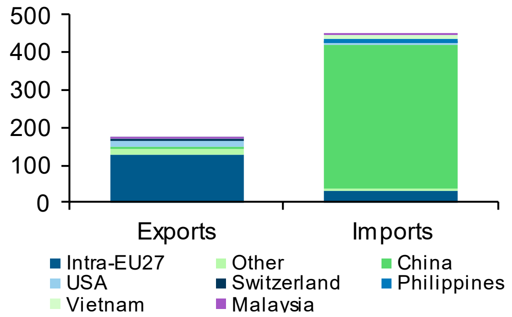
Germany has no economically viable rare earth deposits and will therefore have to continue importing these inputs.[44] The focus is therefore on the European guidelines in order to ensure greater resilience in all stages of the value chain. At the current margin, the EU Commission has identified the projects in mining output and recycling in particular as being insufficient to achieve the objectives set in the CRMA. At the level of the German Federal Government, the Raw Materials Fund marks a first step in this direction.[45] However, the above analysis also shows that even with import diversification it will be difficult for the EU to reduce its dependence on China to below 65% of Union consumption. What is more, if Chinese supplies were to dry up, only a fraction of the expected demand in 2035 could be met.

Estimates of demand for rare earths and the magnet supply chain are complex and subject to numerous assumptions. They are usually guided by the material intensity for specific technologies such as wind energy and battery storage on the basis of political declarations of intent or underlying climate scenarios. Depending on the type of wind farm, each gigawatt requires between 12 and 180 tonnes of neodymium.[46] Thus, on the basis of current policy proposals[47], the IEA estimates global demand for rare earths in strategic technologies at 123 kilotonnes by 2030 and 150 kilotonnes by 2040. In 2023 the EU estimated that compared with 2020 levels, the member states' demand for dysprosium could increase sixfold and for neodymium fivefold already by 2030, while demand for praseodymium and terbium could quadruple. According to the EU, more than 6,000 tonnes of these rare earth elements alone, which are relevant for magnet production, will then be required each year.[48] In 2024, net EU imports of these raw materials and compounds containing them amounted to 244 tonnes. Estimates of total demand for rare earths for the EU range from 30 to 60 kilotonnes by 2030 – at least five times the net import value of 2024 (7,400 tonnes).[49]

There are no official records of total demand for rare earths for Germany. According to Destatis, Germany imported a net amount of around 4,800 tonnes of rare earths worth EUR 41 million in 2024. Germany's net imports of magnet rare earths, the future demand for which has been estimated at European level, were just under 140 tonnes. **Future demand** is likely to be significantly higher. Given the targets for expansion of onshore and offshore wind energy – an example of a strategic technology – a study by Prognos concluded that even if expanding existing capacities by adding and replacing older generators could easily meet demand in the medium term, structural weaknesses, a dynamic market development (with peak demand around 2030) and continuing high dependence on components remain a challenge.

Nonetheless, our analysis also shows that **Germany could play a crucial role in the processing of rare earths to magnets** and thus reduce its import dependence on China for nearly 90% of finished magnets (Figure 8). Ultimately, however, substantial demand for inputs remains, which needs to be met by non-EU imports. And long timeframes (for example, for developing Swedish and Serbian deposits) require short- and medium-term investments in better mechanisms for absorbing shocks. This will also require significant private investment.

Figure 8: Structure of Germany's imports and exports of permanent magnets



In EUR millions (2024)

Source: Own calculation on the basis of Eurostat.

It is certain that Germany and the EU need rare earths for the transition to an economy that is aligned with climate change and for a competitive global position in technologies of the future. In light of geopolitical developments, the demand of the defence sector must also be taken into consideration. Against this backdrop, further efforts towards diversification are required in all stages of the value chain. Important fields of action include:

- At the raw materials level, developing own deposits is essential. Beyond that, raw materials partnerships as well as stable trade relations with China remain a critical element.
- Deepening existing expertise and expanding production capacities for the processing of rare earths and the manufacture of magnets will generate not just a central hub in the supply chain but will also provide advantages in international competition.
- In recycling – but not just here – the focus will lie on the research and development of innovative materials and processes. Scaling up recycling plants and processes is of great importance for a functioning European circular economy in order to establish the foundations for international competitiveness in modern recycling technologies.

Table: Overview of selected countries with current and potential role in rare earths

Countries	Deposits a) In MT	Reserves b) In tonnes of REO	Production: ⚒ Mining / Refining Share in 2024 in per cent	Forecast: c) Share in 2030 per cent	Active mines / projects	Governance index d) [-2.5 / 2.5]	Context role in EU & raw materials partnerships EU and Germany	Export restrictions e) Type
China	**167**	**44 million**	**59% ⚒ 91%**	**51% ⚒ 70%**	**Bayan Obo**	**-0.3**		**Export licences, export ban on technologies**
Brazil	53	21 million	<0.1% ⚒		Araxá	1.1		Export licences
India	8.5	6.9 million	1% ⚒		Chavara	-0.1		
Australia	48	5.7 million	4% ⚒ 0%	3% ⚒ 3%	Mount Weld	1.5	EU raw materials partnership, 2024	none
Myanmar	n.a.	n.a.	8–17% ⚒	11% ⚒	Chipwe-Pangwa	-1.7		Export licences
Russia	48	3.8 million	1% ⚒		Lovozero, Khibiny	-1.1		Export tax
Vietnam	14	3.5 million	1%	1%	Dong Pao	-0.3		n.a.
USA	3.6-14	1.9 million	10% ⚒ 1%	9% ⚒ 6%	Mountain Pass	1.0		none
Malaysia	18	n.a.	<0.1 % ⚒ 5%	9%	Hulu Perak (mine-to-magnet Pilot), Perlis	0.4		Export ban on refined rare earths
Greenland	43	1.5 million	-		Kvanefield Project	1.2	EU raw materials partnership, 2023	none
Tanzania	n.a.	890,000	-		Ngualla	-0.4		n.a.
South Africa	n.a.	860,000	-		Steenkampskraal	-0.1	CRMA strategic project	n.a.
Canada	14-33	830,000	-		Nechalacho, Alces Lakes (exploration)	1.4	EU partnership 2021; German partnership, 2025	none
Thailand	n.a.	4,500	3% ⚒		Korat, Ban Kai	-0.1		none
Lao PDR	n.a.	n.a.	4% ⚒	8% ⚒	Sepon	-0.7		n.a.
Nigeria	6 (Monazit)	n.a.	3% ⚒			-1.0		n.a.
Madagascar	n.a.	n.a.	1% ⚒		Ampasindava	-0.8		Export licences
Processing and magnet supply chain in Europe								
Norway	8.8	n.a.	-		Fen Complex	1.7	EU raw materials partnership, 2024	none
Sweden	29	n.a.	-		Kiruna	1.5	Strategy → Extraction	none
Estonia	-	-	-			1.3	Strategy →metallurgy, magnets	none
France	-	-	-			1.0	Magnets, recycling	none
Slovenia	-	-	-			0.9	Magnet production	none
Belgium	-	-	-			1.1	Recycling	none
Poland	-	-	-			0.6	Separation	none
Finland	-	-	-		Sokli	1.7	Extraction, processing	none
Serbia	n.a.	n.a.	-		Jadar	-0.1	EU partnership, 2024	none

Notes: a) refers to identified, generally extractable deposits worldwide based on Zhou et al. (2017) and various news reports and official websites. Ranges are possible on the basis of various data sources; n.a. = not available; b) partial quantity of deposits on the basis of current mining and extraction methods and economic viability aspects based on the U.S. Geological Survey; c) based on IEA estimates; d) median across six indicators, e.g. corruption, political stability, governance, with -2.5 being the lowest and +2,5 the highest score; e) based on exports of rare earths, as at 2023 except China, Malaysia.

Sources: Zhou et.al. (2017)[50]; US Geological Survey; International Energy Agency; World Bank Governance Indicators; OECD; EU Commission, European Raw Materials Alliance, official websites.

[1]European Commission (2023), Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Grohol, M. and Veeh, C., Study on the critical raw materials for the EU 2023 – Final report, Publications Office of the European Union, 2023, https://data.europa.eu/doi/10.2873/725585

[2] Rare earth elements (REE) comprise a group of 17 minerals (yttrium, 15 lanthanides, which can be subdivided into light and heavy rare earths due to their atomic properties, and scandium).

[3] Köhler-Geib, F., Levinger, H. and Ullrich, K. (2024), Set in stone? The German economy's dependency on copper, lithium and rare earths, Focus on Economics No. 454, KfW Research; Baehr et al. (2024), Kritisch für die Wertschöpfung – Rohstoffabhängigkeit der deutschen Wirtschaft (*Critical for value added – German industry's raw materials dependency* – our title translation, in German), IW Consult and Fraunhofer Institute for Systems and Innovation Research, study for KfW Group.

[4] Prognos (2025), Industrielle Resilienz und Strategische Souveranität Deutschlands (*Germany's industrial resilience and strategic sovereignty* – our title translation, in German), study commissioned by Netzwerk Zukunft der Industrie e.V.

[5] Xémard, M. (2025), China has a monopoly on rare earth metals, Polytechnique insights.

[6] Metal permanent magnets, articles intended as magnets (HS: 850511) Product Trade, Exporters and Importers | The Observatory of Economic Complexity

[7] Renaissance Trend Report (2025), Turning Knowledge into Market Leadership – NIB Magnet Market: A Deep Dive into Market Trends and Growth Projections

[8] China Briefing (2025), Rare Earth Elements: Understanding China's Dominance in Global Supply Chains.

[9] Handelsblatt (2025), China baut Vorsprung bei Rohstoffen aus (*China is expanding its lead in raw materials* – our title translation, in German) 27 August 2025.

[10] OECD (2025), Inventory of Export Restrictions on Industrial Raw Materials 2025: Monitoring the Use of Export Restrictions Amid Growing Market and Policy Tensions, OECD Publishing, Paris, https://doi.org/10.1787/facc714b-en.

[11] IEA Policy Tracker, see also Export controls on certain medium and heavy rare earth items – Policies – IEA

[12] Own calculation, based on China Customs Data.

[13] Handelsblatt, EU will deutschen Firmen helfen (*EU wants to help German firms* – our title translation, in German), 7 July 2025.

[14] Note: In China, rare earths are traded on two spot markets – the Baotou Rare Earth Products Exchange in Inner Mongolia for light rare earths and the Ganzhou Rare Metal Exchange in Jiangxi for heavy rare earths. These exchanges are subject to state supervision and are not forward markets. But the possibility of introducing rare earth futures contracts is repeatedly discussed. See Depraiter et al. (2025), Geopolitical risk and the global supply of rare earth permanent magnets: Insights from China's export trends, Energy Economics 146, https://doi.org/10.1016/j.en; Rare Earth Exchanges (2025), Rare Earth Pricing – Inside China's Grip for Transparency Outside. eco.2025.108496

[15] International Energy Agency, IEA (2025), Global Critical Minerals Outlook 2025, www.iea.org

[16] See Research And Markets, Permanent Magnet Market Global Forecast Report 2024-2029:

[17] Adamas Intelligence (2024), Rare Earth Magnet Outlook to 2040.

[18]Cf. International Energy Agency (2025)

[19] Applies to the Stated Policies Scenario of the International Energy Agency. See IEA (2025).

[20] EU Commission (2025), Statement by President von der Leyen at Session II – working lunch of the G7 on 16 June 2025, retrieved from: STATEMENT_25_1522_EN.pdf

[21] Center for Strategic and International Studies, CSIS (2025), The Consequences of China's New Rare Earths Export Restrictions.

[22]Cf. CSIS (2025).

[23] See: https://chinaobservers.eu/from-extraction-to-innovation-the-eu-and-taiwan-in-the-critical-minerals-value-chain/

[24] See: Solvay launches rare earth processing expansion amid China restrictions - MINING.COM

[25] Gramling (2023), Rare earth mining may be key to our renewable energy future. But at what cost?, Science News.

[26] Financial Times, Pentagon strikes investment deal with US critical minerals producer, 10 July 2025

[27] Edmondson (2024), Magnetic Materials That Could Replace Rare Earths in EV Motors, IDTechEx Research Report.

[28]Cf. International Energy Agency (2025)

[29] See: Researchers develop a new, non-toxic method for rare earth metal processing | Ames Laboratory

[30] Koese et al. (2025), The dynamics of accelerating end-of-life rare earth permanent magnet recycling: A technological innovation systems approach.

[31]Cf. Xémard (2025).

[32] Vgl. Koese et al. (2025).

[33]Cf. Handelsblatt (2025).

[34] North Atlantic Treaty Organization (2024), Factsheet Critical Supply Chain Security Roadmap, retrieved from: NATO - News: NATO releases list of 12 defence-critical raw materials, 11 Dec. 2024

[35] See: Critical Raw Materials Act - European Commission

[36] EU Commission (2025a), Strategic Raw Materials – Rare earth elements for permanent magnets, Factsheet, retrieved from: download

[37] Gauß et al. (2021), Rare Earth Magnets and Motors: A European Call for Action, A report by the Rare Earth Magnets and Motors Cluster of the European Raw Materials Alliance, Berlin.

[38] Cf. Steinbeis Europa Zentrum: Making rare earth magnet supply chains more sustainable and secure – Steinbeis DE

[39] Cf. USA: Companies such as Phoenix Tailings have invested considerable amounts in refining rare earths metals, for example USD 33 million for their Series-B financing round.

[40] Cf. Gauss et al. (2021).

[41] It included the producers MP Materials (Estonia), Magneti (Slovenia), Vacuumschmelze (Germany), Neorem (Finland) and Solvay (France), but also GKN, which maintains a regional office in Bonn

[42] Levinger H. (2023), Der EU Critical Raw Materials Act: Weichenstellung für den Standort Europa (*The EU Critical Raw Materials Act: creating a roadmap for Europe as a location* – in German), Focus on Economics No. 421, KfW Research.

[43] Campbell (2025), Trump Wants Rare Earths. But Challenging China's Dominance Will Take More Than Tariffs, Time.

[44] Low-concentration deposits have been identified in Saxony and Bavaria, for example.

[45] See:→ Raw materials fund | KfW

[46] Carrara et al. (2020), Raw materials demand for wind and solar PV technologies in the transition towards a decarbonised energy system, EUR 30095 EN, Publication Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-16225-4, doi:10.2760/160859, JRC119941

[47] On the basis of a detailed review of the current political situation, the 'Stated Policies Scenario' (STEPS) is to give an idea of the prevailing direction in which the development of the energy system is pointing. See: International Energy Agency (2024), Global Energy and Climate Model, Scenario analysis of future energy trends.

[48] See CRMA Webseite and European Climate, Infrastructure for valuable metals and Environment Executive Agency (2025), Life Inspiree: mining for valuable metals in our waste at large scale, retrieved from: LIFE INSPIREE: mining for valuable metals in our waste at large scale

[49] Pegorin et al. (2023) put the EU demand for permanent magnets in the wind energy sector alone at 21,700 tonnes in 2030. See Pegorin et al. (2023), Materials for Energy Storage and Conversion: A European Call for Action, European Raw Materials Alliance, Berlin.

[50] Zhou, B., Li, Z., & Chen, C. (2017). Global potential of rare earth resources and rare earth demand from clean technologies. *Minerals*, *7*(11), 203.