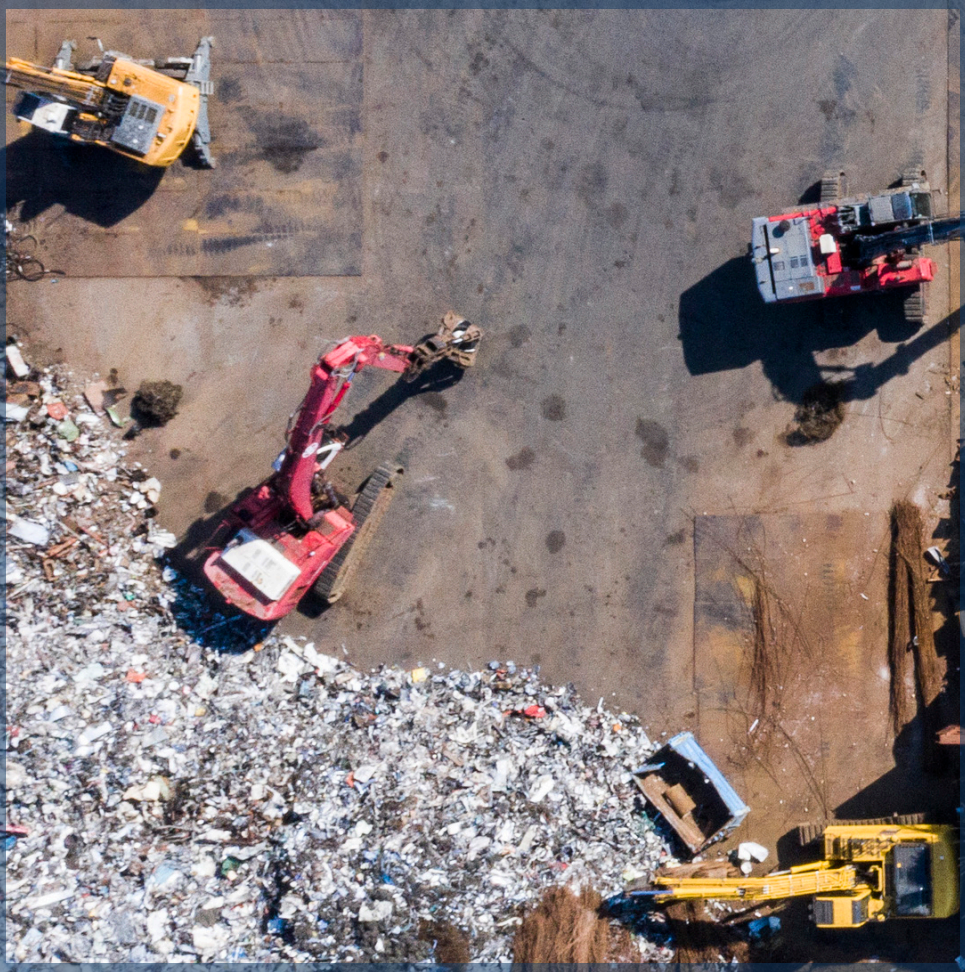
The Hague Centre
for Strategic Studies

Advancing European Mineral Security

Insights from the Dutch industry

Irina Patrahau, Michel Rademaker, Lucia van Geuns and Jeff Amrish Ritoe

October 2023



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Executive Summary

This report, commissioned by the Netherlands Ministry of Foreign Affairs, explores the challenges and opportunities for Dutch companies to expand their presence in the CRM sector and contribute to diversified and resilient supply chains. The study aims to inform the implementation of the *Nederlandse Grondstoffenstrategie* and European Critical Raw Materials Act by offering recommendations on how the Dutch government can support companies in diversifying CRM supply chains.

Access to critical raw materials (CRM) is vital for the most essential sectors of the European Union's (EU) society and economy including energy, transport, digital technologies, health, defence, and space. The EU and its member states face a major challenge. Demand for CRM is on the rise, and it is unsure whether sufficient supplies at affordable prices will be available to match the needs of a green, competitive and secure EU. The risk extends beyond CRM to encompass entire supply chains of strategic technologies located outside European borders.

The recent decoupling from Russia due to the war in Ukraine underscores the undesirable nature of strategic dependencies. Russia's manipulation of energy resources inflicted substantial economic damage on European households and industries, leading EU governments to spend hundreds of billions of euros since September 2021 to mitigate the consequences of this weaponized dependency. As a result, the EU and its member states are now taking proactive measures to safeguard against similar situations taking place in the CRM supply chain.

Yet great power competition and increasing protectionist tendencies are already severely impacting CRM supply security. Geopolitical clout is increasingly intertwined with the control of CRM and strategic technologies, enabling supplier states to coerce others to align with their geopolitical interests. The Chinese government's decision to request licenses for the export of gallium and germanium as of August 2023, for instance, points to significant risk in the years to come.

The EU is moving fast in response to the changing geopolitical setting. In March 2023, the European Commission introduced the proposal for the European Critical Raw Materials Act (CRMA). By September 2023 European Parliament had already voted on its position to boost CRM supply security with a sweeping majority.[1] In parallel, the Netherlands is busy with the implementation of the *Nederlandse Grondstoffenstrategie,* adopted in December 2022.[2] The two acts have a similar goal – to bolster domestic CRM production while simultaneously enhancing supply chain resilience through international collaboration.

1 European Parliament, 'Critical Raw Materials: Securing the EU's Supply and Sovereignty', 14 September 2023, https://www.europarl.europa.eu/news/en/press-room/20230911IPR04927/critical-raw-materials-securing-the-eu-s-supply-and-sovereignty.

2 'Grondstoffen voor de grote transities', Rijksoverheid.nl, 9 December 2022, https://www.rijksoverheid.nl/documenten/kamerstukken/2022/12/09/bijlage-nationale-grondstoffenstrategie.

The report builds on insights from over 30 interviews with industry representatives from the Netherlands. It contributes to the existing debate on CRM in two ways; (1) by providing up-to-date information about the capabilities of companies active in the CRM sector in the Netherlands; (2) by offering first-hand insights from the industry about the challenges and opportunities to strengthen their position within global supply chains.

The Dutch mineral industrial base consists of two types of companies: those with global operations and those primarily active in the Dutch and European markets. Larger companies operate worldwide, relying on international conditions as much as domestic legislation for their daily activity and strategic decisions. In contrast, smaller companies catering to the Netherlands and the EU market are fully dependent on national and European legislation to maintain competitiveness.

Companies active in mineral extraction, processing and recycling in the Netherlands are primarily serving the Dutch and European markets, though exceptions exist. Mining salts and sands is the main extraction operation in the Netherlands, while the processing sector is dominated by steel facilities and, to a lesser extent, minerals like manganese, silica, baryte and zinc. Dutch companies are globally active in the field of deep-sea mining, which could significantly change the industry should the International Seabed Authority allow for exploitation permits. Finally, there is a significant push for recycling in the Netherlands and the sector is expected to grow rapidly.

The Netherlands has a strong representation in global service provision for maritime infrastructure, water management services, environmental assessments, geotechnical and survey services. Dutch companies are assisting operators at mineral extraction and processing sites in South America and Africa.

Table 1 and Table 2 showcase the types of challenges that companies active in the Netherlands face. The data was collected based on more than 30 interviews with industry professionals.

Table 1. Key obstacles to successful operations in the Netherlands and the EU ranked according to the urgency of the issue.

An 'X' means that the company faces an issue. The more companies indicated they face this problem, the more urgent the problem is considered to be. The table shows whether a specific challenge applies to companies primarily active in the Netherlands and the EU, to companies primarily active abroad, or to both.

Ranked in order of urgency	Companies active worldwide	Companies active in the Netherlands and EU
Negative public opinion	X	X
Insufficient dialogue with government and lack of trust	X	X
Delayed action and fragmented mandates	X	
Uneven playing field		X
Cumbersome permitting process		X
Insufficient financial support	X	X
Inconsistent or inexistent legislation	X	X
Inadequate green energy infrastructure		X
Energy costs		X
Inefficient use of space		X
Unskilled labour	X	X

Table 2. Key obstacles to successful operations in the Netherlands ranked according to the urgency of the issue.

An 'X' means that the company faces an issue. The more companies indicated they face this problem, the more urgent the problem is considered to be. The table shows whether a specific challenge applies to companies in one or more parts of the mineral supply chain.

Ranked in order of urgency	Extraction	Processing	Recycling	Service providers	Finance	Trade	Knowledge
Negative public opinion	X	X	X	X	X	X	X
Insufficient dialogue with government and lack of trust	X	X		X	X	X	X
Delayed action and fragmented mandates	X	X	X	X	X		
Uneven playing field	X	X	X	X			
Cumbersome permitting process	X	X	X	X			
Insufficient financial support		X	X	X	X		
Inconsistent or inexistent legislation		X	X		X		
Inadequate green energy infrastructure	X	X	X				
Energy costs	X	X					
Lack of space		X		X			
Unskilled labour		X		X			

Achieving the goals of the EU CRMA and the *Nederlandse Grondstoffenstrategie* requires a comprehensive approach to revitalize domestic industry, empowering it to diversify supply sources and strengthen supply security. Creating the necessary conditions for companies to stay competitive – i.e., an enabling socio-political, economic and legislative environment – is an essential step in creating opportunities for further expansion. Issues must be addressed in relation to public opinion, limited dialogue with the government, lack of a clear vision for industry, slow action and fragmentation of mandates, permitting and red tape. At the same time, the Netherlands can play an important role in strengthening European mineral supply security by encouraging knowledge exchange and industrial partnerships, clarifying financial instruments and investing in knowledge development. Table 3 summarises the challenges and opportunities that companies active in the Netherlands face in continuing operations and looking to expand.

Table 3. Summary of challenges and opportunities for companies active in the Netherlands minerals sector and policy recommendations.

Issue	Recommendation
Challenge: Public opinion	Facilitate a more balanced public debate by offering fact-based information about global mineral supply chains, the EU's footprint, and benefits and risks of reshoring (parts of) supply chains.
Challenge: Dialogue with government	Engage in dialogue with companies to discuss upcoming policy proposals and gain a better understanding of possible unintended consequences of policies as well as find ways to mitigate these. Create a vision for the minerals industry and integrate it in the National Plan for the Energy System.
Challenge: Speed of action and allocation of mandates	Concentrate mandates and responsibilities by creating a 'one stop shop' in one government department for minerals in order to improve the availability of information and accelerate action.
Challenge: Permitting processes and legislation	Reduce red tape for permitting to speed up action. Identify outdated or inconsistent regulation and update it according to new ambitions.
Challenge: Energy costs and infrastructure	Support the expansion of necessary infrastructure such as the electricity grid to allow companies in the minerals sector to develop.
Opportunity: Increase the competitiveness of companies active in the Dutch and European markets	Establish incentives structures that support the expansion of the Dutch footprint in mineral supply chains. Support a more even playing field by establishing standards that can allow Dutch companies to compete with non-EU actors on criteria other than price.
Opportunity: Industrial partnerships	Improve information about the market and facilitate connections. Encourage collaboration with globally active companies that have headquarters and/or operate industrial facilities in the Netherlands.
Opportunity: Financial support	Clarify the availability funding instruments and, when possible, combine efforts with other EU countries.
Opportunity: Knowledge development	Invest in education around minerals and metals to expand skills and strengthen the workforce. Invest in research and development for European-based innovative solutions for CRM value chains.

Management Samenvatting

Dit rapport, uitgevoerd in opdracht van het Nederlandse Ministerie van Buitenlandse Zaken, onderzoekt de uitdagingen en kansen voor Nederlandse bedrijven om hun activiteiten in de kritieke grondstoffensector uit te breiden en daarmee bij te dragen aan gediversifieerde en veerkrachtige toeleveringsketens. De studie beoogt de implementatie van de Nederlandse Grondstoffenstrategie en de Europese Critical Raw Materials Act (CRMA) te ondersteunen door aanbevelingen te doen specifiek over hoe de Nederlandse overheid bedrijven kan helpen bij het diversifiëren van CRM-toeleveringsketens.

Toegang tot kritieke grondstoffen is cruciaal voor de meest essentiële sectoren van de Europese Unie (EU), waaronder energie, transport, digitale technologieën, gezondheid, defensie en ruimtevaart. Daarmee staan de EU en haar lidstaten voor een aanzienlijke uitdaging. De vraag naar CRM neemt toe en het is onzeker of er voldoende voorraden tegen betaalbare prijzen beschikbaar zullen blijven om aan de behoeften van een groen, concurrerend en veilig Europa te voldoen. Grondstoffenrisico's zijn er in de hele toeleveringsketen van strategische technologieën. Deze keten bevindt zich grotendeels buiten de grenzen van Europa.

De recente ontkoppeling van Rusland als gevolg van de oorlog in Oekraïne onderstreept de aard van de risicovolle ongewenste strategische afhankelijkheden. De Russische manipulatie van energiebronnen heeft Europese huishoudens en industrieën aanzienlijke economische schade berokkend. Regeringen van EU-lidstaten werden sinds september 2021 gedwongen om honderden miljarden euro's uit te geven om de klappen van deze energiecrisis op te vangen. Mede als gevolg van die gebeurtenis nemen de EU en haar lidstaten nu proactieve maatregelen om zich te beschermen tegen vergelijkbare situaties in de CRM-toeleveringsketen.

Desalniettemin hebben geopolitieke rivaliteit en een toename in protectionistische maatregelen nu al ernstige gevolgen voor de toeleveringszekerheid van kritieke grondstoffen. In toenemende mate oefenen staten invloed uit door het beheersen van CRM en strategische technologieën, waardoor grondstoffen exporterende staten anderen kunnen dwingen zich te conformeren aan hun geopolitieke belangen. Illustratief voor de recente escalatie en aanzienlijke risico's de komende jaren is Pekings beslissing om vanaf 1 augustus 2023 een vergunning te vereisen voor de uitvoer van gallium en germanium.

De EU reageert snel op de veranderende geopolitieke situatie. In maart 2023 introduceerde de Europese Commissie de voorstellen voor de Europese Wet inzake Kritieke Grondstoffen (CRMA). Al in september 2023 had het Europees Parlement de ontwerpverordening aangenomen met een ruime meerderheid. Tegelijkertijd zet Nederland stappen om zijn eigen Nederlandse Grondstoffenstrategie gepresenteerd in december 2022, uit te voeren. De twee initiatieven hebben een vergelijkbaar doel: het versterken van de Europese binnenlandse productie van CRM en het versterken van toeleveringsketens door internationale samenwerking.

Dit rapport bouwt voort op inzichten uit meer dan 30 interviews met vertegenwoordigers uit de industrie in Nederland. Het draagt op twee manieren bij aan het grondstoffendebat: (1) door actuele informatie te verstrekken over de mogelijkheden van bedrijven die actief zijn in de CRM-sector in Nederland om de leveringszekerheid van CRM te vergroten; (2) door eerste inzichten vanuit de industrie te bieden over de uitdagingen en kansen om hun positie binnen mondiale toeleveringsketens te versterken.

De Nederlandse mijnbouw- en mineralensector bestaat uit twee soorten bedrijven: ze zijn ofwel wereldwijd actief, ofwel voornamelijk op de Nederlandse en Europese markt. Grotere bedrijven opereren wereldwijd en zijn afhankelijk van zowel internationale omstandigheden als nationale wetgeving voor hun dagelijkse activiteiten en strategische beslissingen. Kleinere bedrijven, die de Nederlandse en Europese markt bedienen, zijn juist volledig afhankelijk van nationale en Europese wetgeving om hun concurrentiepositie te behouden.

Bedrijven actief in de delving, verwerking en recycling van mineralen in Nederland bedienen voornamelijk de Nederlandse en Europese markt, hoewel er uitzonderingen zijn. Het winnen van zouten en zanden is de belangrijkste winning in Nederland, terwijl de verwerkingssector wordt gedomineerd door staalfabrieken en in mindere mate mineralen zoals mangaan, silica, bariet en zink. Nederlandse bedrijven zijn wereldwijd actief op het gebied van diepzeemijnbouw. De grondstoffenproductiesector zou ingrijpend kunnen veranderen als de International Seabed Authority besluit exploitatievergunningen te verlenen. Tot slot is er een aanzienlijke inzet voor recycling in Nederland en wordt verwacht dat ook dit deel van de sector snel zal groeien.

Nederland is sterk vertegenwoordigd in de wereldwijde dienstverlening op het gebied van maritieme infrastructuur, waterbeheer, milieubeoordelingen, geotechnische en landmeetkundige diensten. Nederlandse bedrijven assisteren operators op mijnbouw- en verwerkingslocaties in Zuid-Amerika en Afrika.

Tabel 1 en Tabel 2 laten de soorten uitdagingen zien waar bedrijven die actief zijn in Nederland mee worden geconfronteerd. De gegevens zijn verzameld op basis van meer dan 30 interviews met professionals werkzaam in de industrie.

Tabel 1. Belangrijkste obstakels voor het succesvol uitvoeren van activiteiten in Nederland, gerangschikt op basis van de urgentie van het probleem.

Een 'X' betekent dat het bedrijf met een probleem wordt geconfronteerd. Hoe meer bedrijven aangaven met dit probleem te maken hebben, hoe urgenter het wordt beschouwd. Bij elk obstakel wordt aangegeven of dit van toepassing is op bedrijven die voornamelijk actief zijn in Nederland of de EU, of op bedrijven die voornamelijk wereldwijd actief zijn, of op allebei.

Gerangschikt naar urgentie	Wereldwijd actieve bedrijven	Bedrijven die actief zijn in de EU en Nederland
Negatieve publieke opinie	X	X
Onvoldoende dialoog met de overheid en gebrek aan vertrouwen	X	X
Vertraagde actie en versnipperde bevoegdheden	X	
Oneerlijke concurrentie		X
Vermoeiend vergunningenproces		X
Onvoldoende financiële ondersteuning	X	X
Onsamenhangende of ontbrekende wetgeving	X	X
Onvoldoende groene energie-infrastructuur		X
Energiekosten		X
Inefficiënt gebruik van ruimte		X
Ongeschoolde arbeidskrachten	X	X

Tabel 2. Belangrijkste obstakels voor het succesvol uitvoeren van activiteiten in Nederland, gerangschikt op basis van de urgentie van het probleem.

Een 'X' betekent dat het bedrijf met een probleem wordt geconfronteerd. Hoe meer bedrijven aangaven met dit probleem te maken hebben, hoe urgenter het wordt beschouwd. Bij elk obstakel wordt aangegeven of dit van toepassing is op bedrijven die actief zijn in een of meer schakelen in de toeleveringsketen.

Gerangschikt naar urgentie	Winning	Verwerken	Recycling	Dienstverlening	Financiën	Handel	Kennis
Negatieve publieke opinie	X	X	X	X	X	X	X
Onvoldoende dialoog met de overheid en gebrek aan vertrouwen	X	X		X	X	X	X
Vertraagde actie en versnipperde bevoegdheden	X	X	X	X	X		
Oneerlijke concurrentie	X	X	X	X			
Vermoeiend vergunningenproces	X	X	X	X			
Onvoldoende financiële ondersteuning		X	X	X	X		
Onsamenhangende of ontbrekende wetgeving		X	X		X		
Onvoldoende groene energie-infrastructuur	X	X	X				
Energiekosten	X	X					
Inefficiënt gebruik van ruimte		X		X			
Ongeschoolde arbeidskrachten		X		X			

Het behalen van de doelen van de EU CRMA en de *Nederlandse Grondstoffenstrategie* vereist een allesomvattende aanpak om de binnenlandse industrie nieuw leven in te blazen, zodat deze zich kan diversifiëren wat betreft toeleveringsbronnen en de voorzieningszekerheid kan versterken. Het creëren van de nodige voorwaarden voor bedrijven om concurrerend te blijven - oftewel, een gunstige sociaal-politieke, economische en wettelijke omgeving - is een essentiële stap om kansen te bieden voor verdere uitbreiding. Problemen moeten worden aangepakt omtrent publieke opinie, beperkte dialoog met de overheid, gebrek aan een duidelijke visie voor de industrie, trage actie en versnippering van bevoegdheden, vergunningen en bureaucratie. Tegelijkertijd kan Nederland een belangrijke rol spelen in het versterken van de Europese voorzieningszekerheid van mineralen door het stimuleren van kennisuitwisseling en industriële partnerschappen, het verduidelijken van financiële instrumenten en investeren in kennisontwikkeling.

Tabel 3 geeft een overzicht van de uitdagingen en kansen waarmee bedrijven die actief zijn in Nederland worden geconfronteerd bij het voortzetten van hun activiteiten en het zoeken naar uitbreiding.

Tabel 3. Een samenvatting van de uitdagingen en kansen voor bedrijven die actief zijn in de Nederlandse mineralensector en beleidsaanbevelingen.

Probleem	Aanbeveling
Uitdaging: Publieke opinie	Faciliteer een evenwichtigere publieke discussie door feitelijke informatie te verstrekken over mondiale minerale toeleveringsketens, de footprint van de EU en de voordelen en risico's van het (gedeeltelijk) terughalen van toeleveringsketens.
Uitdaging: Dialoog met de overheid	Ga in dialoog met bedrijven om aankomende beleidsvoorstellen te bespreken en om potentiële onbedoelde gevolgen hiervan in kaart te brengen en deze te beperken. Ontwikkel een visie voor de mineralenindustrie en integreer deze in het Nationaal Plan voor het Energiesysteem.
Uitdaging: Snelheid van handelen en toewijzing van bevoegdheden	Concentreer bevoegdheden en verantwoordelijkheden door een 'one-stop shop' voor mineralen te creëren, dat wil zeggen een centraal aanspreekpunt bij één ministerie, om zo de beschikbaarheid van informatie te verbeteren en handelingssnelheid te vergroten.
Uitdaging: Vergunningsprocedures en wetgeving	Verminder bureaucratie bij vergunningverlening om actie te versnellen. Identificeer verouderde of inconsistente regelgeving en werk deze bij in overeenstemming met nieuwe ambities.
Uitdaging: Energiekosten en infrastructuur	Ondersteun de uitbreiding van noodzakelijke infrastructuur, zoals het elektriciteitsnet, om bedrijven in de mineralensector de mogelijkheid te bieden zich te ontwikkelen.
Kans: Verhoog de concurrentiekracht van bedrijven actief op de Nederlandse en Europese markt	Stel structuren op die de uitbreiding van de Nederlandse aanwezigheid in minerale toeleveringsketens stimuleren. Ondersteun een gelijk speelveld door normen vast te stellen op basis waarvan Nederlandse bedrijven kunnen concurreren met niet-EU-actoren.
Kans: Industriële partnerschappen	Verbeter informatie over de markt en faciliteer connecties tussen partijen actief in de sector. Stimuleer samenwerking met internationaal actieve bedrijven die hun hoofdkantoor en/of industriële faciliteiten in Nederland hebben.
Kans: Financiële ondersteuning	Verduidelijk de beschikbaarheid van financieringsinstrumenten en bundel waar mogelijk de inspanningen met andere EU-landen.
Kans: Kennisontwikkeling	Investeer in onderwijs op het gebied van mineralen en metalen om kennis en vaardigheden uit te breiden en de beroepsbevolking te versterken. Investeer in onderzoek en ontwikkeling van innovatieve oplossingen voor CRM-waardeketens in Europa.

1. Introduction

Critical raw materials (CRM) are essential for vital sectors of the European economy and society – energy, transport, digital technologies, health, defence, and space. The demand for CRM is expected to skyrocket in the coming decades, primarily driven by the green energy transition. Globally, the total demand for minerals used in clean energy technologies will double by 2040 under current policy commitments and could quadruple if governments increase their ambitions and pursue net zero policies.[3]

The supply of CRM is concentrated in the hands of a few global players, making consumers like the EU vulnerable to supply shocks. The risk extends further than the raw material – it involves entire supply chains that are outside of European borders. Most nickel is mined and refined in Indonesia and then shipped to China for final processing. Two thirds of global lithium supply comes from South America and goes to China for final processing. More than 70% of cobalt is mined in the Democratic Republic of Congo and transported to China, which refines 70% of all cobalt globally, and is dominant in processing the material into battery packs for electric cars.[4]

The sudden and extreme decoupling from Russia as a consequence of the war in Ukraine made it clear that strategic dependencies are undesirable and brought urgency to the EU and other consumers to act. Russia's weaponization of energy caused significant economic damage for European households and industries. EU governments spent EUR 646 billion since September 2021 to mitigate the consequences of a weaponised dependency in a strategic sector.[5] Learning from this experience, the EU and its member states are trying to prevent a similar situation in the CRM supply chain.

Yet the competition for CRM is already under way for more than two decades. As trade in raw materials is skyrocketing, so are export restrictions. Since 2009,export barriers in raw materials trade have seen a significant increase, led by China and Indonesia having implemented 20% and 15% of export restrictions worldwide, respectively.[6] Controlling a large share of the production of a particular CRM gives states geopolitical clout – they can (threaten to) coerce others to act according to their own geopolitical goals and punish them when they do not.[7] As mineral supply scarcity increases and geopolitical fragmentation intensifies, geopolitically motivated export restrictions are likely to become more commonplace.

3 'The Role of Critical Minerals in Clean Energy: Mineral Requirements for Clean Energy Transitions', IEA, accessed 22 September 2023, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/mineral-requirements-for-clean-energy-transitions.

4 'Cobalt Market Report 2022', Cobalt Institute, 10 May 2023, https://www.cobaltinstitute.org/resource/cobalt-market-report-2022/.

5 Giovanni Sgaravatti et al., 'National Fiscal Policy Responses to the Energy Crisis', Bruegel, 20 September 2023, https://www.bruegel.org/dataset/national-policies-shield-consumers-rising-energy-prices.

6 Przemyslaw Kowalski and Clarisse Legendre, 'Raw Materials Critical for the Green Transition: Production, International Trade and Export Restrictions', OECD Trade Policy Paper (Paris: OECD, April 2023), https://www.oecd-ilibrary.org/trade/raw-materials-critical-for-the-green-transition_c6bb598b-en.

7 Henry Farrell and Abraham L. Newman, 'Weaponized Interdependence: How Global Economic Networks Shape State Coercion', *International Security* 44, no. 1 (1 July 2019): 42–79, https://doi.org/10.1162/isec_a_00351.

As of 2022, the EU and member states are taking active measures to mitigate strategic dependencies. The European Green Deal and European Economic Security Strategy underpin these efforts. In the minerals sector, these measures are primarily codified in the European Critical Raw Materials Act (CRMA) and Net Zero Industry Act (NZIA). On the one hand, the EU aims to strengthen domestic capabilities to produce CRM and advanced technologies. On the other hand, acknowledging the importance of continued international collaboration, the EU has embarked on a journey to strengthen supply chain resilience. European efforts have been mirrored by member states – Germany is currently revisiting its raw materials strategy,[8] Spain introduced a roadmap for the sustainable management of its minerals,[9] and the Netherlands has introduced its *Nationale Grondstoffenstrategie,*[10] and is moving towards the implementation phase.

At the request of the Netherlands Ministry of Foreign Affairs, this report investigates the challenges that Dutch companies face to expand their reach in the CRM sector and contribute to diversified, resilient supply chains. This study aims to inform the implementation of the *Nederlandse Grondstoffenstrategie* and European Critical Raw Materials Act by proposing ways in which the Dutch government can support companies in the diversification of Dutch and European CRM supply chains. This study answers the following question:

What is the potential of internationally active Dutch companies to take on a larger role in global supply chains of critical raw materials?

Based on more than 30 interviews with the industry and supported by desk research, this report provides a state-of-play description of the CRM sector in the Netherlands and an analysis of the challenges faced by Dutch companies to strengthen their position.

The report proceeds as follows. First, it provides a short explanation of the report's methodology. Second, it gives an overview of the vital sectors in which CRMare used, accompanied by the current EU supply base divided per geographical region. Third, it discusses the impact of global strategic competition on supply chain resilience. It shows how governments have already been weaponizing strategic dependencies to further geopolitical goals. Fourth, it offers a description of the main characteristics of the Dutch companies active in the minerals sector and synthesizes the main challenges faced by these companies in sustaining and/or expanding their footprints in global supply chains. Finally, the report provides policy recommendations that could mitigate these challenges and turn them into opportunities for the Netherlands.

8 'Raw Materials – Indispensable for Germany's Industrial Future', BMWK-Federal Ministry for Economic Affairs and Climate, 2023, https://www.bmwk.de/Redaktion/EN/Dossier/raw-materials-and-resources.html.

9 'Roadmap for the Sustainable Management of Mineral Raw Materials – Policies', IEA, 12 December 2023, https://www.iea.org/policies/16806-roadmap-for-the-sustainable-management-of-mineral-raw-materials.

10 'Grondstoffen voor de grote transities'.

2. Methodology

The research combines primary data collection – 30 interviews with industry representatives – desk research, and literature review.

First, an overview of companies active in the metals and minerals sector of the Netherlands was compiled. The companies are either headquartered in the Netherlands or present (with an office and/or operations) in the Netherlands. This includes companies active in mining, processing, end-users and recycling, as well as service providers (equipment, engineering, technology and logistics providers) and knowledge institutions. See Appendix 1.

Second, a selection was made of companies in the various sectors to pursue in-depth interviews. The selection was based on the type of activity of the company to ensure a diversity of perspectives. The focus was placed particularly on companies that supply material flows rather than manufacturers of end products given that the unit of analysis in this research is the material itself rather than the end product. A total of 30 companies were interviewed between May and August of 2023.

Third, the results of the interviews were synthesized with information gathered through desk research with respect to global CRM supply chains, strategic dependencies, and types of governmental interventions implemented by other countries.

Finally, conclusions were drawn regarding the challenges and opportunities of expanding the Dutch footprint in CRM supply chains and ways to add value through possible governmental support for these efforts.

The interviews were conducted based on the following question list:

1. What is your company's main field of activity in the Netherlands & abroad?
2. Which raw materials and minerals do you use?
3. Where do you source the minerals from?
4. What does a typical customer look like? Which industry or end application sector do they come from?
5. Considering Dutch and European ambitions for the energy transition and strategic autonomy, what are your future plans in the field of CRM?
6. Which main obstacles to secure the (raw) materials you require for your business are you currently facing?
7. How are you addressing these obstacles?
8. How could the Dutch government help you overcome these obstacles?

3. Critical raw materials are essential for vital sectors

3.1. Vital sectors: energy, defence, medical equipment, digital technologies

CRM are used throughout sectors of climate change and national security interest for Europe and the Netherlands, including clean energy technology, medical equipment, defence applications and digital technologies (Figure 1).

The energy sector is the main demand driver over the next 20 years. Renewable forms of energy generation such as wind turbines and solar PV panels as well as electric vehicles require significantly more CRM than their fossil fuel-based counterparts. Moreover, extensive energy storage in the form of large-scale batteries is necessary for renewables given their intermittent nature. For instance, to limit the increase in global temperatures to 1.5 degrees, the world will require 42 times more lithium, 21 times more cobalt and 19 times more nickel in 2040 compared to 2020.[11] Even under the stated policies scenario – which involves a less ambitious plan in 2050 – demand for these minerals will grow significantly.

Depending on the application, the EU is vulnerable at different stages of the mineral supply chain. The 34 minerals on the EU's list are considered at either the extraction or processing stage. Figure 2 illustrates the various stages of a supply chain, actors involved and average time to set up operations. The long time and massive investments required to expand the upstream and midstream capabilities are significant bottlenecks to ramping up CRM supply in the short term.

Facilities like specialized storage and transport are essential to the resilience of a supply chain. Even if the EU built conversion or processing facilities, specialised storage is necessary to warehouse chemical compounds. Without this, companies are forced to react to market dynamics and thus conduct business 'just in time' rather than with a 'just in case' approach. Through a 'just in time' inventory approach, companies aim to fulfil demand based on expected sales and minimize waste.[12] A 'just in case' approach implies larger stock levels than necessary in the short term, thus allowing for rapid rebound in case of a shock in global supply chains.[13]

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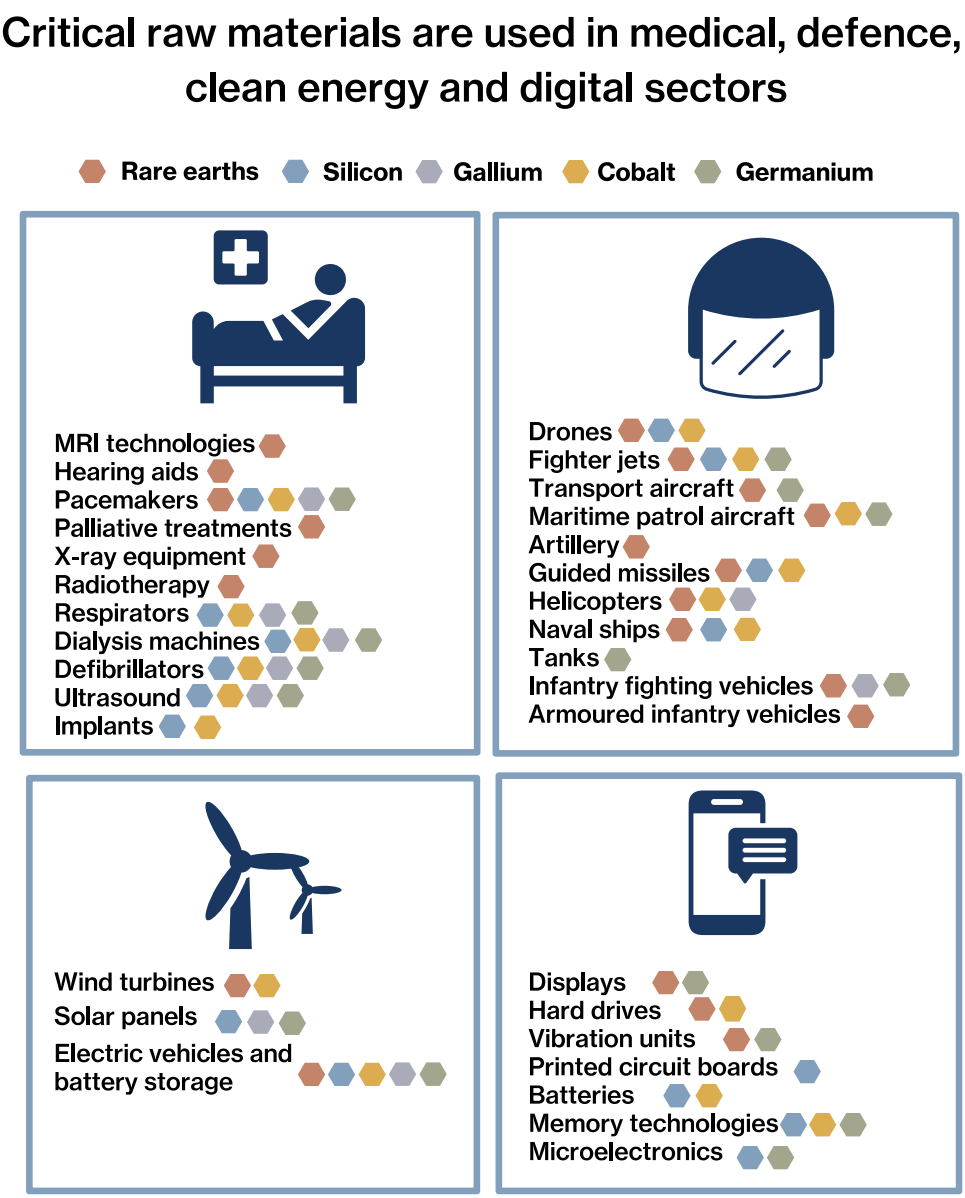
11 'Growth in Demand for Selected Battery-Related Minerals from Clean Energy Technologies in 2040 Relative to 2020 Levels by Scenario', IEA, 5 May 2021, https://www.iea.org/data-and-statistics/charts/growth-in-demand-for-selected-battery-related-minerals-from-clean-energy-technologies-in-2040-relative-to-2020-levels-by-scenario.

12 Abby Jenkins, 'Just-in-Time vs Just-in-Case: Choosing the Right Strategy', Oracle NetSuite, 3 May 2021, https://www.netsuite.com/portal/resource/articles/inventory-management/just-in-time-vs-just-in-case.shtml.

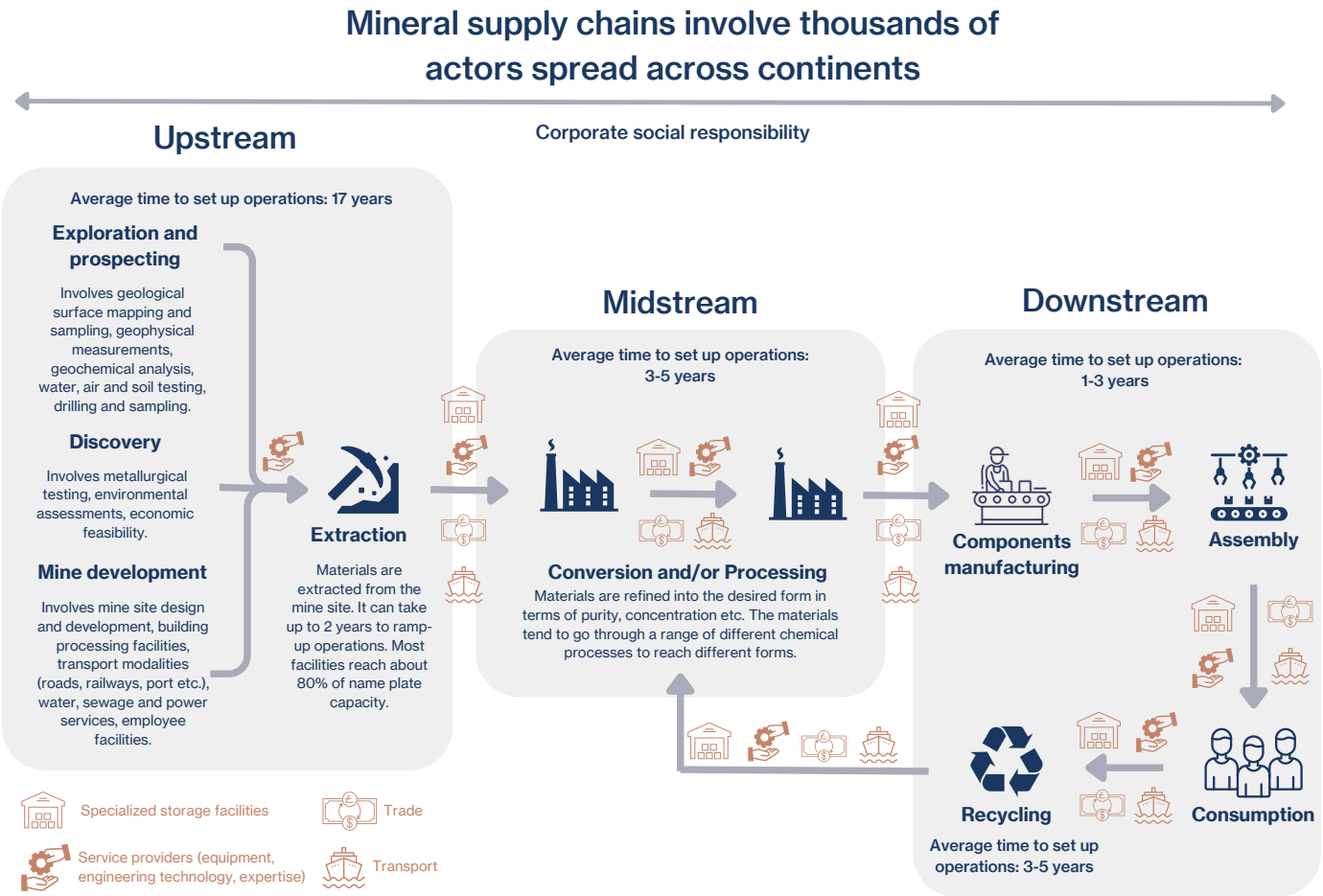
13 Jenkins.

Figure 1. Critical raw materials use in vital sectors. Figure adapted from Teer, Bertolini and Girardi, 'Great power competition and social stability in the Netherlands, 2023.[14]



14 Joris Teer, Mattia Bertolini, and Benedetta Girardi, 'Great Power Competition and Social Stability in the Netherlands: The Risks of Russian Gas, Chinese Materials and Taiwanese Chips to Vital Sectors' (The Hague Centre for Strategic Studies, August 2023), https://hcss.nl/wp-content/uploads/2023/08/Great-power-competition-and-social-stability-in-the-Netherlands-HCSS-2023-V1-1.pdf.

Figure 2. Mineral supply chains.



Countries all over the world have defined various lists of minerals that are essential for their economies and designed strategies to increase resilience. The EU Critical Raw Materials list identifies 34 minerals at the extraction or processing phase to be critical. A material is added to the CRM list once it fulfils criteria of high economic importance and supply risk.[15] The EU also identified strategic raw materials in a specific grade that is necessary for green and digital technologies and for which a high increase in demand is expected, but may not necessarily be considered critical materials (e.g., battery grade lithium, copper).[16] The EU Critical Raw Materials Act (CRMA) sets clear targets to strengthen the resilience of CRM supply chains.[17] The European Parliament is already trying to further increase these targets:[18]

15 'Critical Raw Materials', European Commission, accessed 22 September 2023, https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en.

16 'Proposal for a Regulation of the European Parliament and of the Council Establishing a Framework for Ensuring a Secure and Sustainable Supply of Critical Raw Materials and Amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020', Pub. L. No. COM/2023/160 final (2023), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0160&qid=1695373338533.

17 'European Critical Raw Materials Act'.

18 European Parliament, 'Critical Raw Materials: Securing the EU's Supply and Sovereignty', 14 September 2023, https://www.europarl.europa.eu/news/en/press-room/20230911IPR04927/critical-raw-materials-se-cur¬ing-the-eu-s-supply-and-sovereignty.

- 10% of the minerals demanded in 2030 should be extracted within EU borders,
- 40% of this demand should be processed domestically,
- 15% should be recycled,[19]
- Not more than 65% of the EU's supply should come from one single country.

The US Geological Survey (USGS) has released a list of 50 minerals that are critical for national security.[20] The US government is investing in reshoring mineral supply chains of national interest for energy, defence, transport and digital technologies under the Inflation Reduction Act, the Defence Production Act, and the CHIPS and Science Act.. Canada's list contains a set of 31 minerals.[21] The Canadian Critical Minerals Strategy aims to position Canada as a key supplier of sustainably sourced raw materials.[22]

European countries have some capabilities in the extraction and processing of critical minerals, but this will have to significantly expand in the coming years in order to fulfil the growing demand and the ambitions of the CRMA. Between 2016 and 2020, the EU was able to extract and process some of the minerals it consumed (Figure 3). For instance, silica sand and tungsten, as well as strategic materials like nickel and copper were extracted in EU countries. Moreover, a large part of the consumed cobalt, scandium, hafnium and silicon metal between 2016-2020 was processed by EU countries (Figure 3). As the energy transition will lead to an exponential increase in the EU's demand, capabilities for extraction, processing and recycling will have to grow proportionately to ensure a secure supply.

19 'European Critical Raw Materials Act', European Commission, 16 March 2023, https://single-market-economy.ec.europa.eu/publications/european-critical-raw-materials-act_en.

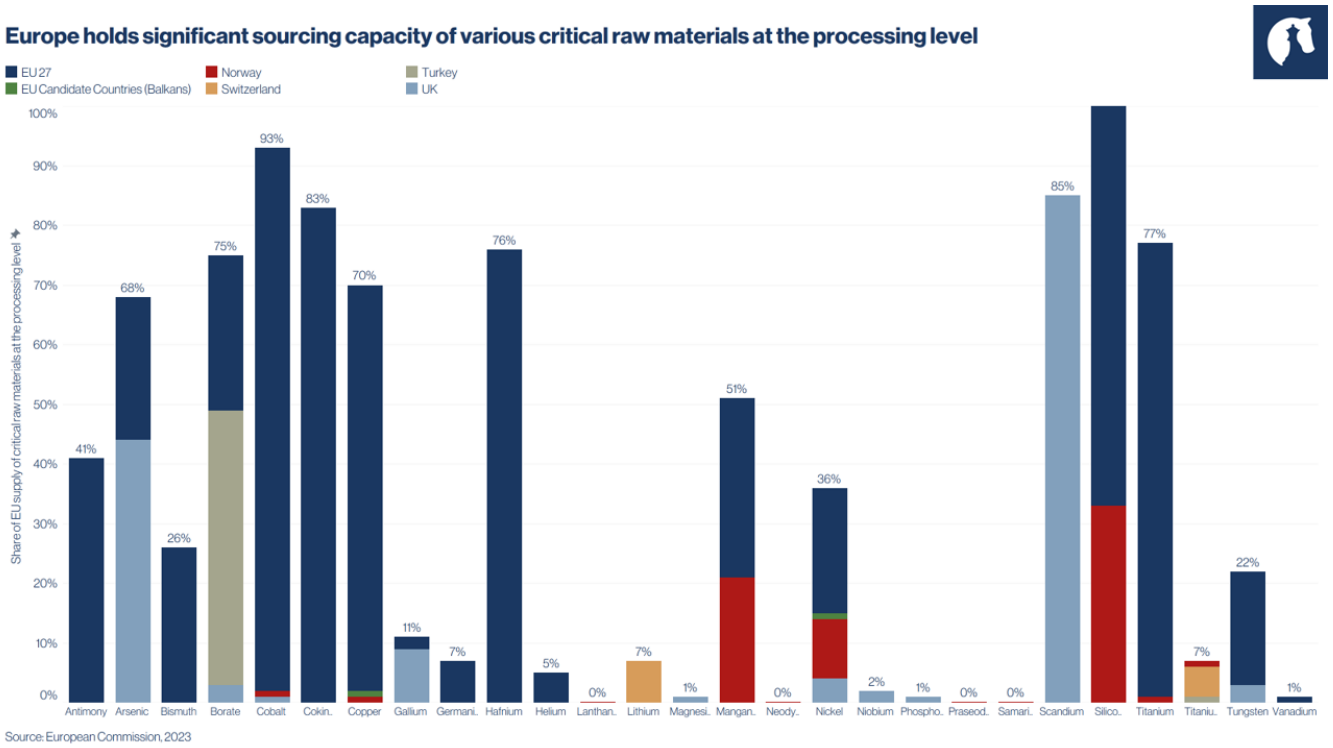
20 Jason Burton, 'U.S. Geological Survey Releases 2022 List of Critical Minerals', usgs.gov, 22 February 2022, https://www.usgs.gov/news/national-news-release/us-geological-survey-releases-2022-list-critical-minerals.

21 'Critical Minerals List 2021', IEA, 27 October 2022, https://www.iea.org/policies/15698-critical-minerals-list-2021.

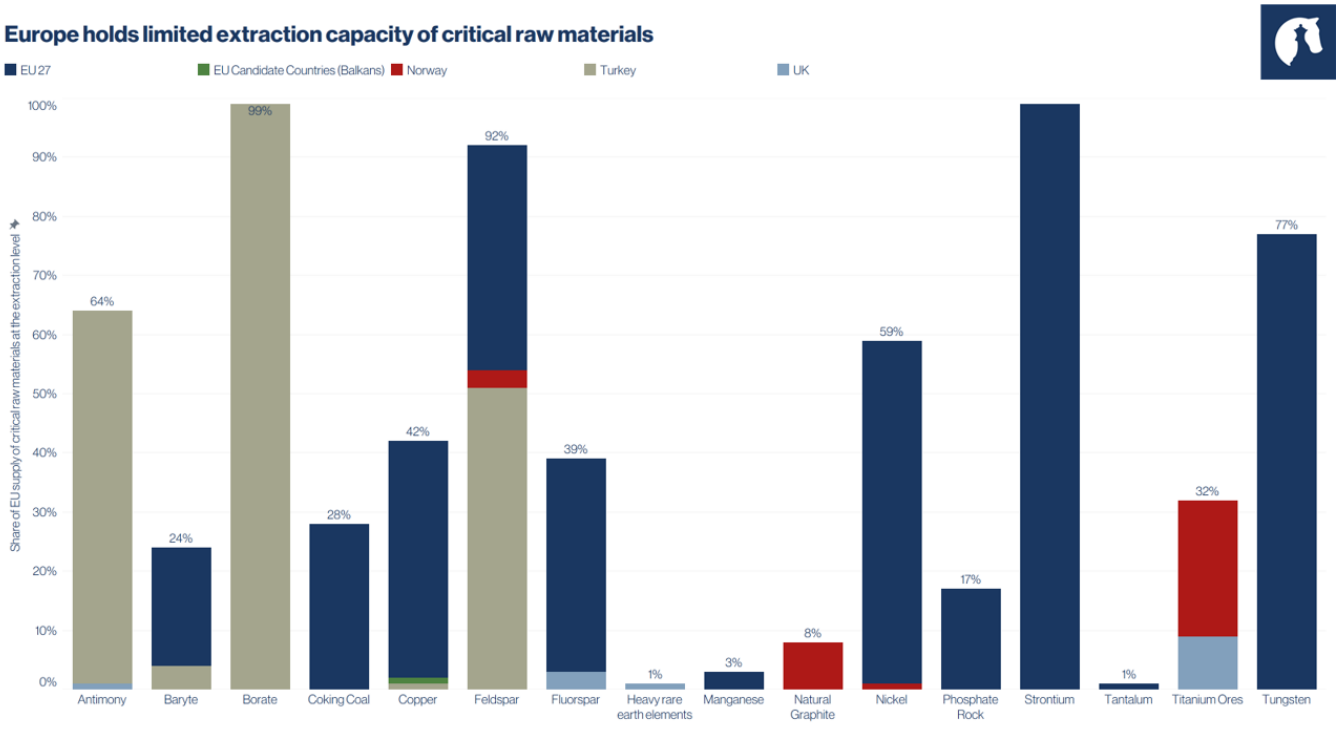
22 Government of Canada, 'The Canadian Critical Minerals Strategy', 9 December 2022, https://www.canada.ca/en/campaign/critical-minerals-in-canada/canadian-critical-minerals-strategy.html.

Figure 3. The ratio of EU CRM supply extracted and processed domestically between 2016-2020. Source: European Commission, 2023.

More than 85% of the EU's supply of silicon metal, cobalt and scandium between 2016 and 2020 was processed domestically. Yet demand will grow exponentially in the coming decade, requiring an upscale of capabilities.



Source: European Commission, 2023



Source: European Commission, 2023

3.2. **Vital partners: regional distribution of EU mineral supply**

The European Union is import dependent on various countries for sourcing its minerals, both at extraction and processing stage. This section outlines the regional diversity of EU mineral supply between 2016-2020. The focus is placed on EU critical and strategic raw materials. Such an outline on the one hand provides an overview of the concentration of supply in various geographies. On the other hand, it offers an overview of opportunities to expand the relationships with those countries that have the potential to play a large(r) role in the EU's supply chains.

It is important to interpret these numbers correctly. First, the data shows EU supply between 2016-2020, meaning that ratios between regions can change with an increase in demand in minerals. Second, a lot of minerals flow into the EU in the form of half fabricates and end products, so looking at mineral supply offers an important perspective but not the full picture. Finally, geographic distribution does not equate a diversity of suppliers. As explained in section 4.3, China is a major investor in global mineral supply chains, meaning that mines in African countries and processing plants in the Indo-Pacific are often partly or fully owned by Chinese companies.

China is the main supplier of both CRM (Figure 4) and clean energy technologies to the EU. China has developed a domestic ecosystem in which the manufacturing of end applications like batteries and solar PV panels generates sufficient demand for processed CRM, creating economies of scale which allow for the production of these material at an affordable price. Chinese investments in renewables and electric vehicles have been monumental in driving down global costs, but they also consolidated its position as a quasi-monopolist in most minerals and clean tech markets. China supplies 98% of EU imports of rare earths and 98% of rare earth permanent magnets.[23] Six of the ten largest EV battery manufacturers are Chinese. The largest one, CATL, controls 35% of the global market.[24]

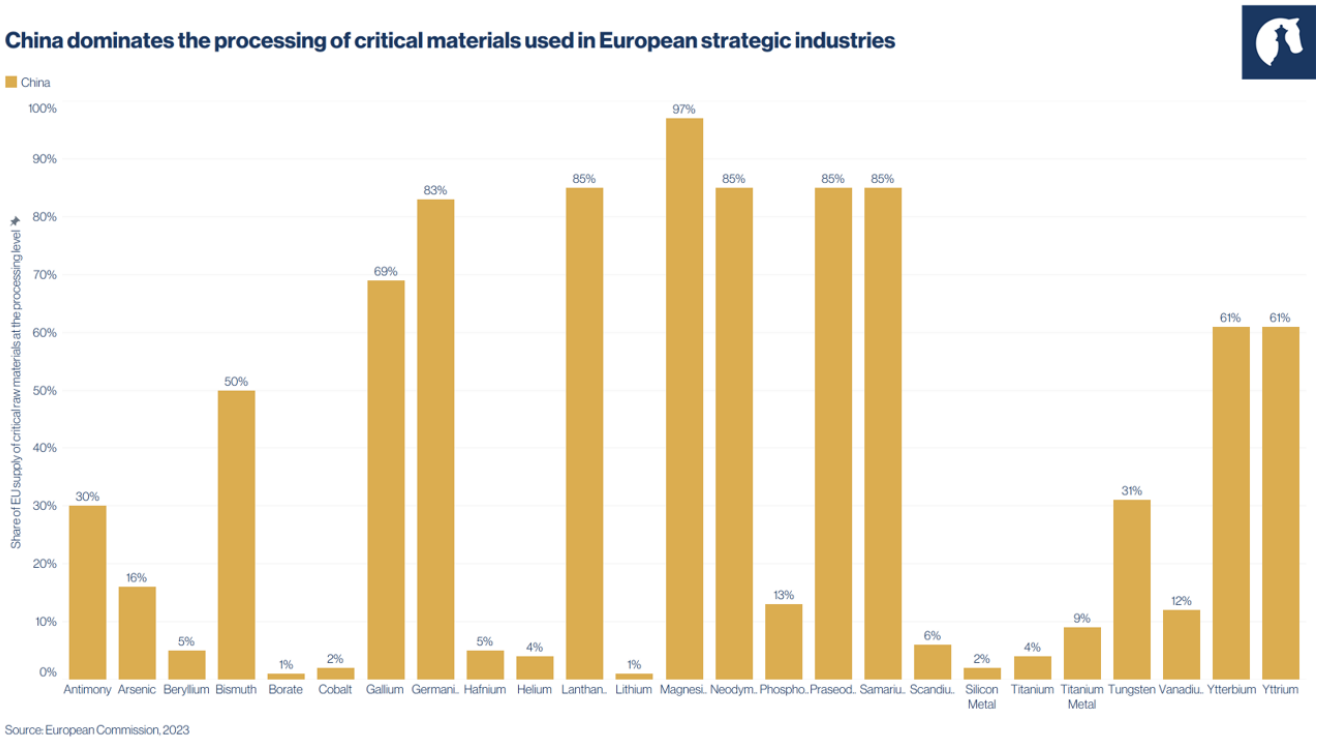
In the Indo-Pacific (excl. China), Japan is a major EU supplier of light and heavy rare earth elements at the extraction level, while Malaysia is a key exporter of processed rare earths (Figure 5). Rare earth elements are used across vital sectors (see section 3.1).

23 Roland Gauß et al., 'Rare Earth Magnets and Motors: A European Call for Action' (Berlin: Rare Earth Magnets and Motors Cluster of the European Raw Materials Alliance, 2021).

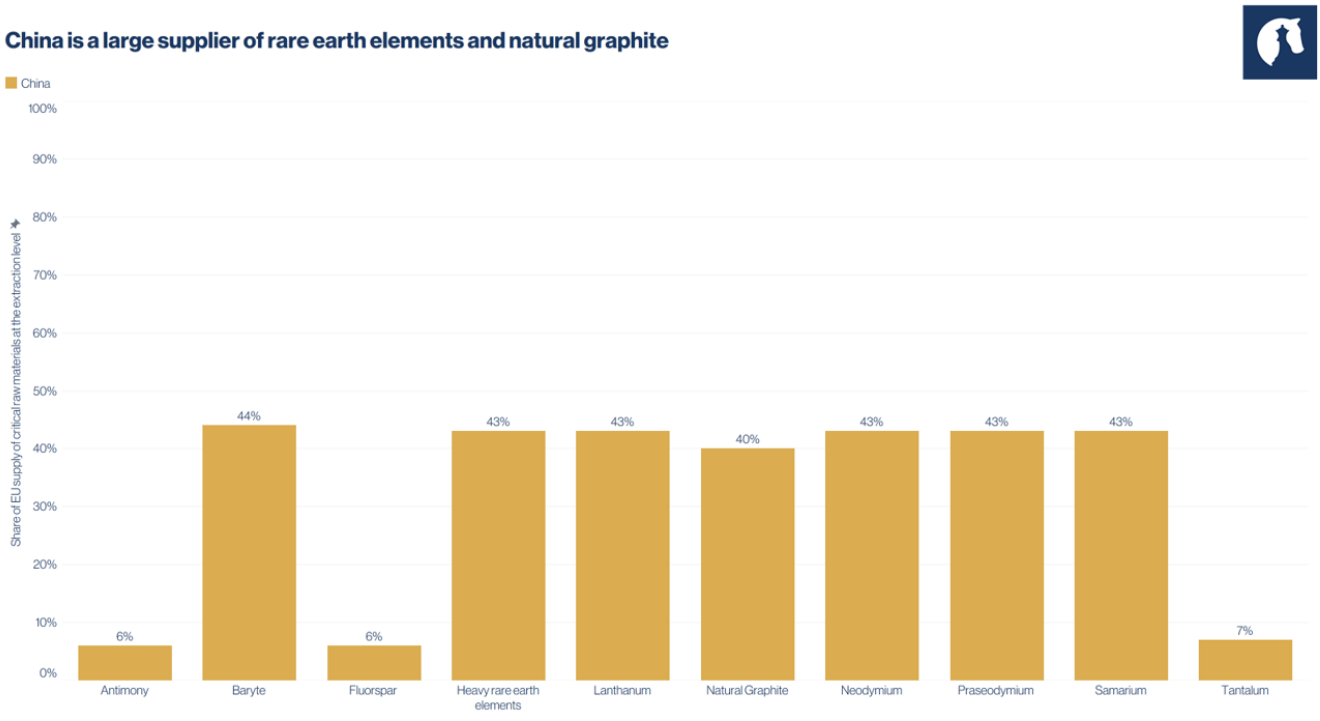
24 Bruno Venditti, 'The Top 10 EV Battery Manufacturers in 2022', Visual Capitalist, 5 October 2022, https://www.visualcapitalist.com/the-top-10-ev-battery-manufacturers-in-2022/.

Figure 4. The ratio of EU CRM supply provided by China between 2016-2020. Source: European Commission, 2023.

China is not only the EU's main supplier of raw and processed critical raw materials. A significant amount of Chinese minerals are used by its considerable domestic manufacturing sector for energy, transport and digital technologies and bought as end products by EU companies.



Source: European Commission, 2023



Source: European Commission, 2023

Figure 5. The ratio of EU CRM supply provided by Indo-Pacific countries (excl. China) between 2016-2020. Source: European Commission, 2023.

Between 2016-2020 Japan supplied 55% of the EU's raw rare earths, while Malaysia was a key supplier of processed light rare earth elements

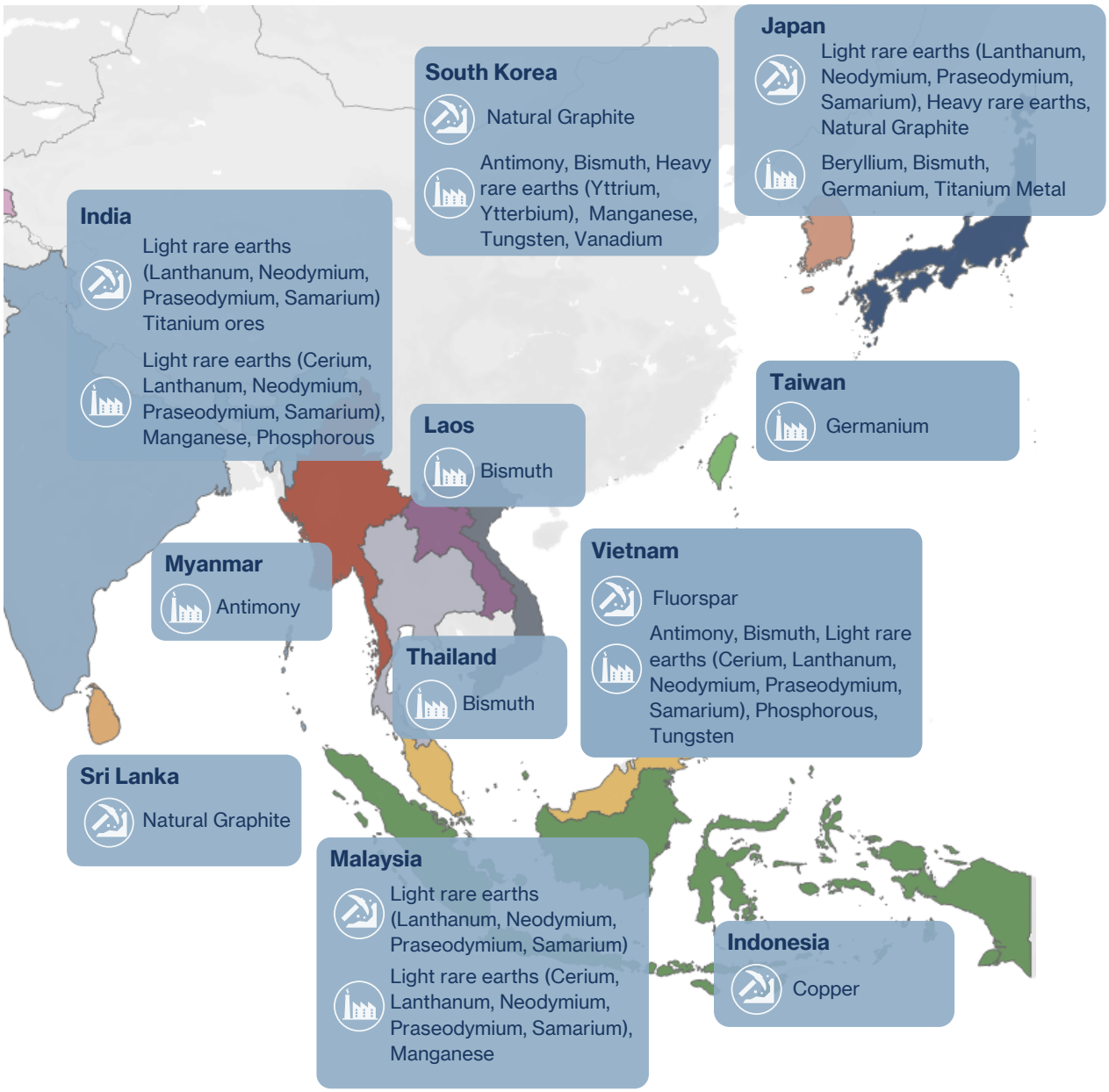
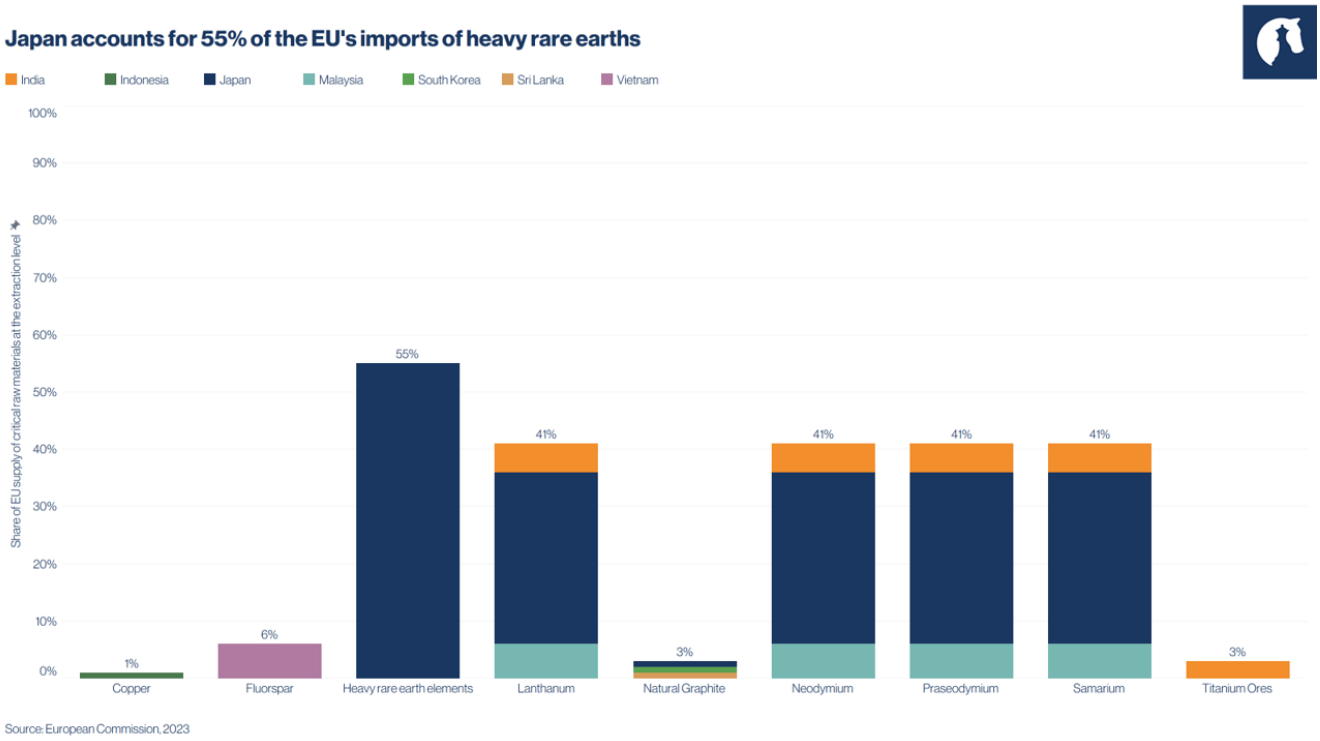
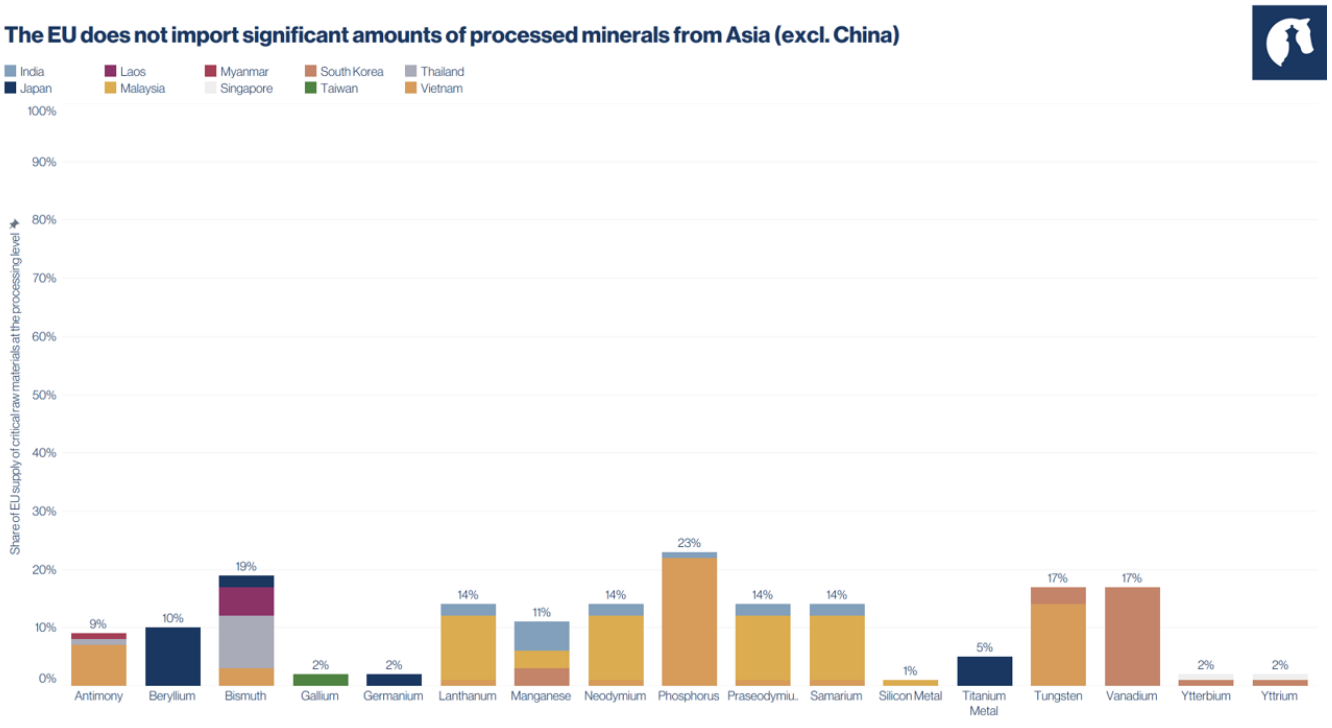


Figure 5. The ratio of EU CRM supply provided by Indo-Pacific countries (excl. China) between 2016-2020. Source: European Commission, 2023. (continued)



Source: European Commission, 2023



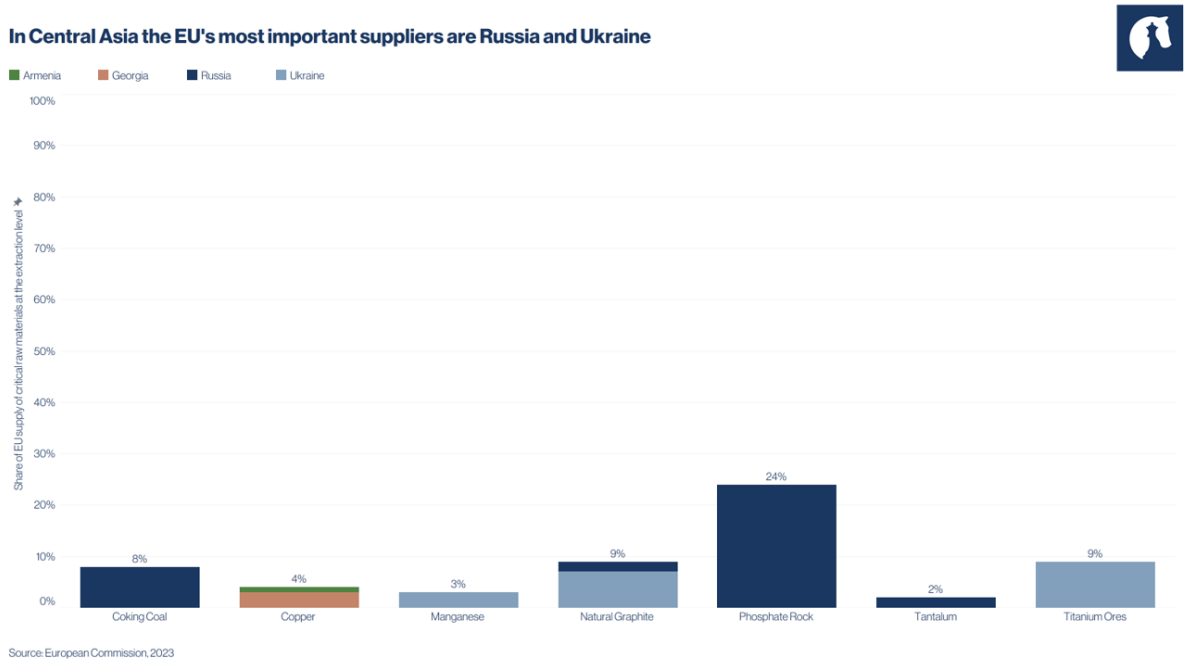
Source: European Commission, 2023

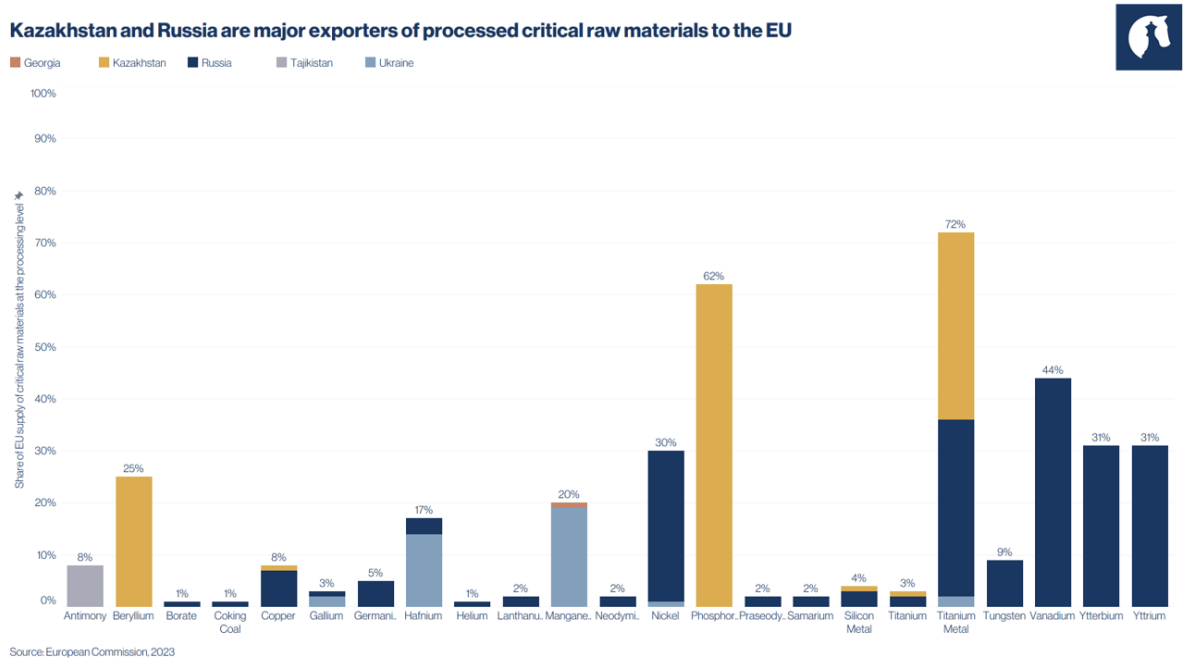
Figure 6. The ratio of EU CRM supply provided by Central Asian countries between 2016-2020. Source: European Commission, 2023.
Note: Platinum group metals were not included in the original dataset, but Russia is a major EU supplier of these minerals.

Russia and Kazakhstan supply processed phosphorous, titanium metal and vanadium to the EU. Ukraine is an EU supplier for small amounts of raw and processed materials

Figure 6. The ratio of EU CRM supply provided by Central Asian countries between 2016-2020. Source: European Commission, 2023. (continued)

Note: Platinum group metals were not included in the original dataset, but Russia is a major EU supplier of these minerals.





Russia and Ukraine are both suppliers to the EU of raw materials, while Russia and Kazakhstan are the largest processing hubs in the region (Figure 6). Between 2016-2020, 62% of the EU's phosphorous supply, used for fertilizers and the chemical industry, was sourced from Kazakhstan. Meanwhile, in the same time period 72% of titanium metal used in Europe's aerospace sector and for medical equipment came from Kazakhstan, Russia and Ukraine.

Figure 7. The ratio of EU CRM supply provided by African countries between 2016-2020. Source: European Commission, 2023.

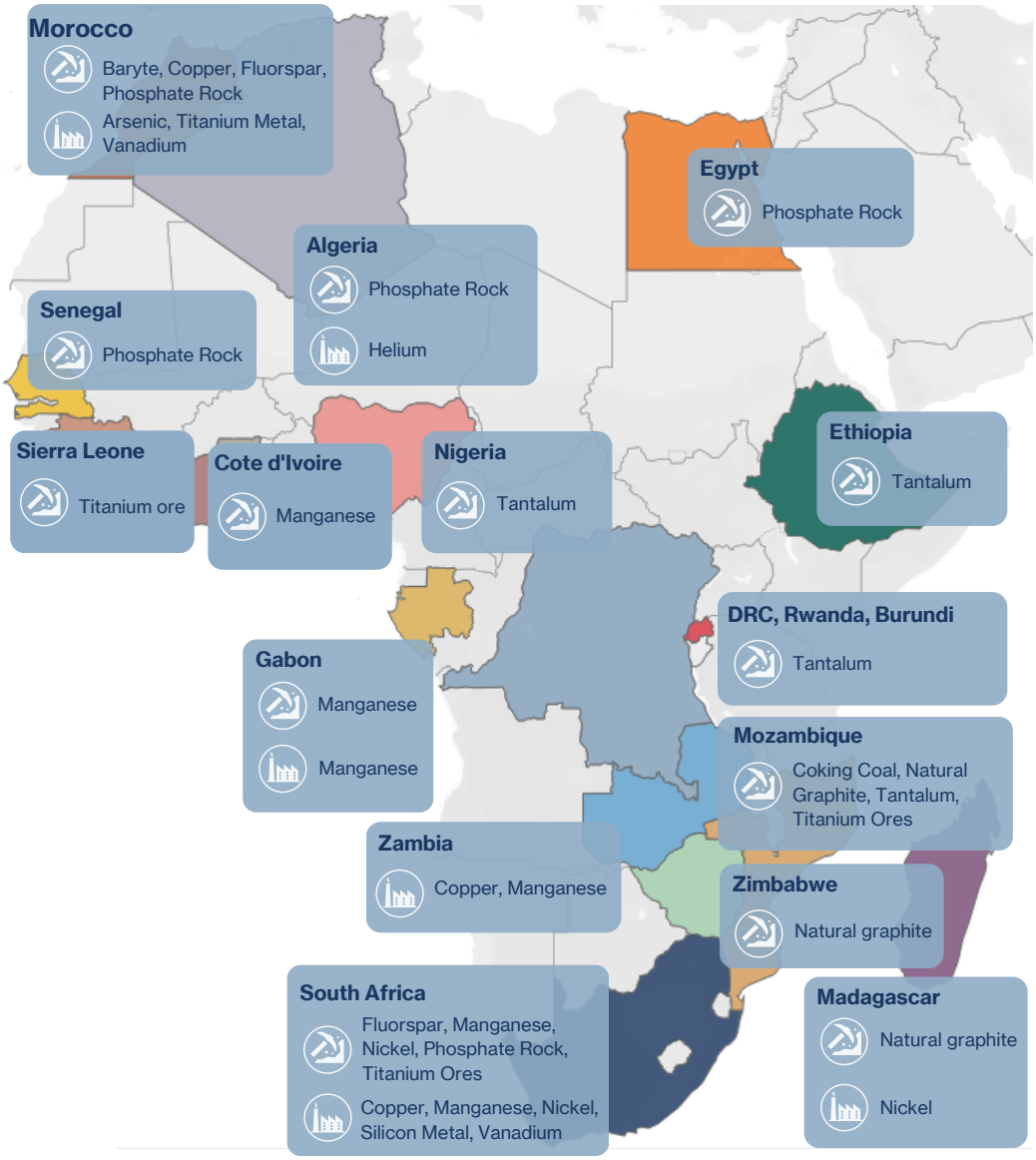
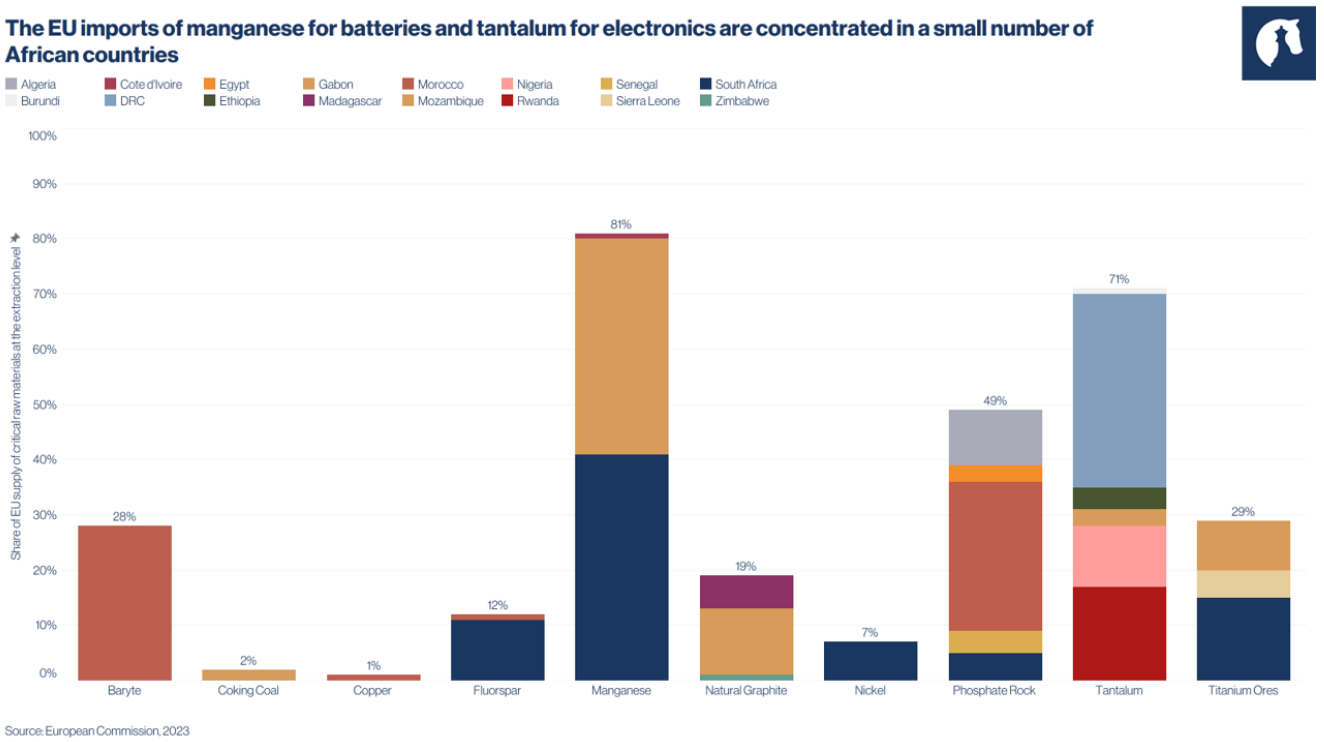
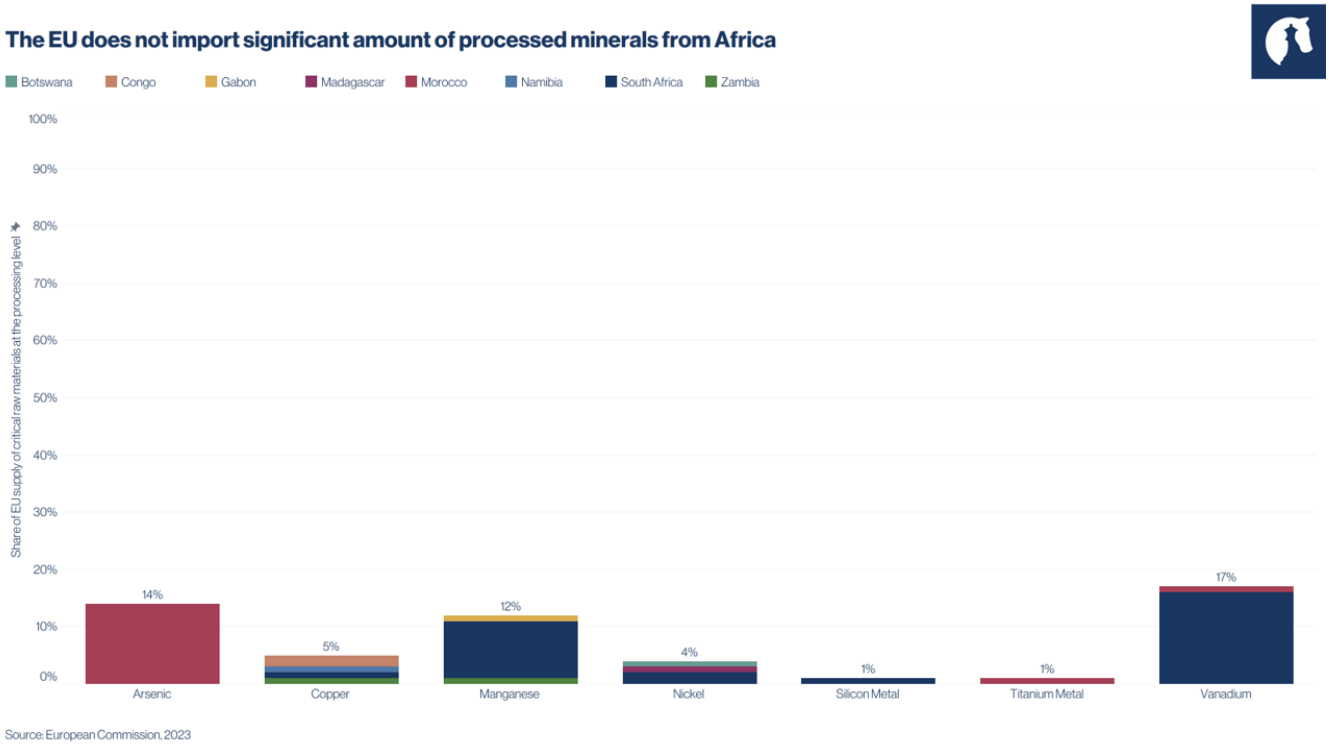


Figure 7. The ratio of EU CRM supply provided by African countries between 2016-2020. Source: European Commission, 2023. (continued)





African countries are important suppliers of raw materials to the EU, but play a marginal role in exporting processed materials (Figure 7). The Netherlands' Africa Strategy 2023-2032 aims to support countries to develop more processing capabilities so that African states gain a more equitable share of value chains and are empowered to contribute to the diversification of global capabilities.[25] Between 2016-2020, almost 80% of EU manganese came from Gabon and South Africa, respectively. In the EU, manganese is used in construction and transport industries, and it is a key component of lithium-ion batteries.[26] Rwanda, Nigeria, and the Democratic Republic of Congo are the largest African suppliers of tantalum, used in electronics. Morocco is the largest EU supplier of sedimentary phosphoric rock, an important feedstock to produce (animal) food but which would require processing into a different purity of phosphoric acid in order to be used in the energy transition.[27]

The largest US export of minerals to the EU was beryllium between 2016-2020, which is used in manufacturing industrial components, aerospace and defence, automotives and electronics (Figure 8).[28] Moreover, the US has extraction capabilities for light and heavy rare earths and processing for the latter. Nickel – a strategic raw material for the EU due to its importance in lithium-ion batteries – is supplied by Canada at both extraction and processing levels.

Finally, a third of copper used in the EU between 2016-2020 was sourced from South America (Figure 9). Copper is a key mineral for electric transmission and therefore essential in the renewable electricity system. Chile alone provided almost 80% of the EU's processed lithium and Brazil 82% of the EU's niobium, which is used for high-strength steel alloys in pipelines and transport infrastructure and the construction of structural application.[29]

25 'Africa Strategy: Government Presents Integrated Approach to Cooperation with Africa', Government of the Netherlands (Ministerie van Algemene Zaken, 31 May 2023), https://www.government.nl/latest/news/2023/05/31/dutch-strategy-on-africa-2023-2032.

26 Milan Grohol and Constanze Veeh, 'Study on the Critical Raw Materials for the EU 2023' (European Commission, 6 May 2023), https://data.europa.eu/doi/10.2873/725585.

27 Marjolein de Ridder et al., 'Risks and Opportunities in the Global Phosphate Rock Market: Robust Strategies in Times of Uncertainty' (The Hague: The Hague Centre for Strategic Studies, 17 December 2012), https://hcss.nl/wp-content/uploads/2012/12/Risks_and_Opportunities_in_the_Global_Phosphate_Rock_Market.pdf.

28 Grohol and Veeh, 'Study on the Critical Raw Materials for the EU 2023'.

29 'Niobium Deposits in the United States', usgs.gov, 4 February 2021, https://www.usgs.gov/data/niobium-deposits-united-states#:~:text=Niobium%20is%20necessary%20for%20strategic,Schulz%20and%20others%2C%202017.

Figure 8. The ratio of EU CRM supply provided by North American countries between 2016-2020. Source: European Commission, 2023.

The United States supplies 60% of processed beryllium to the EU and 4% of yttrium and ytterbium (heavy rare earths).
Canada provides raw and processed nickel.

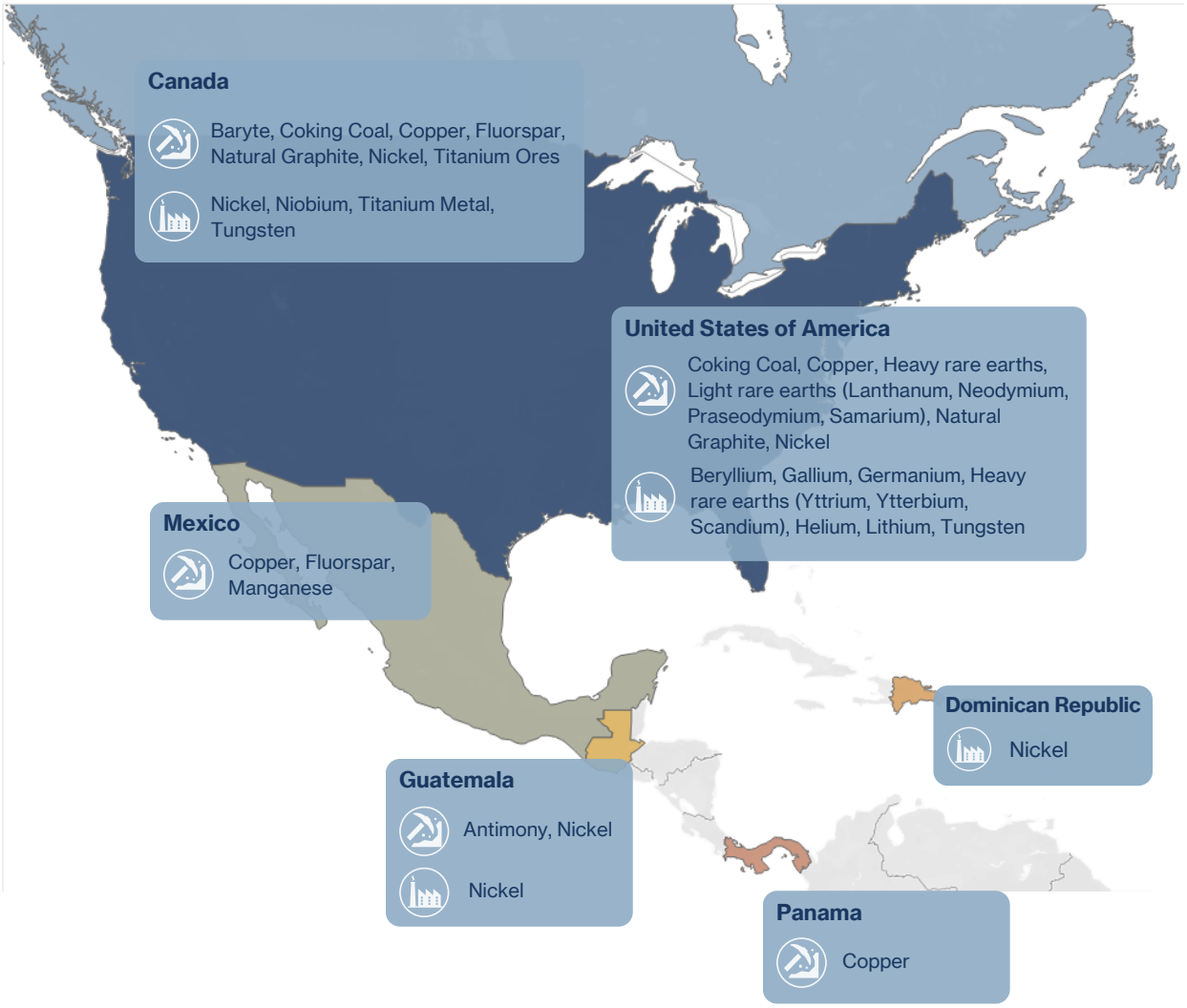
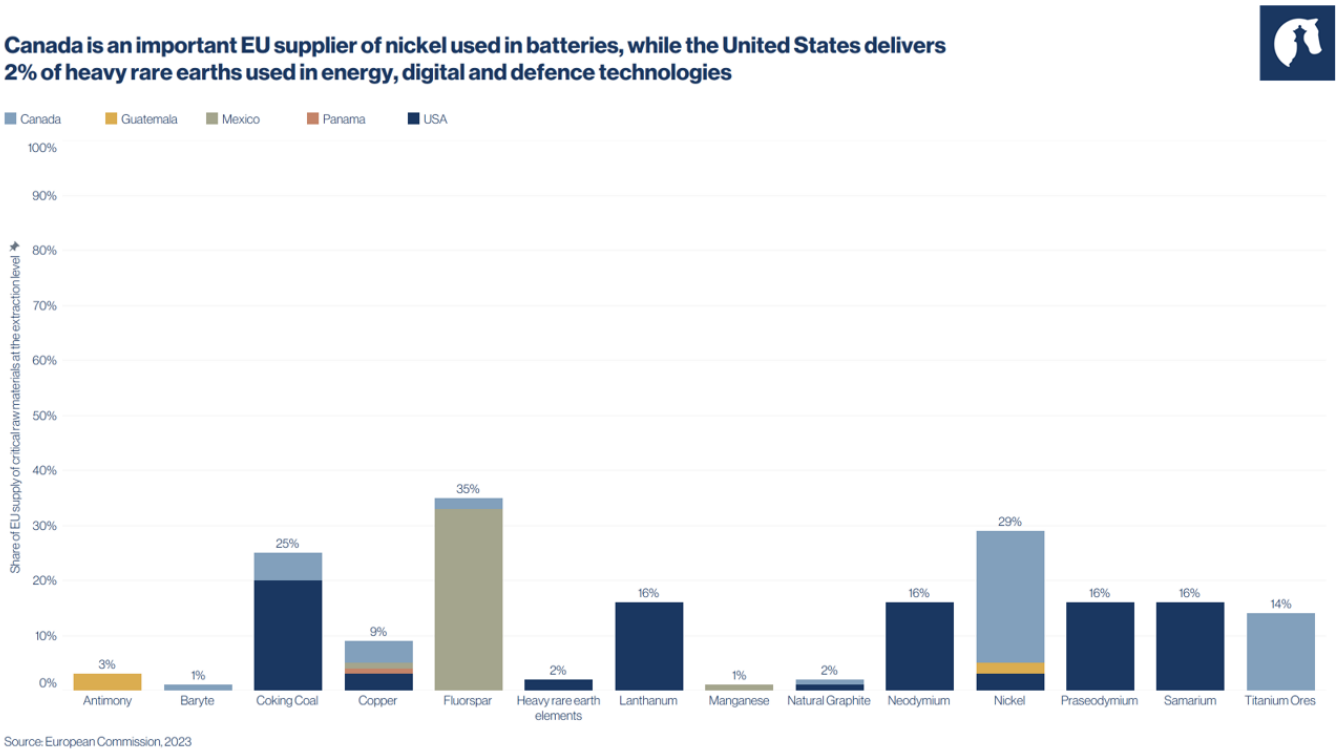
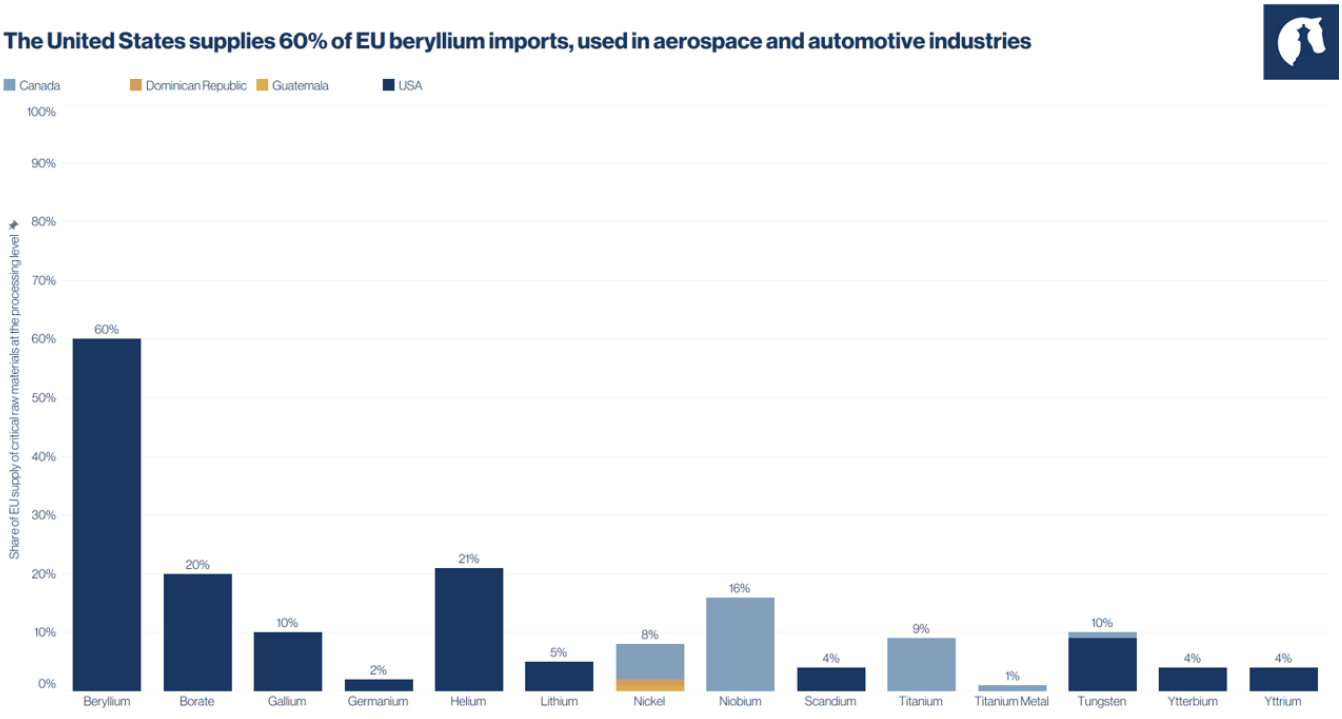


Figure 8. The ratio of EU CRM supply provided by North American countries between 2016-2020. Source: European Commission, 2023. (continued)



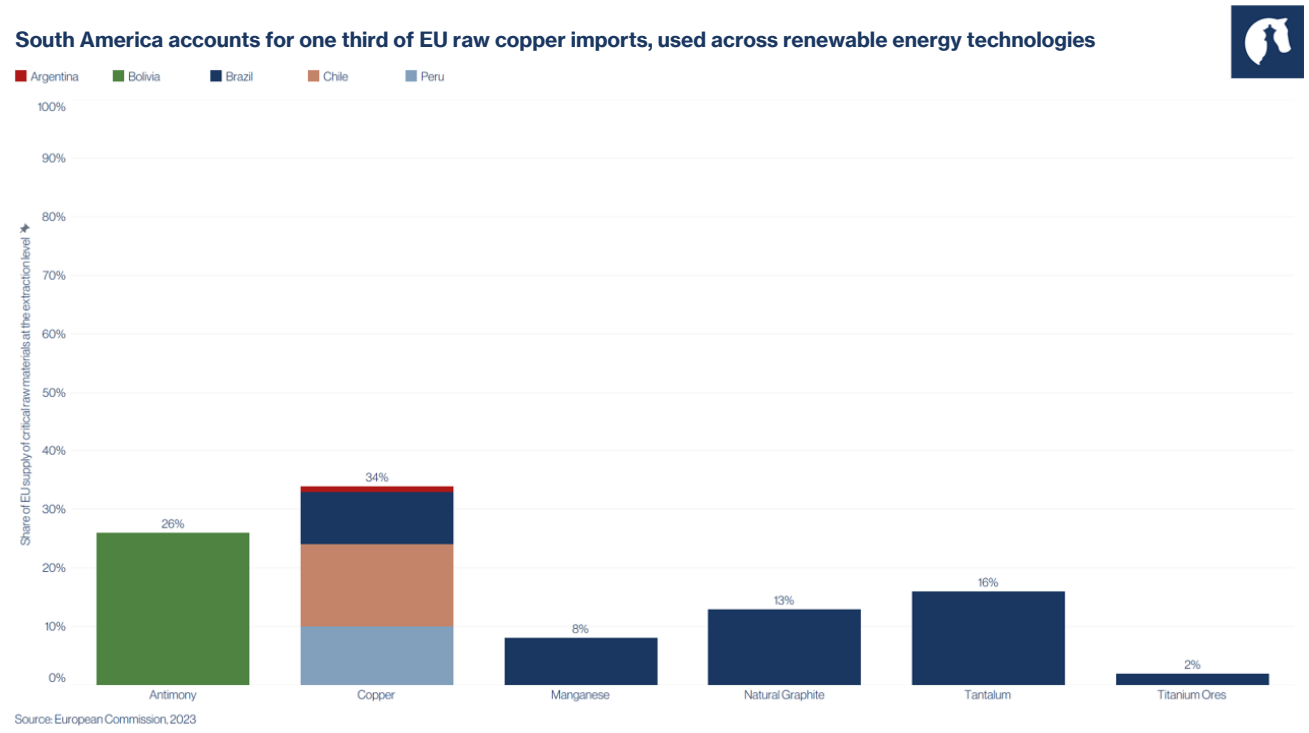
Source: European Commission, 2023

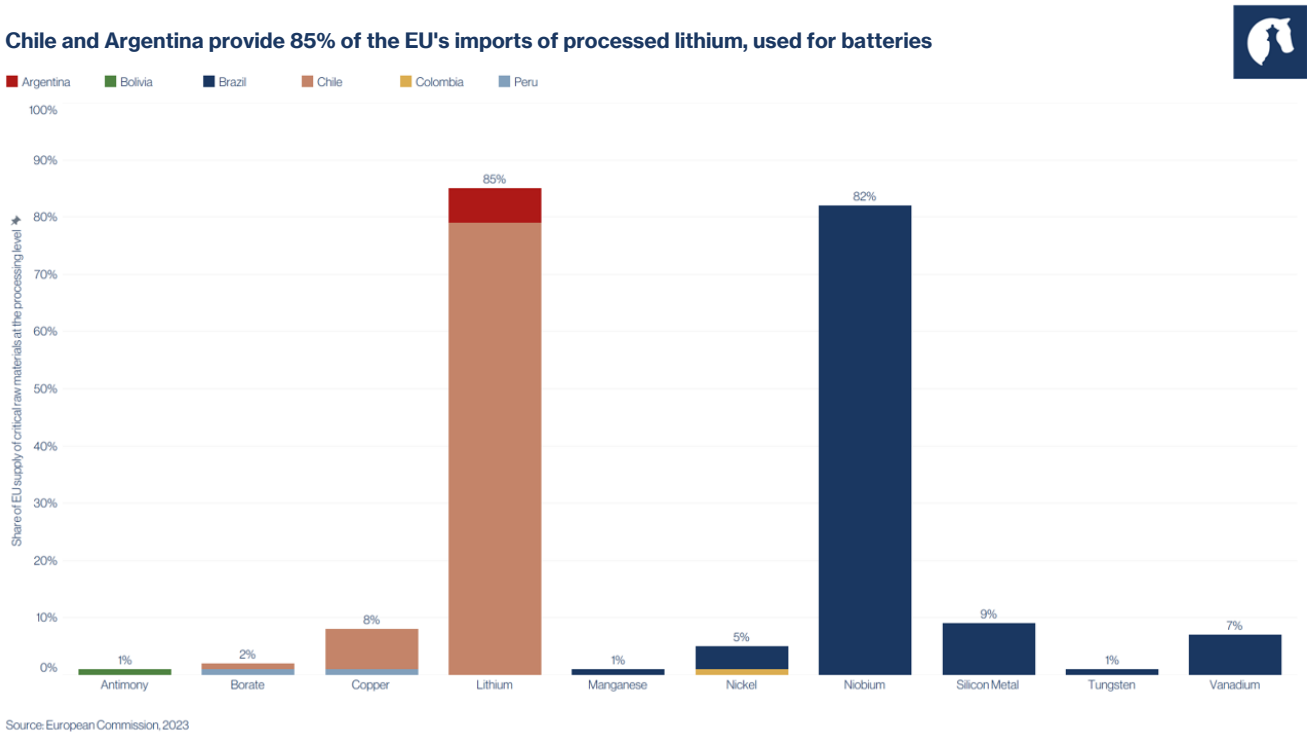


Source: European Commission, 2023

Figure 9. The ratio of EU CRM supply provided by South American countries between 2016-2020. Source: European Commission, 2023.

Figure 9. The ratio of EU CRM supply provided by South American countries between 2016-2020. Source: European Commission, 2023. (continued)





4. Critical raw materials in an age of strategic rivalry

Countries facing insecurity of supply in the CRM sector are particularly vulnerable as strategic competition has come to dominate international trade and inter-state relations. The era of geostrategic rivalry between the US and China, the fragmentation into geopolitical blocs along the lines of this rivalry, and the push for decoupling from unreliable suppliers since the onset of the war in Ukraine have turned CRM into instruments of geopolitical power play. This section offers a snapshot into the geopolitical context surrounding critical minerals as of 2023.

4.1. Strategic dependencies at risk of weaponization

The rapidly growing demand for minerals coincides with an era of growing geopolitical tensions and strategic rivalry, making Europe more vulnerable to the weaponization of mineral supply. As seen in the previous sections, the EU supplier base is relatively concentrated in just a few countries.

The US-China rivalry permeates through geopolitical, military, economic, socio-political and technological sectors. Ever since President Donald Trump imposed the first large-scale set of tariffs on Chinese imports in 2018, tensions between the US and China grew exponentially.[30] Control over clean energy technology is one of the proxies of this rivalry. This was an explicit part of the *Made in China 2025* strategy, which set the target for Chinese companies to expand their market share in high tech sectors, including clean tech.[31] During a speech for China's Central Financial and Economic Affairs Commission in 2020, Xi Jinping explicitly communicated ambitions to increase China's footprint in global value chains of transport, new energy, and communication, "forming a powerful countermeasure and deterrent capability against foreigners who would artificially cut off supply [to China]".[32]

30 Chad P. Bown and Melina Kolb, 'Trump's Trade War Timeline: An Up-to-Date Guide', PIIE, 1 June 2023, https://www.piie.com/blogs/trade-and-investment-policy-watch/trumps-trade-war-timeline-date-guide.

31 Jost Wübbeke et al., 'Made in China 2025: The Making of a High-Tech Superpower and Consequences for Industrial Countries' (Mercator Institute for China Studies, December 2016), https://merics.org/sites/default/files/2020-04/Made%20in%20China%202025.pdf.

32 "We must sustain and enhance our superiority across the entire production chain in sectors such as high-speed rail, electric power equipment, new energy, and communications equipment, and improve industrial quality; and we must tighten international production chains' dependence on China, forming a powerful countermeasure and deterrent capability against foreigners who would artificially cut off supply [to China]" Xi Jinping, 'Major Issues Concerning China's Strategies for Mid-to-Long-Term Economic and Social Development', CSIS, 31 October 2020, https://interpret.csis.org/translations/major-issues-concerning-chinas-strategies-for-mid-to-long-term-economic-and-social-development/.

By 2022 it had become clear that strategic dependencies are not only problematic in times of large-scale logistics crises like a pandemic or extreme weather events but can be weaponized to further geopolitical interests. International trade and industrial production plummeted during the first part of the Covid-19 lockdowns in 2020.[33] Despite a rapid recovery one year later, the pressure put on global supply chains showed the importance of achieving greater resilience in the supply of strategic goods. The world has been affected by record high food prices, inflation, and a global chip shortage. Notwithstanding, it was Russia's weaponization of oil and natural gas supplies to Europe that demonstrated the negative impacts of strategic dependencies on rivals for vital resources. The financial consequences of decoupling from Russian oil and gas have been substantial. European governments were forced to pay over EUR 600 billion in support for consumers and industries and to rapidly diversify supplies of oil and natural gas.[34] Certain energy-intensive industries such as chemicals, base metals, and non-ferrous minerals suffered drops in output across Europe.[35] In order to maintain production, some chemical industries resorted to the import intermediate goods from areas less affected by the energy price crisis.[36] Yet, by August 2022, 70% of Europe's fertiliser production capacity was curtailed as facilities in more than ten EU countries either shut down or decreased production.[37] Some of the impacts are long-lasting, with companies like BASF announcing permanent downsizing in operations.[38] The moderate winter and the reduced demand in China due to Covid-19 lockdowns enabled the EU to successfully replace Russian gas, but relying on such circumstantial factors is not a sustainable policy choice.

The dependence on foreign imports of CRM and clean tech could similarly be weaponized in this era of strategic competition to further geopolitical objectives. Trade sanctions in the minerals sector have been growing over the last decade (Figure 10). Between 2009 and 2020, export restrictions for CRM grew more than five-fold, from 2,518 in January 2009 to 13,102 in December 2020.[39] Export taxes are the most commonly employed restriction, followed by export licensing requirements. Five countries imposed the most restrictions over this period: China, India, Russia, Argentina and the Democratic Republic of Congo. These countries are some of the world's largest suppliers of minerals. Most restrictions were applied to waste and scrap product categories, specifically for precious metals – gold, silver and platinum group metals (PGM).[40] Tin, titanium, gold, platinum, cobalt, cadmium and copper were the other minerals with top restrictions since 2009. Critical minerals with high growth rates were rare earth elements, phosphates, molybdenum, titanium, and natural graphite.[41]

33 'International Trade during the COVID-19 Pandemic: Big Shifts and Uncertainty', OECD, 10 March 2022, https://www.oecd.org/coronavirus/policy-responses/international-trade-during-the-covid-19-pandemic-big-shifts-and-uncertainty-d1131663/.

34 Sgaravatti et al., 'National Fiscal Policy Responses to the Energy Crisis'.

35 Other industries, particularly manufacturing, were not so severely affected. See Giovanni Sgaravatti, Simone Tagliapietra, and Georg Zachmann, 'Adjusting to the Energy Shock: The Right Policies for European Industry', Bruegel, 17 May 2023, https://www.bruegel.org/policy-brief/adjusting-energy-shock-right-policies-european-industry; 'Economic Bulletin', 2 (Frankfurt am Main: European Central Bank, 2023), https://www.ecb.europa.eu/pub/pdf/ecbu/eb202302.en.pdf.

36 'Economic Bulletin'.

37 Paul Hodges, 'Food Costs and Interest Rates Rise as Energy and Fertilizer Supplies Are Hit by the Invasion', ICIS, 4 September 2022, https://www.icis.com/chemicals-and-the-economy/2022/09/food-costs-and-interest-rates-rise-as-energy-and-fertilizer-supplies-are-hit-by-the-invasion/; Fertilizers Europe, 'Europe's Fertilizer Industry Victim of EU's Energy Chaos', 26 August 2022.

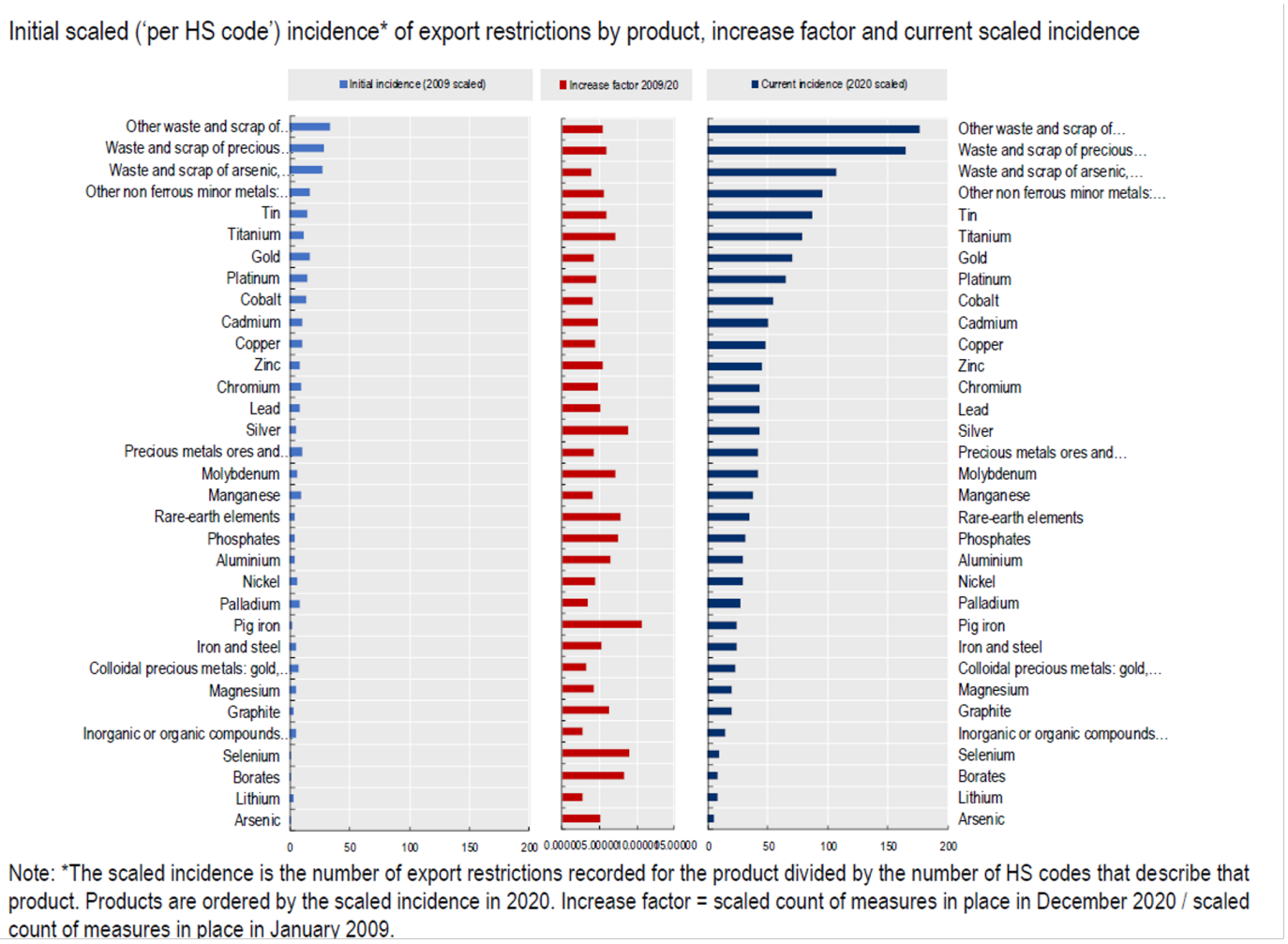
38 'BASF to Cut 2,600 Jobs on High Costs in Europe', CNBC, 24 February 2023, https://www.cnbc.com/2023/02/24/basf-to-cut-2600-jobs-on-high-costs-in-europe.html.

39 Przemyslaw Kowalski and Clarisse Legendre, 'Raw Materials Critical for the Green Transition: Production, International Trade and Export Restrictions', OECD Trade Policy Paper (Paris: OECD, April 2023), https://www.oecd-ilibrary.org/trade/raw-materials-critical-for-the-green-transition_c6bb598b-en.

40 Kowalski and Legendre.

41 Kowalski and Legendre.

Figure 10. Export restrictions for critical raw materials 2009-2020 – data and original figure by OECD[42]



Note: *The scaled incidence is the number of export restrictions recorded for the product divided by the number of HS codes that describe that product. Products are ordered by the scaled incidence in 2020. Increase factor = scaled count of measures in place in December 2020 / scaled count of measures in place in January 2009.

The US is increasingly aggressive in its trade policy towards China, and European countries and their allies are at risk of being pulled into this rivalry. As of 2023, a new trade conflict between the US and its allies on the one hand, and China on the other, has emerged. The US embarked on a path to strengthen its domestic chip-making industry and weaken China's. The United States' CHIPS and Science Act set aside significant subsidies for domestic manufacturing and was followed by a set of export controls for chip-making technology to China in October 2022. After a few months of negotiations, the Netherlands and Japan announced they would impose export controls themselves. Soon after, the Chinese government has introduced restrictions on the exports of gallium and germanium. According to US National Security Advisor Jake Sullivan, technology export controls "can be a new strategic asset in the U.S. and allied toolkit to impose costs on adversaries, and even over time degrade their battlefield capabilities."[43]

The EU is pursing open strategic autonomy – i.e., the ability to act autonomously in global politics and be resilient to shocks but continue investing in international trade relations whenever

42 Kowalski and Legendre.

43 Jake Sullivan, 'Remarks by National Security Advisor Jake Sullivan at the Special Competitive Studies Project Global Emerging Technologies Summit', The White House, 16 September 2022, https://www.whitehouse.gov/briefing-room/speeches-remarks/2022/09/16/remarks-by-national-security-advisor-jake-sullivan-at-the-special-competitive-studies-project-global-emerging-technologies-summit/.

possible.[44] However, it is likely to get caught in the great power rivalry more often and suffer from its consequences.

The impact of restricting supplies can be significant, leading to high mineral prices and possible interruptions in manufacturing advanced (energy) technologies. The global chip shortage during the pandemic caused massive interruptions in the production of medical equipment, computers, smartphones and cars, among others. This led to a shortage of millions of components for medical ventilators, increase in consumer prices for TVs and companies like Samsung to shut down production of entire product lines (Galaxy Note in this case).[45]

4.2. Significant acceleration of global CRM policies

Supply security for CRM has been at the forefront of governments, who have passed a number of interrelated policies to strengthen supply chain resilience (see Table 5). The list is not comprehensive but aims to illustrate the type of instruments EU and non-EU countries have been implementing. Appendix 3 includes a more detailed list.

Table 5. Types of policy instruments implemented by selected countries.
Note: An 'X' refers to the existence of policies for the minerals sector in the specific category (domestic coordination, innovation & scale-up, human capital, financial support, stockpiling, international collaboration).

	Domestic coordination	Innovation & scale-up	Human capital	Financial support	Stockpiling	International collaboration
European Union	X	X				X
Germany	X			X		X
France	X			X		X
Netherlands	X			X		X
Sweden	X			X		
Finland	X	X		X		X
Spain	X					
United Kingdom	X	X				
United States	X	X	X	X	X	
Canada	X	X	X	X		X
Australia	X	X		X		X
Indonesia	x					
Japan	X			X	X	X
South Korea	X			X	X	X

44 'EU Strategic Autonomy 2013-2023: From Concept to Capacity', Think Tank European Parliament, 8 July 2022, https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2022)733589.

45 Wassen Mohammad, Adel Elomri, and Laoucine Kerbache, 'The Global Semiconductor Chip Shortage: Causes, Implications, and Potential Remedies', *IFAC-PapersOnLine*, 10th IFAC Conference on Manufacturing Modelling, Management and Control MIM 2022, 55, no. 10 (1 January 2022): 476–83, https://doi.org/10.1016/j.ifacol.2022.09.439; Frans van Houten, 'Global Chip Shortages: Why Supplies Must Be Prioritized for Healthcare Capabilities', World Economic Forum, 24 May 2022, https://www.weforum.org/agenda/2022/05/global-chip-shortages-put-life-saving-medical-devices-at-risk/.

Domestic coordination measures are aimed to reduce bureaucracy, streamline internal processes, establish monitoring tools and common standards. In 2023, the EU proposed a net-zero industrial policy to (re)establish EU-based manufacturing of clean tech through the Net-Zero Industry Act[46] and the Critical Raw Materials Act.[47] Ensuring fast permitting for industrial processes, identifying and promoting European strategic projects and aligning standards across member states to accelerate the scale-up of technologies are some of the main measures included in these acts. The Netherlands has introduced its Raw Materials Strategy *(Nationale Grondstoffenstrategie)* in December 2022 and is looking to expand the competitive advantages of its industries in order to secure supply of minerals.[48] The Strategy is focused on five pillars: (1) circular economy; (2) European mining and processing; (3) diversification; (4) sustainable supply chains; and (5) knowledge building and monitoring.[49] Finland created a national body that can foster efficient cooperation across various stakeholders in the national battery and electrification sector to strengthen cooperation, interaction and information flow across different members of the battery value chain.[50]

Innovation and scale-up policies support research and development (R&D) and the rapid scale-up of technologies. The UK allocated £15 million within the Circular Critical Materials Supply Chains (CLIMATES) fund to R&D in rare earth elements and introduced an Accelerate-to-Demonstrate Facility with a dedicated funding pillar on technology innovations for critical minerals in developing countries.[51]

Human capital policies aim to expand and develop the labor force in the minerals sector. The Canadian Critical Minerals Strategy aims to facilitate the training of people transitioning from other energy sectors to the CRM industry, focusing on assisting youth in developing relevant skills and involving the business sector in developing university curricula for mining.[52] The US Department of Energy has announced the development of a comprehensive workforce infrastructure dedicated to Science, Technology, Engineering and Mathematics (STEM) disciplines in the CRM sector.[53]

Financial instruments promote and incentivize private investments and include tax benefits, subsidies and export control agencies. The German government has announced plans to allocate up to €2 billion to support CRM mining activities. This complements the earlier announcements of offering untied loan guarantees for German companies investing in raw materials projects abroad and of partnering with commodity trader Trafigura to ensure security of supply of minerals from the global market. Japan, South Korea, Sweden and Finland also offer untied loan guarantees in the minerals sector.[54] France has announced the

46 Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, 'Net Zero Industry Act', European Commission, 16 March 2023, https://single-market-economy.ec.europa.eu/publications/net-zero-industry-act_en.

47 'European Critical Raw Materials Act'.

48 'Grondstoffen voor de grote transities'.

49 'Grondstoffen voor de grote transities'.

50 Ministry of Economic Affairs and Employment of Finland, 'National Battery Strategy 2025 - Executive Summary', julkaisut.valtioneuvosto.fi (Ministry of Economic Affairs and Employment of Finland, 26 January 2021), https://julkaisut.valtioneuvosto.fi/handle/10024/162685.

51 Department for Business, Energy & Industrial Strategy, 'Critical Minerals Refresh: Delivering Resilience in a Changing Global Environment', GOV.UK, 13 March 2023, https://www.gov.uk/government/publications/uk-critical-mineral-strategy/critical-minerals-refresh-delivering-resilience-in-a-changing-global-environment-published-13-march-2023.

52 Government of Canada, 'The Canadian Critical Minerals Strategy', campaigns, 9 December 2022, 31–32, https://www.canada.ca/en/campaign/critical-minerals-in-canada/canadian-critical-minerals-strategy.html.

53 Critical Minerals and Materials: U.S. Department of Energy's Strategy to Support Domestic Critical Mineral and Material Supply Chains" (U.S. Department of Energy, 2018).

54 'Korea Trade Insurance Corporation (K-Sure)', IISD, accessed 22 September 2023, https://www.iisd.org/credit-enhancement-instruments/institution/korea-trade-insurance-corporation-k-sure; 'Raw Material Guarantee', Finnvera, accessed 22 September 2023, https://www.finnvera.fi/eng/financing/export-credit-guarantees/raw-material-guarantee; 'JOGMEC & JBIC Financial Support for Overseas Minerals Projects', IEA, 27 October 2022, https://www.iea.org/policies/16642-jogmec-jbic-financial-support-for-overseas-minerals-projects; 'Export Credits', *Svensk Exportkredit* (blog), accessed 22 September 2023, https://www.sek.se/en/product/export-credits/.

launch of an investment fund for critical minerals of €2 billion, €500 million of which would be provided by the Government.[55] The US government had already moved towards investments in green energy in 2021 with the Bipartisan Infrastructure Law (BIL) that allocated $70 billion to energy funding. The Inflation Reduction Act (IRA) of 2022 was a significant elevation of this law, adding almost $370 billion in funding to energy infrastructure, innovative clean energy and advanced technology for vehicle manufacturing.[56] Canada and Australia have received special status under the IRA so that they qualify for funding as well.

Stockpiling of CRM is growing in importance. Stockpiling refers to the accumulation of stocks of a mineral or specific refined product to mitigate short-term risks. The Japanese and South Korean governments are building stockpiles of minerals whilst planning to expand the size of their stocks to 180 and 100 days, respectively, for materials considered high-risk. Similarly, the United States National Defence Stockpile was created in 1939. In 2022, the US government has announced its expansion to include critical minerals.[57]

International coordination entails bilateral and multilateral initiatives which facilitate CRM trade and/or promote cross-border cooperation between states. Through the Global Gateway Partnership, the EU will facilitate investments abroad in clean energy infrastructure, including CRM.[58] At the same time, EU trade agreements with Canada, Australia, Chile and Indonesia are under development, seeing that these are large global suppliers of CRM.[59] The US integrated Australia and Canada to qualify for funding under the IRA. Multilateral agreements like the Minerals Security Partnership and the Sustainable Critical Materials Alliance also aim to enhance cooperation.

4.3. Chinese dominance in the foreseeable future

The Chinese government has been able to consolidate its dominant position over the last 25-30 years by ensuring that state-owned enterprises (SOEs) are actively pursuing this long-term goal.[60] China's state capitalist system allows it to direct its SOEs into actions that may not be the most economically advantageous but have a political gain. Over time, strategies of resource nationalism have been targeted to the same goal of achieving strong domestic capabilities in CRM supply chains at the expense of China's rivals (Table 6).[61] Trade restrictions, heavy subsidies for domestic industries, vertical integration of SOEs across supply chains and targeted investments into strategic goods abroad ensured that the goals of the Chinese government would be fulfilled. The Belt and Road Initiative spans across several strategies and it has led to the integration of logistics services across the largest trade routes.

55 Paul Messad, 'Métaux critiques : la France devrait aller au-delà des 2 milliards de fonds', EURACTIV France, 11 May 2023, https://www.euractiv.fr/section/economie/news/metaux-critiques-la-france-devrait-aller-au-dela-des-2-milliards-de-fonds/.

56 Justin Badlam et al., 'The Inflation Reduction Act: Here's What's in It', McKinsey & Company, 24 October 2022, https://www.mckinsey.com/industries/public-sector/our-insights/the-inflation-reduction-act-heres-whats-in-it.

57 'Strategic and Critical Materials Stock Piling Act', IEA, 31 October 2022, https://www.iea.org/policies/15534-strategic-and-critical-materials-stock-piling-act.

58 'Global Gateway', European Commission, accessed 22 September 2023, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/stronger-europe-world/global-gateway_en.

59 'Negotiations and Agreements', European Commission, 13 September 2023, https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/negotiations-and-agreements_en.

60 Irina Patrahau et al., 'Securing Critical Materials for Critical Sectors: Policy Options for the Netherlands and the European Union' (The Hague: The Hague Centre for Strategic Studies, December 2020), https://hcss.nl/wp-content/uploads/2021/01/Securing-Critical-Materials-for-Critical-Sectors.pdf.

61 Patrahau et al.

Table 6. China's strategies to secure mineral supply chains. Based on HCSS, 2020.[62]

Strategies		Definition	Example
Resource Nationalism	Vertical integration	Acquire a monopoly position and create entry barriers for junior companies. States can nationalize companies or subsidize sectors to strengthen domestic companies' international position.	In 2021, three of China's six rare earth companies were merged into a state-owned giant, leaving only four key players in China's rare earths market. The companies that merged are Minmetals Rare Earth, Chinalco Rare Earth & Metals Co and China Southern Rare Earth Group Co.[63]
	Stockpiling	Accumulate a strategic stock of a certain asset in order to become less vulnerable to short-term disruptions in the market.	The Chinese government has had a strategic stockpile of rare earth elements since 2011, which has been expanded over time.[64] In 2016, the first commercial stocks of rare earths were approved.[65]
	Export restrictions	Export quotas, export taxes, obligatory minimum export prices lead to an increase in global prices and decrease in global availability. It becomes more challenging to meet domestic demand.	The Chinese government has imposed the most export restrictions in the mineral sector between 2009-2020, particularly in the form of export taxes.[66] As of August 2023, the government has imposed restrictions on the exports of gallium and germanium.[67]
Foreign investments for supply security		Ensure secure supplies by investing in a diversified supply base and foreign assets.	Chinese companies have financial stakes in 15 out of the 19 existing cobalt mines in the Democratic Republic of Congo.[68] Chinese companies are a key investor in Indonesia's Morowali Industrial Park, where they process nickel sourced from Indonesian and (partly) Chinese-owned mines.[69]
Resource diplomacy		Build alliances with strategic partners – supplying. Countries as well as countries which share similar import dependence vulnerabilities	The relations built with companies within Belt and Road Initiative are a part of China's strategy of resource diplomacy.
Standard Setting/ Certification frameworks		Create differentiation between very similar products, allowing competition based on characteristics other than solely the price. This has the potential to lead to first-mover advantage and market dominance.	Chinese state-owned companies are leading technical committees for minerals within the International Standardization Organisation. The government has passed several laws, the most important being 'China Standards 2035', empowering companies to contribute to global standard setting.[70]
R&D		Expand knowledge and encourage innovation in order to secure patents for relevant future technologies.	Between 1950 and 2019, China filed 25.911 patents for rare earth elements compared to 9.810 by the US, 13.920 by Japan and 7.280 by EU countries combined.[71]
Circular Economy Strategies		Recycle (the Urban Mine), Reuse, Reduce, Substitution	Circularity in China has grown exponentially over the last two decades. Copper recycling has increased from 300.000 tonnes in 2000 to 3 million in 2019. Moreover, 49 demonstration facilities for 'Urban Mining' have been approved by the central government to accelerate recycling.

62 Patrahau et al., 'Securing Critical Materials for Critical Sectors: Policy Options for the Netherlands and the European Union'.

63 Tom Daly, 'Minmetals Confirms China Rare Earths Merger, Creating New Giant', *Reuters*, 22 December 2021, sec. China, https://www.reuters.com/world/china/minmetals-unit-confirms-china-rare-earths-merger-2021-12-22/.

64 Jost Wübbeke, 'Rare Earth Elements in China: Policies and Narratives of Reinventing an Industry', *Resources Policy* 38, no. 3 (1 September 2013): 384–94, https://doi.org/10.1016/j.resourpol.2013.05.005.

65 Nabeel A. Mancheri et al., 'Effect of Chinese Policies on Rare Earth Supply Chain Resilience', *Resources, Conservation and Recycling* 142 (1 March 2019): 101–12, https://doi.org/10.1016/j.resconrec.2018.11.017.

66 Kowalski and Legendre, 'Raw Materials Critical for the Green Transition: Production, International Trade and Export Restrictions'.

67 Annabelle Liang and Nick Marsh, 'Gallium and Germanium: What China's New Move in Microchip War Means for World', *BBC News*, 2 August 2023, sec. Business, https://www.bbc.com/news/business-66118831.

68 Eric Lipton and Dionne Searcey, 'Chinese Company Removed as Operator of Cobalt Mine in Congo', The New York Times, 28 February 2022, https://www.nytimes.com/2022/02/28/world/congo-cobalt-mining-china.html.

69 Ellen Moore, 'Indonesia Morowali Industrial Park (IMIP)', *The People's Map of Global China* (blog), 22 November 2021, https://thepeoplesmap.net/project/indonesia-morowali-industrial-park-imip/.

70 Irina Patrahau et al., 'Standards for Critical Raw Materials: Strategic Standard Setting in China, the EU and the Netherlands' (The Hague: The Hague Centre for Strategic Studies, n.d.), https://hcss.nl/wp-content/uploads/2021/01/Standards-for-Critical-Raw-Materials.pdf; Yi Wu, 'The China Standards 2035 Strategy: Analyzing Recent Developments', China Briefing, 26 July 2022, https://www.china-briefing.com/news/china-standards-2035-strategy-recent-developments-and-their-implications-foreign-companies/.

71 Eric Ng, 'China's War Chest of Rare Earth Patents Give an Insight into Total Domination of the Industry | South China Morning Post', South China Morning Post, 20 July 2019, https://www.scmp.com/business/companies/article/3019290/chinas-war-chest-rare-earth-patents-give-insight-total.

Even though investments increased significantly in 2022, looking at the geographical distribution of investments may hide the ownership of these future projects. Global investment in CRM primary supply has increased in 2022 compared to 2019, from about USD 30 billion to slightly over USD 40 billion.[72] Yet most of the exploration and production of minerals remains concentrated in few countries, with China being present in most of these mineral markets. Even though most planned refining projects for nickel are located in Indonesia, this is only half of the story. Chinese companies are heavily involved in Indonesia's nickel sector. In 2022, Chinese companies invested USD 3.2 billion in Indonesia, a large part of it in smelting facilities for nickel.[73] Moreover, the Chinese government invested the record amount of $10 billion in mineral industries in the first half of 2023 across African, South American and Asian countries.[74]

72 'Critical Minerals Market Review 2023', IEA, accessed 22 September 2023, https://www.iea.org/reports/critical-minerals-market-review-2023/key-market-trends.

73 Yudith Ho and Eko Listiyorini, 'Chinese Companies Are Flocking to Indonesia for Its Nickel', *Bloomberg*, 15 December 2022, https://www.bloomberg.com/news/articles/2022-12-15/chinese-companies-are-flocking-to-indonesia-for-its-nickel.

74 Edward White, 'China's Overseas Investment in Metals and Mining Set to Hit Record', *Financial Times*, 31 July 2023, https://www.ft.com/content/dff6b029-43af-46e7-947d-06981cd988ec.

5. Dutch companies in metals and minerals supply chains: capabilities, challenges and opportunities

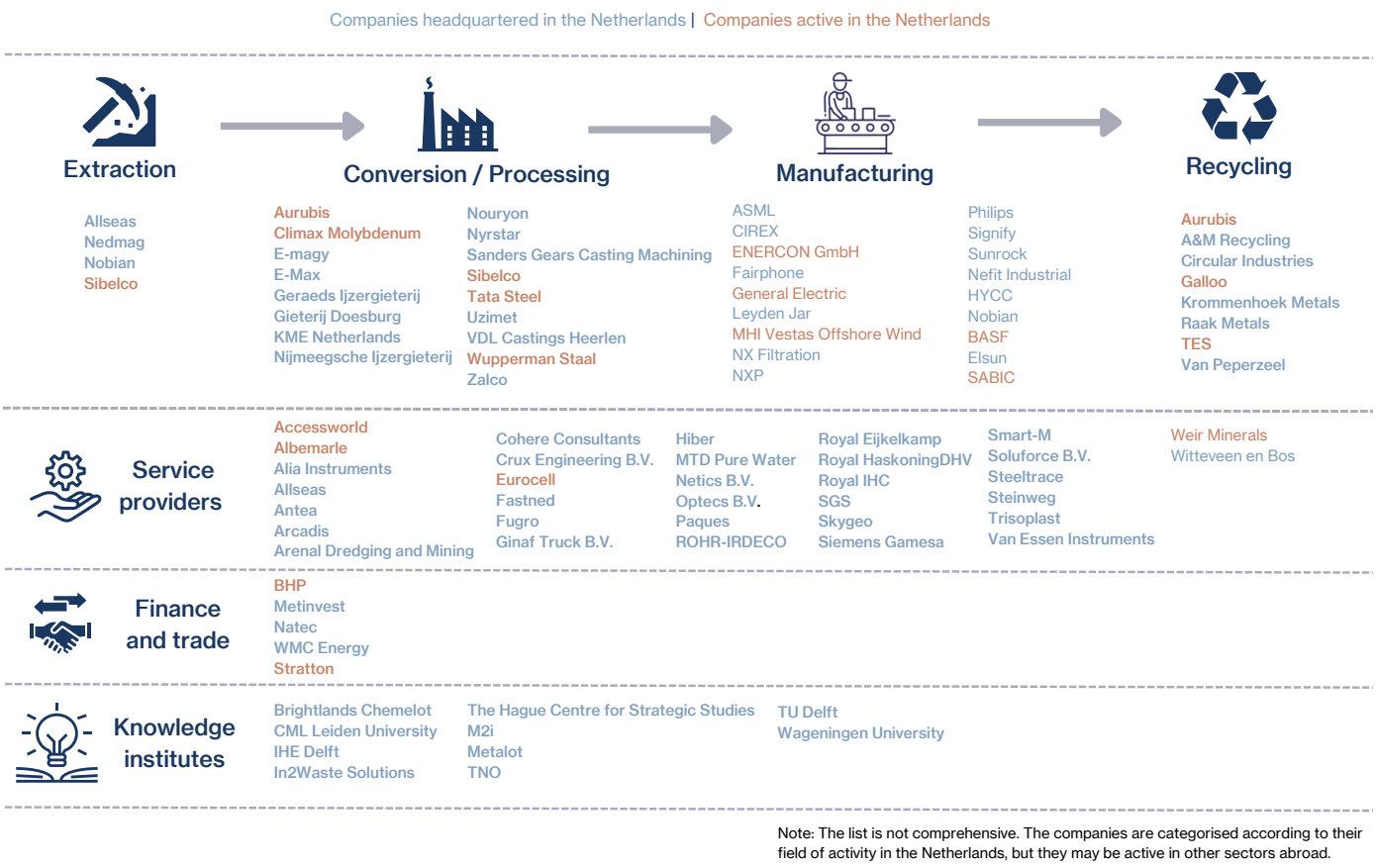
5.1. Types of companies active in the Netherlands and their capabilities

The metals and minerals sector in the Netherlands consists of companies active across the supply chain in the extraction, processing, manufacturing and recycling of minerals, both as operators and as service providers – including equipment and technology, software, storage and logistics (Figure 11). To this group are added financial and trade companies and knowledge institutes.

Broadly speaking, two types of companies are active in the Dutch metals and minerals sector: multinational companies with global operations, and smaller companies that have most of their operations in Europe, though are sometimes active in non-European countries in addition to the Netherlands. Larger companies may be headquartered or have an office in the Netherlands but have most of their operations in mineral industries across the world. They are not dependent solely on domestic legislation to stay in business, but on international conditions as well. Contrastingly, Dutch companies that have most operations in the Netherlands and Europe tend to be smaller (start-ups, and small –and –medium-sized enterprises) and are highly dependent on national and EU legislation.

The industry is closely interconnected and mutually dependent. As the country is relatively small and very dense, the various functions of industry are closely integrated for efficiency gains. For instance, the extraction and processing of magnesium salts produces base chemicals for industry. In turn, chemical re-agents like ammonia and hydrochloric acid are necessary for the processing of fertilizers and certain minerals. Many industrial processes result in byproducts that may not be directly relevant for the company itself but that can be reused by someone else. As such, a temporary or permanent closure of a company is likely to impact the entire industrial ecosystem as well.

Figure 11. The activity of companies in metals and minerals supply chains in the Netherlands.



Note: The list is not comprehensive. The companies are categorised according to their field of activity in the Netherlands, but they may be active in other sectors abroad.

Below, some of the key capabilities of Dutch companies or global companies active in the Netherlands are outlined.

Extraction

When it comes to the extraction of minerals, salt mining in the form of both sodium chloride and magnesium chloride is a large-scale operation in the Netherlands.[75] Reserves in the North and East of the country continue to be exploited by companies active primarily in the Dutch and European markets. Depending on their characteristics and purity, salt-based products can be used in chlor-alkali industries, the food and agriculture sector, in pharmaceuticals, and lastly, in road safety (e.g., the provision of grit). [76]

Another notable industry in the Netherlands is sand extraction. In the North Sea, supplétion and fill sand are extracted as a means to protect the Dutch coastline as well as being employed in the construction industry.[77] Additionally, the Netherlands has reserves of silica

75 E L J Scherpbier and H C Eerens, 'Decarbonisation Options for the Dutch Salt Industry' (TNO, PBL, 2021), https://www.pbl.nl/sites/default/files/downloads/pbl-2021-decarbonisation-options-for-the-dutch-salt-industry-3477.pdf.

76 Scherpbier and Eerens.

77 'Surface Mineral Extraction', Noordzeeloket, accessed 21 September 2023, https://www.noordzeeloket.nl/en/functions-and-use/artikel-baseline/.

sand that is converted into silica.[78] This is used in the glass, metallurgy and construction industries. At the right purity, silica sand is one of the raw materials used for the production of silicon metal, a key part of the EU's CRM list.[79]

Moreover, the Netherlands has a strong basis of companies that have developed deep-sea mining equipment and technology. While most of these remain service providers of equipment to global mining companies, there are also companies that would operate the equipment themselves and thus engage in extraction in international waters, granted that the International Seabed Authority (ISA) gives them the green light. As of 2023, no official decision has been made by the ISA on permits for the exploitation of minerals in international waters given uncertainty about environmental impacts. The decision has been postponed to July 2024.

Conversion and/or processing

Steel processing makes up a dominant part of the Netherlands metals and minerals processing. This is undertaken primarily by smelters, steel production plants and foundries that feed the Dutch and European markets, with a few exceptions of internationally active companies.

Moreover, there are companies engaged in the Netherlands in the processing of manganese, silica and baryte, which are either part of the EU's CRM list (manganese, baryte) or can be used in the production of a CRM (silica). The processing of zinc, molybdenum and aluminium also takes place in the Netherlands. Most of these companies are also active abroad, both in processing and extraction of various minerals.

Recycling

Most recycling companies in the Netherlands serve the domestic and/or European markets. While the recycling of CRM is a complex process given that technology is often still under development or the process is very inefficient and thus expensive, there is an increasing move towards such activities, such as start-up developing facilities for recycling digital technologies (e.g., print circuit boards) and large-scale multinationals investing in battery recycling.

Service providers

The Netherlands has particularly strong capabilities in service provision in minerals and metals value chains, especially at the global level. Dutch companies have a good reputation in water management, environmental assessment and sustainable design, engineering and infrastructure. These services are essential for the mining and processing of minerals. Several large Dutch companies are active in these industries in North and South America as well as Africa.

At the same time, as part of the well-developed Dutch maritime industry, large scale Dutch-based multinational companies have emerged. They are involved in dredging, offshore fossil and renewable energy infrastructure and, increasingly, deep sea mining, across the world.

The Netherlands is also known for its innovative business environment. As such, there are Dutch startups developing software to optimize processes and increase efficiency in minerals extraction and processing.

78 P Ike, 'Mineral Planning Policies and Supply Practices in The Netherlands' (University of Groningen, 2005), https://pure.rug.nl/ws/files/36009669/The_Netherlands.pdf.

79 Grohol and Veeh, 'Study on the Critical Raw Materials for the EU 2023'.

Finally, the Netherlands is a global trade hub, making it an attractive location for traders and specialized storage providers. The Port of Rotterdam is the hub for metals trade in Europe and even serves as a key location for the delivery of metals to North America. Customs and other related services are highly efficient and digitized, facilitating these processes. Traders often opt to maintain stock-level presence in Rotterdam or in the vicinity in order to be flexible and be able to react rapidly to changes in global demand and supply.

5.2. Obstacles to successful operations

This section outlines the key challenges that the interviewed companies active in the Netherlands face in maintaining operations and/or expanding. Table 7 maps the challenges according to the part of the supply chain that the company referred to, while Table 8 divides the issues depending on whether the company has operations primarily within the Netherlands and the EU market or worldwide. Each of the challenges is, in turn, described below.

Table 7. Key obstacles to successful operations in the Netherlands and the EU ranked according to the urgency of the issue.
An 'X' means that the company faces an issue. The more companies indicated they face this problem, the more urgent the problem is considered to be. The table shows whether a specific challenge applies to companies primarily active in the Netherlands and the EU, to companies primarily active abroad, or to both. The data was collected based on 30 interviews with industry representatives.

Ranked in order of urgency	Extraction	Processing	Recycling	Service providers	Finance	Trade	Knowledge
Negative public opinion	X	X	X	X	X	X	X
Insufficient dialogue with government and lack of trust	X	X		X	X	X	X
Delayed action and fragmented mandates	X	X	X	X	X		
Uneven playing field	X	X	X	X			
Cumbersome permitting process	X	X	X	X			
Insufficient financial support		X	X	X	X		
Inconsistent or inexistent legislation		X	X		X		
Inadequate green energy infrastructure	X	X	X				
Energy costs	X	X					
Lack of space		X		X			
Unskilled labour		X		X			

Table 8. Key obstacles to successful operations in the Netherlands ranked according to the urgency of the issue.

An 'X' means that the company faces an issue. The more companies indicated they face this problem, the more urgent the problem is considered to be. The table shows whether a specific challenge applies to companies in one or more parts of the mineral supply chain. The data was collected based on 30 interviews with industry representatives.

Ranked in order of urgency	Companies active worldwide	Companies active in the Netherlands and EU
Negative public opinion	X	X
Insufficient dialogue with government and lack of trust	X	X
Delayed action and fragmented mandates	X	
Uneven playing field		X
Cumbersome permitting process		X
Insufficient financial support	X	X
Inconsistent or inexistent legislation	X	X
Inadequate green energy infrastructure		X
Energy costs		X
Inefficient use of space		X
Unskilled labour	X	X

A. Negative public opinion

Mining and industrial processes have an unfavourable reputation in European society. Coal mines have embedded mining in European culture as a highly polluting industry that should be. This goes hand in hand with the 'not in my back yard' mentality whereby local communities oppose the idea of expanding industrial facilities close to their homes.

Several projects have been cancelled or postponed due to public opposition in Europe. In Serbia, nation-wide protests against a lithium exploration site by Rio Tinto led to the government opposing the project's further development.[80] In Spain, the Extremadura lithium mine has been a contested topic for more than 5 years. Due to local opposition, the plans were updated from an open-cast mine to an underground operation to minimise environmental impact.[81] The new plans are still opposed by the local population.

However, reshoring some of the mining and processing of minerals in Europe cannot be seen in isolation of the global minerals industry. A balanced view would acknowledge the negative impacts of mining and processing in Europe in relative terms to current global mining operations that take place in countries with limited standards for the environment, human rights and labour conditions. Opposing mineral industries in Europe only externalises the issue to other

80 'Serbia: Thousands Protest against Rio Tinto Lithium Mine Project and New Draft Laws Allegedly Designed to Benefit Business', Business & Human Rights Resource Centre, 17 January 2022, https://www.business-humanrights.org/en/latest-news/serbians-are-protesting-against-lithium-mine-and-new-draft-laws-which-allegedly-benefit-business/.

81 Joyner Caceres, 'EU Green-Tech Homeshoring Plans Face Resistance in Spain', DW, 16 March 2023, https://www.dw.com/en/spanish-lithium-eus-green-tech-homeshoring-plans-face-resistance-on-the-ground/a-64996771.

countries.[82] Moreover, long-term monitoring of restoration efforts in mining sites shows positive results within 10-15 years.[83]

Companies in the Netherlands share this struggle, especially those in the extraction and processing sectors. The conversation is currently taking place of whether mining magnesium salts in the Netherlands is of national interest. Deep sea mining tends to be highly divisive in public debate too. There is a lack of balanced discussions about industrial processes in the Netherlands and Europe.

B. Insufficient dialogue with the government and lack of trust in government policy

The industry is under significant pressure because of climate regulation, geopolitical developments and geo-economic competition. Throughout the interviews, companies expressed the feeling of being unwelcome in the Netherlands due to the increasingly stringent regulations, the structural difficulties of adapting to these new conditions such as lack of (affordable) green electricity, grid connections and space, and negative public opinion. Companies feel like there is insufficient support and understanding given by the government despite having some of the most sustainable processes in the world. The relationship between the mineral industry and the government is characterised by a general lack of trust.

C. Delayed action and fragmented mandates

The EU made significant progress in one year to start reducing dependence on foreign suppliers. However, further than a shift in political narrative, companies interviewed in this study have not yet experienced concrete changes. Initiatives in the Netherlands and EU are constrained by slow decision-making compared to the US, Canada or South-Korea, where governments have been much more proactive in their support for industry. Due to the use of CRM throughout a wide variety of sectors, the responsibility for various parts of minerals supply chain was spread across departments within the Government. If a company needed information, they would have to reach out to various departments responsible for a small part of the answer, making it very difficult to get a comprehensive picture. The fragmentation in mandates brings uncertainty and discourages companies from expanding, whether domestically or abroad. For instance, a start-up that developed software to increase the efficiency of mineral processing wants to expand abroad. It would be more productive to support creating insights into the different countries' mineral sectors, for (large) Dutch companies to assess partnerships. Having an 'agency or diplomatic point of contact' hat has a good overview of the latest developments in the sector as a whole that could support partnering with local partners, financing opportunities etc. Now, in absence of support, the company must invest a significant amount of time and capital to find this information.

D. Uneven playing field with non-EU countries

Most companies operating in the Netherlands and the EU are experiencing an uneven playing field compared to non-EU countries due to weaker regulations abroad and the heavy governmental support that these non-EU companies receive. The high energy costs, lack of space and high labour costs in the Netherlands are contributing to the uneven playing

82 Guillaume Ragonnaud, 'Securing Europe's Supply of Critical Raw Materials' (European Parliamentary Research Service, March 2023), https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/739394/EPRS_BRI(2023)739394_EN.pdf.

83 Tim Stephens, 'Long-Term Monitoring Shows Successful Restoration of Mining-Polluted Streams', UC Santa Cruz News, 4 March 2021, https://news.ucsc.edu/2021/05/mine-remediation.html.

field – higher operating costs are forcing companies to increase their prices. However, they operate in international markets and must offer competitive prices with China, India or Turkey to stay profitable.

Several interviewed companies reinforced that customers value quality and sustainability, but price is always the deciding factor of whether a product is purchased. According to a company that surveyed its customer base, no customer agreed to a 2-3% increase in price in order to guarantee a sustainable production process.

E. Permitting processes and inconsistent legislation

The duration and complexity of the permitting process was mentioned throughout interviews with the extraction, processing, recycling and service providing sectors active in the Netherlands. Including permits, it takes an average of 17 years to open a mine according to the International Energy Agency and 3-5 years to set up processing and recycling facilities.[84] As such, companies must start developing projects as soon as possible to make the 2030 target. The permitting process has not yet been updated to match the fast pace of EU and Dutch ambitions.

In the extraction and processing sectors, permitting is difficult due to the complex and large-scale industrial processes they perform. This means that companies have to be in contact with several different agencies and levels of government, often due to insufficient capacity or knowledge within permitting agencies. Compared to companies outside of the EU, Dutch companies are operating in a relatively sustainable manner and have minimized possible environmental damage. Still, the regulatory difficulties they face make it difficult to stay in business or to expand to reach 2030 goals. Companies are considering expanding operations in other jurisdictions in South America, the Middle East and the United States due to the difficulties of staying in business in the Netherlands.

The recycling sector is energy intensive as well and permitting can take a long time. Moreover, issues arise with the type of feedstock that they can use given that legislation has not been fully adapted to support circularity. Often waste streams require a different type of handling than raw materials, making it difficult and expensive for recycling companies in the Netherlands to source. Changing definitions of waste streams and categories could benefit the Dutch recycling industry.

For service providers such as storage and logistics companies, permitting is difficult due to the outdated legislation regarding non-ferrous materials. Many minerals like lithium are considered hazardous materials and require very extensive permitting process to transport large amounts, comparable to the processes required for large-scale chemical plants with which they claim they are incomparable with. This puts a significant burden on (smaller) storage and logistics companies even though their operations are less risky than those of a chemical plant. As such, an in-between layer of legislation would be useful to distinguish between the scale and risk of operations, facilitating faster permitting.

84 'Global Average Lead Times from Discovery to Production, 2010-2019 – Charts – Data & Statistics', IEA, 3 May 2021, https://www.iea.org/data-and-statistics/charts/global-average-lead-times-from-discovery-to-production-2010-2019.

F. Unclear financial instruments

The goals to expand the Dutch footprint in mineral supply chains are not paired with clearly defined financial instruments, especially when contrasted with the US, Germany, Sweden or France. Dutch companies either lack knowledge of financial support possibilities through the Dutch government and are thus discouraged from expanding or consider expanding operations abroad given attractive conditions offered by other governments. Especially start-ups and small and medium enterprises (SME) are struggling to find initial investments to scale activity domestically and abroad. For instance, the US Defence Production Act and Inflation Reduction Act offer significant subsidies for European companies to open up extraction, processing and manufacturing on US soil. Germany's untied loan guarantees are de-risking investments for German companies abroad. The Dutch government can play a key role in de-risking investments across the sector and creating accelerators for smaller companies to scale.

G. Energy costs and inadequate green energy infrastructure

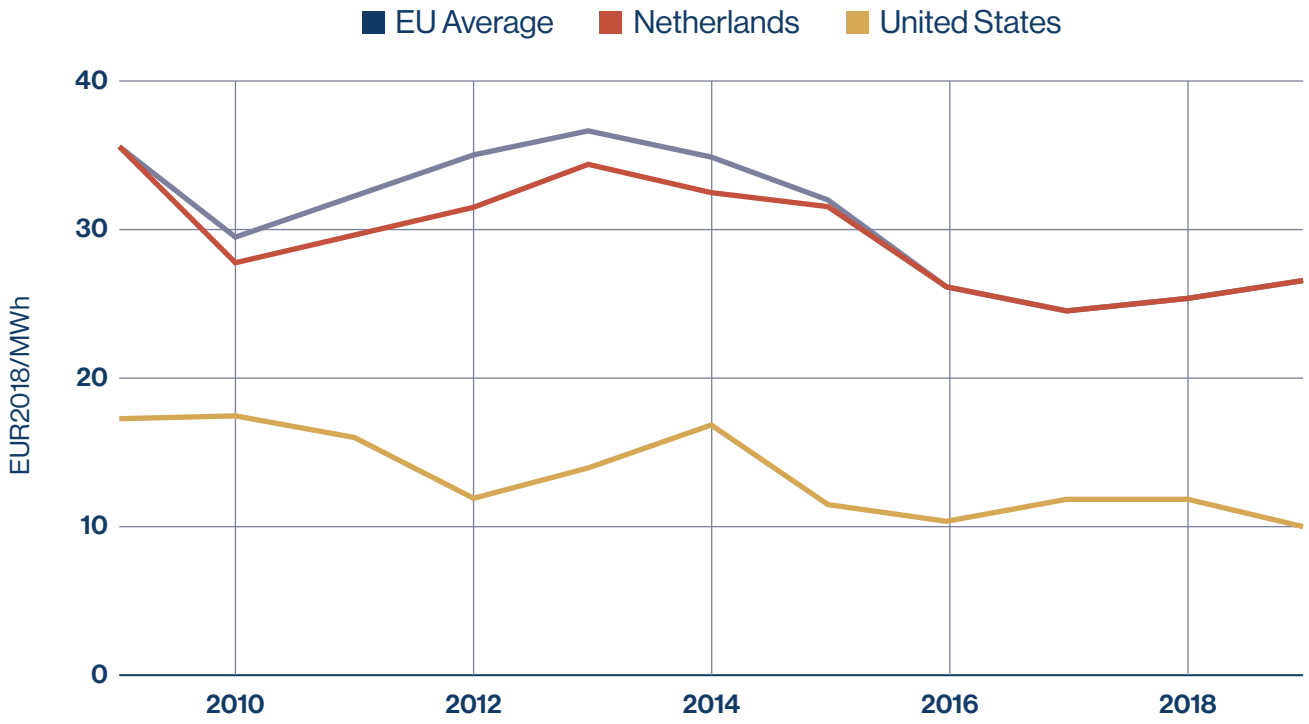
Companies that operate in the Netherlands in the extraction, processing, recycling and logistics sectors face challenges to maintain operations and expand due to high costs and infrastructural constraints. Many companies are part of globally integrated mineral value chains. Financial difficulties in the Netherlands constrain their ability to maintain current facilities and expand both domestically and abroad.

As climate regulations are becoming increasingly stringent, companies in extraction, processing and recycling sectors are caught between high costs on the one hand, and infrastructural limitations that slow down their decarbonization on the other hand. Many companies are taking active steps to reduce emissions by investing in advanced and energy efficient furnaces, electrifying (parts of) operations and looking into investments in green hydrogen or biomass. Yet high costs and severe infrastructural constraints limit the speed at which they can transition and expand operations.

Energy prices and the taxation on fossil fuel energy in the EU is significant, and in the Netherlands it is more stringent than in other EU countries. Energy prices in Europe have historically been much higher than China or India given their use of coal rather than natural gas. The industry retail price for natural gas in the US has been less than half the price of gas in the Netherlands since the early 2010s (Figure 12).[85] Especially since the energy price crisis in 2022, industrial energy costs have skyrocketed. Added to natural gas and electricity prices is the taxation on emissions in the Netherlands. The Netherlands does not provide support schemes like the Indirect Cost Compensation and Volume Correction Scheme that are available in various other EU countries and approved at the EU level.

85 'Dashboard for Energy Prices in the EU and Main Trading Partners', European Commission, accessed 22 September 2023, https://energy.ec.europa.eu/data-and-analysis/energy-prices-and-costs-europe/dashboard-energy-prices-eu-and-main-trading-partners_en.

Figure 12. Natural Gas Industry Retail Prices excluding recoverable taxes and levies, 2009-2019.[86]



Moreover, green energy is insufficiently available in the Netherlands and the transmission grid is not strong enough to support (extra) connections for industrial facilities, whether for smelting or recycling. The market for green hydrogen and biofuels is still under development and prices remain high, so a transition will require some more time. The current electricity grid is not suited to connect processing or recycling facilities for CRM and supply the necessary (green) power to support these energy-intensive processes.

These domestic issues are constraining the companies' willingness and ability to expand operations. Companies have expressed uncertainty about staying in business in the Netherlands over the next 5 years. Some have plans to expand abroad, in the US, Middle East and South America. The expansion into extraction and processing abroad would bring benefits to facilities in the Netherlands as supply chains would become more integrated, resilient to shocks and therefore secure. However, companies tend to be reluctant to invest before knowing whether their main operations in the Netherlands will remain profitable.

H. Limited knowledge and intellectual property development

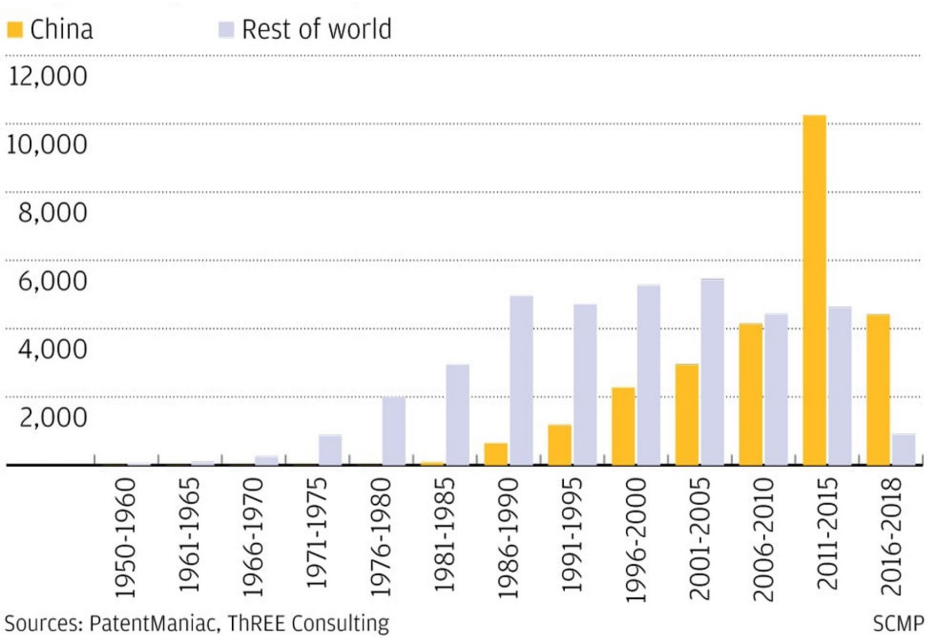
The focus of technical research and university education for upstream mineral industries has declined over the last two decades, reducing the speed of knowledge development and the size of a skilled labour force to support strategic autonomy in the mineral sector. In contrast, academic research on circular economy and the contribution of secondary material flows to resilient mineral supply chains is a strong component in Dutch universities.

86 'Dashboard for Energy Prices in the EU and Main Trading Partners'.

In the 1980s mining engineering emerged as a strong sector in the Netherlands, but the last 20 years have seen a significant decline. The academic focus on earth sciences grew significantly in the 1980s-1990s due to the focus on coal, natural gas and petroleum engineering. The number of students in the Applied Earth Sciences department of the TU Delft grew threefold – from 15-20 students in the early 1900s to 60 in 1980-1990.[87] Membership in the KNGMG (Royal Geological and Mining Society of the Netherlands) peaked in the mid-1980s at 1550 members, compared to 500 in 1925.[88] As of 2023, the KNGMG has 700 members, which they explain it is due to "the closing of the coal mines in the nineteen sixties and the disappearance of mining engineers in Dutch industry".[89] The lack of knowledge development is directly impacting the labour force in the long run.

At the same time, EU intellectual property (IP) in the mineral processing industry tends to be weak compared to competitors like China. Significant investments of Chinese companies over time gave them IP rights over a number of processes, including the refining of rare earths and magnesium metal. Between 1950 and 2019, China filed 25.911 patents for rare earth elements compared to 9.810 by the US, 13.920 by Japan and 7.280 by EU countries combined (Figure 13).[90] As such, European companies that want to enter new mineral markets often must source their technology from China or spend time and capital developing alternative technologies even before starting to plan a facility, for instance.

Figure 13. Global patent filings by Chinese firms covering rare earth elements compared to firms in the rest of the world[91]



87 'De Mijnbouwstraat 120. Van 1912-2021 een markant gebouw', TU Delft, 10 June 2021, https://www.tudelft.nl/2021/citg/de-mijnbouwstraat-120-van-1912-2021-een-markant-gebouw.

88 'Geschiedenis van het KNGMG', KNGMG, accessed 22 September 2023, https://www.kngmg.nl/geschiedenis/.

89 'Geschiedenis van het KNGMG'.

90 Ng, 'China's War Chest of Rare Earth Patents Give an Insight into Total Domination of the Industry | South China Morning Post'.

91 Ng.

While up- and midstream research and innovation has declines in the last years, research on circularity has been relatively stable. Departments of Industrial Ecology, Industrial Design and Circular Built Environment departments of Leiden University and the Technical University of Delft have been researching circular approaches to mineral supply chains over the last years.

I. Inefficient use of space

Serious limitations to the existence of mineral industries stem from the competition for space in the Netherlands. On the one hand, space is required to transition the Dutch and European economies given the coexistence of fossil and green energy in the short and mid-term. While demand for oil and gas remains high and green fuels are on the rise, the industries will function in parallel. On the other hand, there are many competing ambitions for the Netherlands (and the EU) to become central actors in mineral supply chains, circularity and recycling, green hydrogen supply chains, green electricity etc. This comes in addition to pressures around population density and the housing crisis.

All these various societal functions are competing for space. As of 2023, facilities of companies involved in the storage, logistics and stockpiling of critical minerals are being overtaken by housing plans around big cities. A centralised vision over the type of facilities wanted in the Netherlands and good spatial planning are required to ensure that important assets for Dutch and European strategic autonomy are not accidentally chased out of the country. The Port of Rotterdam is the central hub for minerals in North-Western Europe, but re-purposing infrastructure from other ports in the Netherlands could allow the country to better participate in CRM supply chains for the European hinterland.

5.3. Opportunities to strengthen mineral security in the Netherlands and abroad

This section outlines opportunities to strengthen mineral security for companies active in the Netherlands. The data was collected through interviews with the industry and research institutes.

Extraction

In the Netherlands the mining sector is limited to a few minerals including salts and sands. These can be leveraged in the production of certain CRM (making silicon metal from silica sands) or substances that are essential for the functioning of Dutch and European industries. Supporting these companies would be beneficial for the Dutch position in industrial supply chains. At the same time, showing that existing industries are supported gives a positive indication to other companies looking to invest in CRM supply chains. It would signal that the Netherlands is a good candidate for new investments.

Another strength of Dutch companies lies in deep sea mining technology and operations. If approved by the International Seabed Authority, deep sea mining could support the establishment of new supply chains and diversify mineral imports. For this to happen, a balanced debate is necessary around deep sea mining based on comprehensive information about global supply chains, their challenges and opportunities. Governments can choose to be sponsor states for companies at the ISA. For instance, Belgium is a sponsor state while

Germany has refrained from doing so.[92] Assuming that deep sea mining would take effect, it is important to think along supply chains. Once a mineral is extracted from the seabed, it will go through conversion and processing. This is a key opportunity to establish a reliable supply chain with trustworthy players.

Processing

The current social, political and economic environment is making it difficult for companies engaged in conversion and processing of minerals and metals to stay in business in the Netherlands. This also inhibits their ability and willingness to expand activities. As such, when trying to strengthen the mineral processing sector in the Netherlands, attention should be paid to existing companies and their challenges. As mentioned above, this not only supports industrial competitiveness, but it also points to a more certain and stable environment for (new) businesses to operate in.

Recycling

Recycling and circular approaches are key pillars of the Netherlands minerals strategy. However, companies that try to expand in this sector in the Netherlands face difficulties in terms of energy costs and availability, grid connections, permitting requirements and space limitations in industrial clusters. Moreover, revising permitting regulations for waste can support a bigger role for Dutch companies in recycling processes and providing secondary materials.

Service providers

Dutch service providers have a significant international footprint in engineering and consultancy for water management, maritime technology, sustainability and environmental assessments, geotechnical and survey services. Supporting their efforts abroad could strengthen the position of the Netherlands in mineral supply chains. Moreover, enhanced collaboration between Dutch companies can create a comprehensive and diverse proposition of Dutch service providers for potential clients within mineral supply chains.

Stockpiling and trade

The Netherlands is known for being an international trade hub and this function expands to the minerals sector too. The Rotterdam area is rich in opportunities for strengthening mineral security through international trade, as companies may choose to establish their base operations there as well as hold stockpiles. Given the scarcity of land around the already busy Port of Rotterdam and considering the nation-wide good infrastructure, other parts of the Netherlands could be leveraged into a role in trade and stockpiling of CRM.

Knowledge development

To enhance the knowledge position of the Dutch industry and policy makers, expertise could be formally consolidated into an institution that on the one hand could expand knowledge on issues of national importance, and, on the other hand act, could act as a bridge between academia, policymakers and industry.

92 Kingdom of Belgium Foreign Affairs, Foreign Trade and Development Cooperation, 'Belgium Helps Decide on the Seabed's Fate', FPS Foreign Affairs - Foreign Trade and Development Cooperation, 30 March 2023, http://diplomatie.belgium.be/en/policy/policy-areas/highlighted/belgium-helps-decide-seabeds-fate-11-questions; BMWK-Federal Ministry for Economics Affairs and Climate Action, 'Marine Conservation: Germany Will Not Sponsor Deep-Sea Mining until Further Notice', 2022, https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2022/11/20221101-marine-conservation-germany-will-not-sponsor-deep-sea-mining-until-further-notice.html.

Global presence of companies active in the Netherlands minerals and metals sector

Many companies active in the Netherlands with an office or an industrial plant (e.g., chemical industry, mineral processing, manufacturing half fabricates) are engaged in various mineral supply chains abroad. Creating synergies between these companies' Dutch branches and country offices and their foreign operations offers significant opportunities to strengthen European and Dutch mineral security through international collaboration. For instance, actors in the Netherlands could expand collaboration on the import of raw materials to increase supply security. Partnerships could be made between processing facilities in the Netherlands and foreign extraction activities, or between Dutch recycling companies and end users abroad. In addition to diplomatic measures, financial instruments like untied loan guarantees or import guarantees can support these processes.

Figure 14. Presence of companies active in the Netherlands minerals and metals sector in Africa

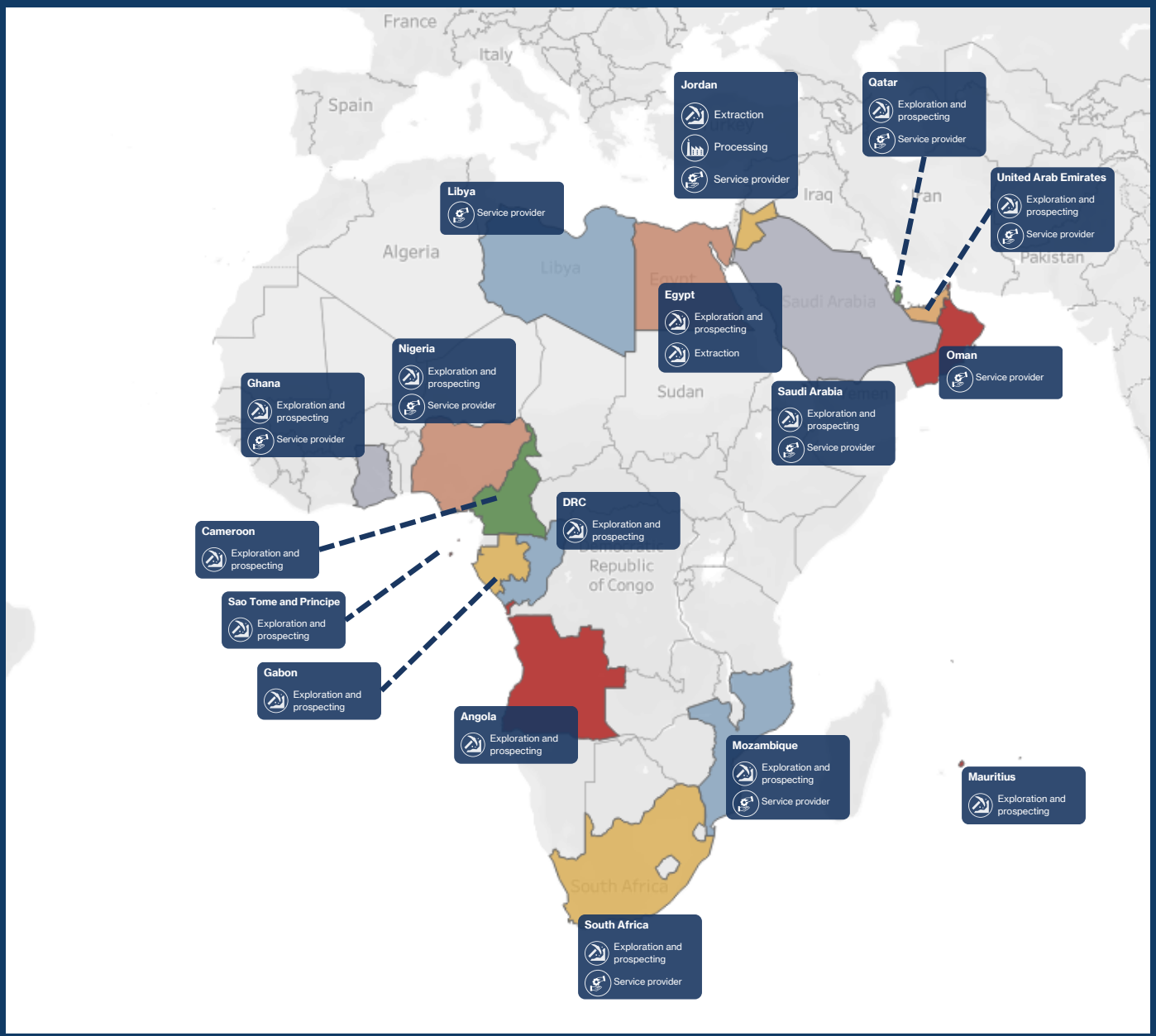


Figure 15. Presence of companies active in the Netherlands minerals and metals sector in the Indo-Pacific

Figure 16. Presence of companies active in the Netherlands minerals and metals sector in North America

Figure 17. Presence of companies active in the Netherlands minerals and metals sector in South America

6. Policy recommendations

Achieving the goals of the EU CRMA and the *Nederlandse Grondstoffenstrategie* requires a comprehensive approach to revitalize domestic industry, empowering it to diversify supply sources and strengthen supply security. This report offers a set of recommendations for the Netherlands government to support companies active in the mineral industry in the Netherlands, the EU and globally (Table 9). The level of action indicates whether the Netherlands government should act through national or European-level policy instruments in other to maximize the efficiency of a specific action.

Table 9. Summary of challenges and opportunities for companies active in the Netherlands minerals sector and policy recommendations.

Issue	Recommendation	Level of action	Best practices from other countries
Challenge: Public opinion	Facilitate a more balanced public debate by offering fact-based information about global mineral supply chains, the EU's footprint, and benefits and risks of reshoring (parts of) supply chains.	European level	Under its Critical Minerals Refresh, the British government is championing London as the world's capital of responsible finance for critical minerals.[93]
Challenge: Dialogue with government	Engage in dialogue with companies to discuss upcoming policy proposals and gain a better understanding of possible unintended consequences of policies as well as find ways to mitigate these.	National level	Finland's National Battery Strategy created a national body to foster efficient cooperation across various stakeholders in the sector, facilitate interaction and information flow across different members of the battery value chain.[94]
	Create a vision for the minerals industry and integrate it in the National Plan for the Energy System.	National level	The Netherlands National Plan for the Energy System offers a clear vision about what the green energy system should look like.[95]
Challenge: Speed of action and allocation of mandates	Concentrate mandates and responsibilities by creating a 'one stop shop' in one government department for minerals in order to improve the availability of information and accelerate action.	National level	The Norwegian Government has designated its Directorate of Mining as the "national competent authority for coordinating critical and strategic metal and mineral projects (one-stop shop)."[96]

93 Department for Business, Energy & Industrial Strategy, 'Critical Minerals Refresh'.

94 Ministry of Economic Affairs and Employment of Finland, 'National Battery Strategy 2025 - Executive Summary'.

95 Ministerie van Economische Zaken en Klimaat, 'Concept Nationaal Plan Energiesysteem', Open Overheid, 2023, https://open.overheid.nl/documenten/5a6e1180-844e-4f42-ab06-d63a559cd795/file.

96 Ministry of Trade, Industry and Fisheries, '– Norway Will Develop the World's Most Sustainable Mineral Industry', Government.no (regjeringen.no, 6 July 2023), https://www.regjeringen.no/en/aktuelt/-norway-will-develop-the-worlds-most-sustainable-mineral-industry/id2986277/.

Issue	Recommendation	Level of action	Best practices from other countries
Challenge: Permitting processes and legislation	Reduce red tape for permitting to speed up action.	National level	The EU CRMA sets out to streamline permitting processes and accelerate project development, but it is up to the individual member states to implement this change and streamline cross-European projects.[97]
	Identify outdated or inconsistent regulation and update it according to new ambitions.	National level	
Challenge: Energy costs and infrastructure	Support the expansion of necessary infrastructure such as the electricity grid to allow companies in the minerals sector to develop.	National level	Public investments through wholly or partly state-owned companies.
Opportunity: Increase the competitiveness of companies active in the Dutch and European markets	Establish incentives structures that support the expansion of the Dutch footprint in mineral supply chains.	National level	The US IRA provides financial incentives for companies starting mining and processing activities under the condition that part of the produced materials is for industries in the US.[98]
	Support a more even playing field by establishing standards that can allow Dutch companies to compete with non-EU actors on criteria other than price.	European level	N/A
Opportunity: Industrial partnerships	Improve information about the market and facilitate connections.	National and European level	The International Energy Agency's Critical Minerals and Clean Energy Summit is a platform for stakeholders across supply chains to create relations and exchange information.[99]
	Encourage collaboration with globally active companies that have headquarters and/or operate industrial facilities in the Netherlands.	National level	N/A
Opportunity: Financial support	Clarify the availability funding instruments and, when possible, combine efforts with other EU countries.	National level	The German, Swedish, Finnish governments are offering loan guarantees to companies investing in mineral facilities abroad.[100]
Opportunity: Knowledge development	Invest in education around minerals and metals to expand skills and strengthen the workforce.	National level	The Canadian government supports efforts to retain and grow female participation in the mining sector and facilitate the immigration of talented workers to communities with CRM projects.[101]
	Invest in research and development for European-based innovative solutions for CRM value chains.	National level	The UK allocated £15 million to R&D in rare earth elements.

97 'European Critical Raw Materials Act'.

98 'Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action' (Department of Energy, January 2023).

99 International Energy Agency, 'IEA Critical Minerals and Clean Energy Summit', accessed 25 September 2023, https://www.iea.org/events/iea-critical-minerals-and-clean-energy-summit.

100 'Untied Loan Guarantees', UFK-Guarantees, accessed 22 September 2023, https://www.ufk-garantien.de/en/products/guarantees/for-untied-loan-guarantees/untied-loan-guarantees.html; 'Raw Material Guarantee'; 'Export Credits'.

101 Government of Canada, 'The Canadian Critical Minerals Strategy'.

6.1. Address the challenges: creating an enabling environment

Creating the necessary conditions for companies to stay competitive – i.e., an enabling socio-political, economic and legislative environment – is an essential step in creating opportunities for further expansion. The sequence in which the recommendations are tackled reflects their respective urgency.

- **Public opinion:**
  - **Facilitate a more balanced public debate by offering fact-based information about global mineral supply chains, the EU's footprint, and benefits and risks of reshoring (parts of) supply chains.** The public debate around mineral supply chains in the EU is highly polarised and focused on absolute rather than relative perspectives. The opposition of the general public to upstream and midstream operations is based on the negative environmental and social consequences that these may bring to Europe. However, rejecting these processes in the EU has substantial greenhouse gas and social footprints when considering weak corporate social responsibility abroad, child labour, the financial cost and emissions required to transport the materials all the way to Europe. The government can play a role in ensuring transparency and availability of information to the public about global supply chains and the consequences of outsourcing the EU's mineral industry compared to reshoring.

- **Dialogue with government:**
  - **Engage in dialogue with companies to discuss upcoming policy proposals and gain a better understanding of possible unintended consequences of policies as well as find ways to mitigate these.** The industry in the Netherlands and the EU is under pressure to change to achieve climate goals but often does not have the necessary instruments to perform this change. Limited space, energy costs, weak grid connections, insufficient green energy are structural challenges that are too large for individual companies to resolve. Climate regulation is getting progressively more stringent, and companies will continue to be pressured. Structural engagement is necessary in order to better understand challenges, find common solutions and support domestic industry to operate, change and/or expand.
  - **Create a vision for the minerals industry and integrate it in the National Plan for the Energy System.**[102] The energy transition is bringing significant challenges to transform and replace industrial processes. The Netherlands aims to be a rapid mover in several sectors like critical minerals and green hydrogen, but it is often difficult to determine priorities. This inhibits the willingness and ability of companies active in the Netherlands to expand operations domestically and abroad. The cabinet should make a priority list for ambitions in the mineral sector that aligns with other national plans for the energy transition to deconflict choices and create a more certain business environment.

- **Speed of action and allocation of mandates:**
  - **Concentrate mandates and responsibilities by creating a 'one stop shop' in one government department for minerals in order to improve the availability of information and accelerate action.** As of now, many different departments and institutions are responsible for a part of mineral supply chains, but there is a lack of overview of the entire process, significantly affecting the speed of action. Companies find it difficult to

102 Ministerie van Economische Zaken en Klimaat, 'Concept Nationaal Plan Energiesysteem'.

identify the right department to reach out to with questions. The various institutions are often unaware of what their colleagues are precisely doing or who they are engaging with. The Netherlands representations abroad are not familiar with the domestic industry and their needs, nor are minerals on their priority lists. Dialogue between Dutch companies involved in mineral supply chains and the Dutch foreign representations is not always streamlined. For that reason, creating a 'one stop shop' that centralises efforts and information, and is in regular contact with industry can reduce the burden of individual companies by providing a collective service.

- **Permitting and legislation:**
  - **Reduce red tape for permitting to speed up action.** The time to 2030 is limited and ambitions for strategic autonomy in the energy and mineral sector are high. The significant expansion of energy and manufacturing industries in the Netherlands (including minerals, green hydrogen, carbon capture and storage, etc.) puts significant pressure on permitting departments in terms of capacity and knowledge development. Moreover, processes can be inherently slow due to outdated regulation. The expansion of mineral industry requires faster and more streamlined permitting processes.
  - **Identify outdated or inconsistent regulation and update it according to new ambitions**. Certain regulations do not progress as fast as political ambitions. For that reason, companies often find it difficult to advance at the same fast pace. For instance, the legal criteria for labelling certain material flows as waste have negative implications for the recycling industry, which is not allowed to reprocess it. At the same time, storage and logistics companies that wish to handle minerals must obey the same permitting legislation as large chemical companies, even though there is a large difference in the types of operations. Identifying such instances and ensuring that regulations are streamlined creates the necessary conditions for companies to take a bigger role in mineral supply chains.

- **Energy costs and infrastructure:**
  - **Support the expansion of necessary infrastructure such as the electricity grid to allow companies in the minerals sector to develop.** Insufficient (green) energy and lack of grid connection are major concerns of companies, especially those engaged in energy-intensive processes like recycling or processing. To reach 2030 ambitions, immediate and decisive solutions must be found to this issue.

6.2. Bolster opportunities: leveraging Dutch capabilities to strengthen mineral security

The Netherlands can play an important role in strengthening European mineral supply security. The recommendations below aim to capitalise on opportunities.

- **Increase the competitiveness of companies active in the Dutch and European markets**:
  - **Establish incentives structures that support the expansion of the mineral industry.** Companies that are active in mineral industries can take active steps in building resilient supply chains if incentives are introduced. Tax benefits or loans for companies taking steps in reaching the *Nationale Grondstoffenstrategie* goals can encourage

industry-wide participation. Upon receiving support from the government, the companies could agree on a set of criteria according to which their activity will contribute to the Dutch and European mineral supply security.

- **Support a more even playing field by establishing standards that can allow Dutch companies to compete with non-EU actors on criteria other than price.** Most of the interviewed companies in this study mentioned price competition to be highly problematic for their profitability. Even though clients may support sustainable processes, the cheaper product will always win. As such, the government in collaboration with the EU could develop mandatory regulations and standards that can support a more equal playing field with non-EU companies. Leveraging standards codified in the Carbon Border Adjustment Mechanism or Corporate Sustainability Due Diligence Directive could be a first step in this direction.[103]

- **Industrial partnerships:**
  - **Improve information about the market and facilitate connections.** The Dutch industry is strong in various parts of the supply chain, but companies are not always aware of each another's activity. The government can take on a facilitating role for companies to make contact and create synergies. For instance, collaboration through Partners for International Business (PIB) are known to work quite effectively across sectors, and increasingly in mineral supply chains too.[104] The Dutch government can bring together industry representatives that may have complementing capabilities in terms of expertise or regional experiences, so alliances can be formed to combine volumes and create a better value proposition for global partners to cooperate. This can then be supported by the Netherlands foreign missions abroad.
  - **Encourage collaboration with globally active companies that have headquarters and/or operate industrial facilities in the Netherlands.** As the Netherlands is an important trade hub and is placed in the centre of the North-Western industrial cluster between Germany and Belgium, many companies have country offices or industrial plants in this area. While they are often not active in mineral supply chains in the Netherlands, many of them have global operations of this kind. As such, partnerships between Dutch industry and foreign suppliers could be encouraged by leveraging the presence of the various companies in the region.

- **Financial support:**
  - **Clarify the availability funding instruments and, when possible, combine efforts with other EU countries.** Funding projects in mineral supply chains abroad entails significant risks that can be too high for private investors. Governmentally led financial instruments can mitigate these risks. Through untied loan guarantees foreign entities can take a loan with Dutch sovereign risk in exchange for delivering a certain percentage of their supply to the Netherlands. Import guarantees ensure mineral imports from a specific country to be used in Dutch processing plants. Germany and Sweden have already been activating such financial instruments to support their companies. The Netherlands government could consider various financing schemes to support companies that want to expand as well. Moreover, certain Export Credit Agencies (ECAs) in the EU have the ability to front for other ECAs. For instance, the Dutch government could provide a share of the

103 European Commission, 'Carbon Border Adjustment Mechanism', accessed 25 September 2023, https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en; European Commission, 'Proposal for a Directive of the European Parliament and of the Council on Corporate Sustainability Due Diligence and Amending Directive (EU) 2019/1937', 2022, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX-%3A52022PC0071.

104 'Partners for International Business - PIB', accessed 25 September 2023, https://english.rvo.nl/subsidies-programmes/partners-international-business-pib.

loan guarantee of another European country in exchange for some Dutch companies becoming involved in a different country's partnership. This could also support smaller companies like innovative start-ups that are looking to expand in the market.

- **Knowledge development:**
  - **Invest in education around minerals and metals to expand skills and strengthen the workforce.** Getting a competitive edge in the mineral sector requires a segment of the workforce to be educated in mineral upstream, midstream and downstream processes. Moreover, the government can facilitate exchanges with countries with more developed mineral sectors for industry and representatives of NL embassies to expand knowledge.
  - **Invest in research and development for European-based innovative solutions for CRM value chains.** Universities in the Netherlands should offer more doctoral programmes (PhD) and academic research grants in the minerals to expand knowledge and foster innovation. Talent from likeminded countries that have more extensive mineral industries could be attracted to conduct research projects in the Netherlands, facilitating knowledge exchange and development.

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Appendix 1. **Companies active in the metals and minerals sector in the Netherlands**

The table below offers an overview of companies and organizations active in the metals and minerals sector in the Netherlands. They were divided into supply chain sectors based on their activity in the Netherlands. They may have other facilities in other parts of the supply chain, abroad. This is not a comprehensive list of all companies and institutions working in the metals and minerals sector in the Netherlands. All the information has been collected from open sources.

Name	Sector	Description
Allseas	Extraction, Service provider (equipment)	Deepwater infrastructure for offshore energy, deepsea mining
BHP	Extraction	Mining copper, iron ore, potash, nickel, metallurgical coal. Over 90 locations worldwide
Nedmag	Extraction	Magnesium salt extraction in NL
Nyrstar Budel B.V.	Extraction, Processing	Zinc and zinc alloys
Sibelco	Extraction, Processing, recycling	Mining and processing silica, clays, feldspathics, olivine; Recycling glass
Albemarle	Processing	Industry leader in lithium. In the Netherlands, it produces catalysts
Century Aluminium	Processing	Carbon anode production facility in Vlissingen
Climax Molybdenum B.V.	Processing	Produce metallurgical molybdenum. Facility in Port of Rotterdam
E-magy	Processing	Developer of new battery anode material
Geraeds Ijzergieterij B.V.	Processing	Iron casting and alloys
Gieterij Doesburg B.V.	Processing	Iron casting and alloys
KME Netherlands B.V.	Processing	Fully integrated copper- and copper alloy mill
Nijmeegsche Ijzergieterij B.V.	Processing	Iron casting and alloys
Sanders Gears Casting Machining BV	Processing	Castings
Uzimet B.V.	Processing	The only lead sheet producer in Benelux

Name	Sector	Description
VDL Castings Heerlen B.V.	Processing	Iron castings
Wupperman Staal Nederland	Processing	Producer of galvanized flat steel
Zalco B.V.	Processing	Aluminium foundry
Tata Steel	Processing	Steel producers
E-Max	Processing	Sustainable aluminium
Nouryon	Processing	Specialty chemicals
Aurubis	Processing, Recycling	Supplier of non-ferrous metals and copper recycling
Akzonobel	End user	Paints and performance coatings
ASML	End user	Lithography technology
BASF	End user	Chemicals
CIREX B.V.	End user	Manufacturing complex steel components for cars, trucks, aviation etc.
Elsun	End user	Solar panels
Eneco Group	End user	Renewable energy generation services
ENERCON GmbH	End user	Development, construction, maintenance of wind turbines
Eurocell	End user	Battery manufacturer
Fairphone	End user	Electronics with sustainable supply chains
Fastned	End user	Owns and operates electric vehicle charging stations
FNsteel B.V.	End user	Steel wire products
General Electric	End user	Wind and gasturbines
HYCC	End user	Electrolysers for green H2
Leyden Jar	End user	Pure silicon anode technology for batteries
MHI Vestas Offshore Wind A/S	End user	Design, manufacture, install and service wind turbines for the offshore wind industry
Nefit Industrial B.V.	End user	Casting and assemblies
Nobian	End user	Essential chemicals
NX Filtration	End user	Fiber membrane producer
NXP	End user	Semiconductors
Orsted A/S	End user	Develops, builds and operates offshore and onshore wind farms, solar farms, energy storage facilities, renewable hydrogen and green fuel installations and bio-energy plants.
Philips	End user	Electronics
RWE AG	End user	Electricity generation, building storage systems and energy trading
SABIC	End user	Chemicals
SHELL	End user	Electrolysers for green H2
Signify	End user	Lighting company (former branch of Philips)
Sunrock	End user	Building and operating large-scale solar parks

Name	Sector	Description
Vattenfall AB	End user	Producer and retailer of electricity and heat
A&M Recycling	Recycling	Recycling industrial waste, battery and catalyst injectors, metal waste, e-waste etc
Circular Industries	Recycling	Currently developing the Urban Mining Factory - Printed Circuit Boards (Q2 2025)
Galloo	Recycling	Recycling and recovery of old metals
Krommenhoek Metals	Recycling	Metal and electronics recycling
Raak Metals	Recycling	Metals recycling
TES	Recycling	Solutions provider for electrical installation technology
Van Peperzeel	Recycling, Trade	Collector of old batteries, national sorting centre of waste consumer batteries, trade of non-ferrous metals
Steeltrace	Service provider (Certification)	Certification of raw materials
Blast Mining Enterprises	Sevice provider (Consultancy)	Mining consultancy services
Cohere Consultants	Service provider (Consultancy)	Expert consultancy subsurface and dynamics
Crux Engineering B.V.	Service provider (Consultancy)	Geotechnical consulting agency in the field of geotechnical engineering, geohydrology, ground and settlement risk assessment.
Netics B.V.	Service provider (Consultancy)	innovative research and consultancy firm in the field of sediment reuse
Deltares	Service provider (Engineering)	Knowledge in the field of water and subsurface
Fugro	Service provider (Engineering)	Geotechnical, survey and geoscience services
MTD Pure Water	Service provider (Engineering)	Provide technology, project management and implementation of projects for water reuse, disposal of wastewater etc.
Royal HaskoningDHV	Service provider (Engineering)	Engineering consultancy
SGS	Service provider (Engineering)	Testing, inspection and certification
Antea	Service provider (Engineering, consultancy)	Engineering for sustainability, energy transition, climate adaptation etc.
Arcadis	Service provider (Engineering, Consultancy)	Sustainable design, engineering, and consultancy solutions for natural and built assets
Boskalis	Service provider (Engineering, consultancy)	Dredging and marine experts
Witteveen en Bos	Service provider (Engineering, Consultancy)	Consultancy on engineering projects for energy and infrastructure
Alia Instruments	Service provider (Equipment)	Equipment for mining, dredging, tunelling, well servicing industry
Arenal Dredging and Mining	Service provider (Equipment)	Equipment for mining, dredging, metal refining, drilling, tunneling

Name	Sector	Description
Ginaf Truck	Service provider (Equipment)	Mining equipment, producer of electric trucks
ROHR - IDRECO	Service provider (Equipment)	Designs and manufacture deep digging electric dredging vessels and equipment for the mining and dredging industries
Royal Eijkelkamp	Service provider (Equipment)	Advanced equipment for various activities within all phases of mining
Royal IHC	Service provider (Equipment)	Maritime technology for dredging, offshore, mining, and defence industry
Siemens Gamesa	Service provider (Equipment)	Energy generation equipment
Smart-M	Service provider (Equipment)	Manufacture advanced machinery to produce ferrous and non-ferrous semi-finished products
Soluforce B.V.	Service provider (Equipment)	High pressure Flexible Composite Pipe (FCP or RTP) systems
Trisoplast	Service provider (Equipment)	Isolation solution consisting of a special clay-polymer component mixed with sand and water
Van Essen Instruments	Service provider (Equipment)	Water level data loggers and monitoring tools for groundwater, aquifer, remediation, and mining applications
Weir Minerals	Service provider (Equipment)	Engineering solutions for minerals and mining technology markets
Accessworld	Service provider (Storage & logistics)	Storage and logistics
Steinweg	Service provider (Storage & logistics)	Storage and logistics
Hiber	Service provider (Technology)	IoT solutions for the energy industry
Optecs	Service provider (Technology)	Artificial intelligence for mining
Skygeo	Service provider (Technology)	Earth observation platform and tools for mining, industries etc.
Metinvest	Trade	International steel and mining group with vast iron ore reserves, coal mines and steelmaking assets in Europe and North America.
Natec	Trade	Wholesaler of solar energy
Stratton	Trade	Metals trade
WMC Energy	Trade	Uranium, battery materials
Mining Governance Europe	Finance, Consultancy	Consultancy
Brightlands Chemelot	Knowledge	Chemical industry
Institute of Environmental Sciences (CML) Leiden University	Knowledge	Research
In2Waste Solutions	Knowledge	Circular and social economy
M2i	Knowledge	Materials innovation institute
Metalot	Knowledge	Sustainable, circular developments in the field of metals and renewable energy

Name	Sector	Description
The Hague Centre for Strategic Studies (HCSS)	Knowledge	Geopolitical and geo-economic analysis, risk assessments and anticipatory action
The Netherlands Organisation for Applied Scientific Research (TNO)	Knowledge	Research
Faculty of Industrial Design Engineering; Faculty of Architecture and Built Environment at the Technical University of Delft (TU Delft)	Knowledge	Research
Wageningen University and Research (WUR)	Knowledge	Research
Convenant Hernieuwbare energie	Association	Solar and wind energy supply chain sustainability
European Partnership for Responsible Minerals	Association	EPRM is an accompanying measure to the EU Conflict Minerals Regulation
Eurometaux	Association	European non-ferrous metals association
Holland Solar	Association	Association of Dutch solar energy companies
Metaal Nederland	Association	Association for Dutch metal industry
Metaalconvenant	Association	Internationaal MVO-convenant voor de Metaalsector
Nederlandse Vereniging Duurzame Energie	Association	Sustainable energy
Nederlandse Windenergie Associatie	Association	Wind energy
Vereniging ION	Association	Association for Industrial Surface Treatment
VNCI	Association	Chemicals
WindEurope	Association	Wind energy

Appendix 2. **International quick scan of policy interventions**

Recent years have seen a significant increase in policy interventions in CRM sectors. HCSS compiled a non-comprehensive list of policy interventions below. They are ordered alphabetically.

Domestic coordination

- **Australia:** 2022 Critical Minerals Strategy[105]
  - Regional hubs will promote innovation, attract talent, boost efficiency, create jobs, incentivise investment. AUD 4 million are allocated to scope possible hubs.
  - Significant investments in ESG standards aim to promote strong standards to gain credentials with international partners. AUD 25 million from the Government and AUD 130 million from the Future Battery Industries Cooperative Research Centre aim to develop certification programs to boost standards.
- **Canada:** FDI screening[106]
  - Strict FDI screening rules in CRM sector grant the Canadian government the power to determine whether an investment poses a risk to national security to increase control over the strategic sector.
- **EU:** Critical Raw Materials Act[107]
  - Streamlined and predictable permitting procedures by giving Strategic Projects priority status.
    - Rapid administrative treatment.
      - Permit granting procedures should not take a maximum of 1 year for processing and recycling, and a maximum of 2 years for extraction-related SPs.
    - Urgent treatment in all judicial and dispute resolution procedures.
    - Member States have to designate a single national competent authority which is responsible for coordinating the entire permit granting process.
  - Supply chain monitoring tools to inform companies about the risks of supply chain disruptions.

105 Australian Government, 'Critical Minerals Strategy 2023–2030', https://www.industry.gov.au/node/92581, 7 July 2023, https://www.industry.gov.au/publications/critical-minerals-strategy-2023-2030.

106 'Canada: Government Announces FDI Screening Measures', Global Trade Alert, 24 March 2021, https://www.globaltradealert.org/intervention/101926/fdi-entry-and-ownership-rule/canada-government-announces-fdi-screening-measures.

107 'European Critical Raw Materials Act'.

- **Finland:** National Battery Strategy[108]
  - Creating a national body that can foster efficient cooperation across various stakeholders in the national battery and electrification sector to strengthen cooperation, interaction and information flow across different members of the battery value chain.
- **France:** Varin Report 2022[109]
  - Strengthening local dynamics for setting-up industrial sites in the processing, battery components, and recycling sectors.
- **Japan:** International Resource Strategy 2020[110]
  - In 2020, Japan updated its national resource strategy to also focus on securing its supply of rare earths due their role in the lithium-ion battery industry by:
    - Diversifying supply sources.
    - Establishing emergency reserves.
    - Strengthening international cooperation in supply chains.
- **Norway:** Minerals Strategy[111]
  - The Directorate for Mining is the principal institution responsible for critical raw materials in Norway, functioning as a 'one-stop-shop'.
- **Spain:** Decree 5/2022 Establishing Urgent Measures Necessary to Regulate the Exploitation of Lithium Mineral Resources in Extremadura[112]
  - The Spanish Government issued a decree to expedite administrative processes and public funding to exploit lithium reserves in Extremadura, the largest deposit in Spain.
  - The Decree allows projects to be exempt of a license, speeding up processes and enabling access to subsidies.
- **South Africa:** Exploration Strategy for the Mining Industry of South Africa[113]
  - To take advantage of South Africa's mineral wealth, the government has established some policies to boost its sectors.
  - Increasing the number of exploration drilling projects in the country.
  - Promote investments, attracting 5% share of global exploration expenditure by 2025.
  - Streamline regulatory requirements, reduce bureaucracy to facilitate exploration projects.
- **US:** Inflation Reduction Act[114]
  - US government aims to accelerate the move toward clean energy and climate action and ensure US leadership in clean energy innovation and technology.

108 Ministry of Economic Affairs and Employment of Finland, 'National Battery Strategy 2025 - Executive Summary'.

109 BRGM, 'Strategic Metals: BRGM in the Forefront of the Actions Announced by the State', 17 January 2022, https://www.brgm.fr/en/news/news/strategic-metals-brgm-forefront-actions-announced-state.

110 'Japan's New International Resource Strategy to Secure Rare Metals', METI: Agency for Natural Resources and Energy, 31 July 2020, https://www.enecho.meti.go.jp/en/category/special/article/detail_158.html.

111 Ministry of Trade, Industry and Fisheries, '– Norway Will Develop the World's Most Sustainable Mineral Industry'.

112 Comunidad Autónoma de Extremadura, 'Decreto-Ley 5/2022, de 31 de Agosto, Por El Que Se Establecen Medidas Urgentes Necesarias En La Regulación Del Aprovechamiento de Recursos Minerales de Litio En Extremadura', Pub. L. No. Decreto-ley 5/2022, § 1, BOE-A-2022-16900 140774 (2022), https://www.boe.es/eli/es-ex/dl/2022/08/31/5.

113 'The Exploration Strategy for the Mining Industry of South Africa' (Department of Mineral Resources and Energy, Republic of South Africa, 14 April 2022), https://www.gov.za/sites/default/files/gcis_document/202204/46246gon2026.pdf.

114 'Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action', 182.

Innovation and scale-up

- **Australia**: Critical Minerals Strategy
  - Creating an enabling environment through R&D[115]
    - AUD 50 million in the next 3 years to identify how to take advantage of Australia's resources and connect the mining to other CRM sectors.
    - The AUD 50 million will be used towards building the National Critical Minerals R&D Centre which will build Australian intellectual property, target bottlenecks, and drive collaborative research.
  - Major Projects Facilitation Agency[116]
    - If you are developing a project with a capital investment of over $50 million, you are eligible for Major Project Status. To qualify for this, the project must showcase its contribution to Australia's strategic priorities, growth, employment.
- **Canada**: The Canadian Critical Minerals Strategy[117]
  - R&D funding to de-risk technological innovation for upstream and midstream segments of the value chain.
- **EU**: Strategic projects under CRMA[118]
    - Climate, Digital, Defence and Space related projects will get priority if considered strategic projects.
- **UK**: Critical Minerals Refresh: Delivering Resilience in a Changing Global Environment[119]
  - Champion London as the world's capital of responsible finance for critical minerals.
  - Accelerating collaboration on critical minerals with international partners, specifically Canada and South Africa.
  - Circular Critical Materials Supply Chains (CLIMATES) fund (£15 million) to make the UK's Rare Earth Element supply chains more resilient and boost the circular economy.
  - Accelerate-to-Demonstrate Facility includes a dedicated funding pillar on technology innovations for critical minerals in developing countries.
- **US**: U.S. Department of Energy's Strategy to Support Domestic Critical Mineral and Material Supply Chains 2021-2031[120]
  - Coordinating R&D strategy across CRM supply chains

Human capital

- **Canada**: Canadian Critical Minerals Strategy[121]
  - Federal skills and training to help institutions and employers train and re-skill people:
    - The initiatives include a range of programs that help forecast future skill requirements, green-skills training, and growing the indigenous workforce.
    - The existing programs will see new federal investments and the establishment of the Sustainable Jobs Training Centre and the Sustainable Jobs Secretariat.

115 Australian Government, 'Critical Minerals Strategy 2023–2030'.

116 'Major Projects Facilitation Agency', business.gov.au, 7 March 2023, https://business.gov.au/expertise-and-advice/major-projects-facilitation-agency.

117 Government of Canada, 'The Canadian Critical Minerals Strategy'.

118 'European Critical Raw Materials Act'.

119 Department for Business, Energy & Industrial Strategy, 'Critical Minerals Refresh'.

120 'Critical Minerals and Materials: U.S. Department of Energy's Strategy to Support Domestic Critical Mineral and Material Supply Chains' (US Department of Energy, 2021), https://www.energy.gov/eere/amo/2021-doe-critical-materials-strategy.

121 Government of Canada, 'The Canadian Critical Minerals Strategy'.

  - Assisting youth in developing skills and entering the labour market
    - The Youth Employment and Skills Strategy (YESS) will help 15-30 year olds to develop skills and transition into the labour market.
    - The YESS has an existing initiative, the Canada Summer Jobs Program which could include the critical minerals sector.
  - Mobilise a more diverse and inclusive CRM sector
    - The Government will support efforts to retain and grow female participation in the mining sector and facilitate the immigration of talented workers to communities with CRM projects through the Rural and Northern Immigration Pilot Program.
  - Partnerships between business sectors and universities will incentivise enrolment in mining curriculum, trade, and increase awareness of the roles CRM will play in the energy transition.
  - Continued collaboration with indigenous business leaders and organizations
- **Finland**: National Battery Strategy[122]
  - Developing skills in the battery sector by creating:
    - Virtual campuses integrating battery and electrification education available to students and companies.
    - National doctoral school on topics related to the national battery sector.
    - Education program for battery engineers.
- **US**: U.S. Department of Energy's Strategy to Support Domestic Critical Mineral and Material Supply Chains 2021-2031[123]
  - The US government promotes interdisciplinary collaboration among material and chemical science, computer science, and related disciplines to modernize the minerals supply sector industry.
  - DOE can establish a coordinated national plan with academic institutions, including community colleges, technical professional societies, the National Laboratories, research centres and industrial mining sites to create a comprehensive workforce development infrastructure dedicated to the engineering and STEM disciplines relevant to the identification of deposits, extraction, processing, separation, processing, reprocessing, and recycling of critical materials.

Financial instruments

- **Australia**: 2022 Critical Minerals Strategy[124]
  - AUD 2 billion to help projects get off the ground, supporting local jobs and communities.
  - Critical minerals accelerator initiative aims to bring new sources of supply online supporting early and mid-stage projects that contribute to creating robust supply chains.
  - Modern manufacturing initiative: Mid-stage CRM projects have access to AUD 1.3 billion to pilot, demonstrate, or scale up techniques or processes to achieve commercial competitiveness.
  - Attracting investments through Austrade, the trade facilitation agency of Australia, which aims to deliver specialised services to companies including trade missions to facilitate global commercial partnerships.

122 Ministry of Economic Affairs and Employment of Finland, 'National Battery Strategy 2025 - Executive Summary'.

123 'Critical Minerals and Materials: U.S. Department of Energy's Strategy to Support Domestic Critical Mineral and Material Supply Chains'.

124 Australian Government, 'Critical Minerals Strategy 2023–2030'.

- **Canada**: The Canadian Critical Minerals Strategy.[125]
  - $1.5 billion to support CRM projects prioritising advanced manufacturing, processing, and recycling applications.
  - $40 million to support regulatory processes in reviewing and permitting CRM projects.
  - $21.5 million supporting the CRM Centre of Excellence (CMCE) dedicated to developing federal policies and programs on CRM and assisting project developers.
  - $1.5 billion for infrastructure development of CRM supply chains, seeing as deposits are located in remote areas with challenging terrain.
- **France**: National investment fund[126]
  - National investment fund worth €2 billion combining public and private funding for mining projects. The state will initially contribute €500 million.
- **Finland**: Raw material guarantee
  - The Finnish government offers import credit guarantees as "security for a loan granted to a foreign borrower in connection with a long-term contract with a Finnish buyer concerning import of raw materials".[127]
- **Germany**: Untied Loan Guarantees[128]
  - The German Federal Government provides lenders to raw material projects abroad covering against commercial and political credit default risks. The projects have to be in the national and macroeconomic interest of Germany and to sign a long-term supply contract for the raw materials to a German off-taker.
- **Japan:** JOGMEC Funding for Exploration and Technology Development[129]
  - Japan Oil, Gas, and Metals National Corporation (JOGMEC) allocated a budget of 25 million in the form of subsidies, that will be implemented in:
    - Geological structure survey projects, collection, analysis and provision of information of surveys overseas conducted by Japanese companies.
    - Technological development projects promoting resource exploration which ensure a stable supply of metal.
    - Mining pollution prevention support for projects preventing mining pollution.
- **U.S.**: California Lithium Valley Development[130]
  - California Energy Commission is requesting $5 million to support planning of geothermal development and lithium extraction and processing facility with the proposal to
    - Streamline permission of geothermal facilities.
    - Funding for mitigation for communities affected by the development of geothermal.
    - Create a lithium extraction tax.
    - Reporting and fee requirements for geothermal mining.
    - Incentives for projects manufacturing, processing, or recovering lithium.
    - Funding for restoration and community grants supporting the region.
- **US**: Inflation Reduction Act
  - Advanced Manufacturing Production Credit

125 Government of Canada, 'The Canadian Critical Minerals Strategy', 22.

126 EURACTIV.com, 'The EU's Critical Raw Materials Act', www.euractiv.com, 15 November 2022, https://www.euractiv.com/section/energy-environment/special_report/the-eus-critical-raw-materials-act/.

127 'Raw Material Guarantee'.

128 'Untied Loan Guarantees'.

129 'Financial Support for Japanese Companies', JOGMEC: Japan Organization for Metals and Energy Security, accessed 22 September 2023, https://www.jogmec.go.jp/english/stockpiling/metal_10_000003.html.

130 'Clean Energy Investments', DF-46 (REV 10/20) § (2022), https://esd.dof.ca.gov/Documents/bcp/2223/FY2223_ORG3900_BCP5438.pdf.

    - Tax credit for domestic manufacturing of components in the solar modules, wind turbines, battery cells, and critical raw materials processing supply chain.[131]
    - Tax credit is equal to 10% and is applicable for a range of CRM.
- **Sweden:** Export credits
    - "Swedish exporters can strengthen their competitiveness by offering their foreign customers financing in connection with the sale of their products or services." [132]
- **South Korea:** Overseas investment insurance
    - "The Overseas Investment Insurance offers coverage to banks that provide loans to Korean overseas developers that require large-scale and long-term financing."[133]

International collaboration

- **Australia-India Strategic Research Fund**[134]
    - Grants for Australian and Indian organizations researching downstream processing, recycling, and reclamation of CRM.
- **Canada-EU Strategic Partnership on Raw Materials**[135]
    - Canada and the EU established a strategic partnership on CRM, advancing security and sustainability of trade and investment of CRM and downstream value chains, supporting the green and digital transition.
- **Canada-US Joint Action Plan on Critical Minerals Collaboration**[136]
    - The Canada-US Joint Action Plan on CRM aims to advance interest of the two countries to secure the supply chains of materials in strategic sectors including communication technology, aerospace and defence, clean technology.
- **Critical Minerals Mapping Initiative (CNMI)** [137]
    - The CNMI is an initiative between the Australian, Canada, and the US' Geological/ Geoscience survey organizations aiming to boost their understanding of known CRM. It has three concrete objectives:
        - Develop a database for CRM geochemistry, mineral deposit/system classifications.
        - Analyse CRM trends.
        - Develop modelling approaches to increase accuracy and analysis.
- **Energy-Resource Governance Initiative (ERGI)**[138]
    - Initiative of Australia, Botswana, Canada, Peru, and US aiming to use best practices in the sourcing of CRM and the international mining sector, share information about mining development, mapping of CRM, and closing/reopening mines.

131 'Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action', 26.

132 'Export Credits'.

133 'Korea Trade Insurance Corporation (K-Sure)'.

134 'Australia-India Strategic Research Fund – Collaborative Research Projects – Round 14', business.gov.au, 7 March 2023, https://business.gov.au/grants-and-programs/australia-india-strategic-research-fund-aisrf.

135 'EU-Canada Strategic Partnership Agreement', European Union External Action, 1 April 2017, https://www.eeas.europa.eu/node/13529_en.

136 Government of Canada, 'Canada and U.S. Finalize Joint Action Plan on Critical Minerals Collaboration', 9 January 2020, https://www.canada.ca/en/natural-resources-canada/news/2020/01/canada-and-us-finalize-joint-action-plan-on-critical-minerals-collaboration.html.

137 'Critical Minerals Mapping Initiative – Policies', IEA, accessed 10 May 2023, https://www.iea.org/policies/16092-critical-minerals-mapping-initiative.

138 'Energy Resource Governance Initiative Toolkit', ERGI, accessed 25 September 2023, https://ergi.tools/.

- **Finland National Battery Strategy**[139]
  - Ensure Finnish experts and companies gain European-level visibility.
  - Raise Horizon Europe financing instruments.
  - Strengthen national research with Nordic, European, and global communities.
  - Promoting Finnish clusters requires the following actions.
    - Increasing communication of the battery sector, organizing conferences and events in line with Slush, the largest start-up event in Europe.
    - Participate in international battery forums promoting Finnish participation as a whole and not as separate companies.
- **Minerals Security Partnership (MSP)** [140]
  - Partnership between Australia, Canada, Finland, France, Germany, Japan, Korea, Sweden, the UK, the US, and the EU with objectives:
    - Strengthening information sharing.
    - Increasing investments in CRM supply chains.
    - Developing recycling technologies.
- **Sustainable Critical Materials Alliance (SCMA)**[141]
  - SCMA is an initiative of Canada, Australia, France, Germany, Japan, the UK, and the US that focuses on ESG standards in the CRM supply chain.
  - The SCMA will allow members to develop sustainable and inclusive mining practices which:
    - Have a nature-positive approach encouraging practices that reduce environmental harm.
    - Support local communities by promoting safe working conditions.
    - Reduce GHG emissions by promoting sustainable practices compliant to ESG.
    - Restore ecosystems through requirements to close mine sites.
    - Build a circular economy by improving recovery from waste.
    - Foster ethical corporate practices by implementing due diligence in supply chains.
- **South Korea and Canada MOUs on CRM**[142]
  - The RoK and Canada have held talks discussing the importance of expanding cooperation on CRM.
  - Four MOUs have been signed between LG and Canadian companies (Avalon, Electra Snow Lake) on supply chain cooperation and information sharing. LG will be able to tap into Canada's supply stream of CRM for its industry and the RoK will support the private sector in Canada through data on mining investments.

139 Ministry of Economic Affairs and Employment of Finland, 'National Battery Strategy 2025 - Executive Summary'.

140 'Minerals Security Partnership – Policies', IEA, 27 October 2022, https://www.iea.org/policies/16066-minerals-security-partnership.

141 Natural Resources Canada, "Countries Commit to the Sustainable Development and Sourcing of Critical Minerals," news releases, December 12, 2022, https://www.canada.ca/en/natural-resources-canada/news/2022/12/countries-commit-to-the-sustainable-development-and-sourcing-of-critical-minerals.html .

142 Ministry of Trade, Industry and Energy, 'Korea and Canada Sign Critical Minerals Supply Chain Cooperation MOUs', Korea.net, 26 September 2022, https://www.korea.net/Government/Briefing-Room/Press-Releases/view?articleId=6602&type=O.

Strategic stockpiling

- **Japan:** International Resource Strategy[143]
  - In 2020, the Japanese Government announced plans to review the volume of its stockpiles, setting targets for national stockpiles not including industry stockpiles. The duration of supplies is set at 60 days but for 'high risk' materials, the Japanese government wants to increase the number up to 180 days.
- **South Korea:** Increase of stockpiles[144]
  - South Korea announced in 2021 that it planned to increase its stockpiles of CRM like cobalt, nickel, REEs, which are used in important sectors like EV batteries and renewable energy. Currently, stockpiles cover 56.8 days but the Ministry of Trade, Industry, and Energy is planning to increase stockpiles to cover 100 days.
- **US**: Strategic and Critical Materials Stock Piling Act[145]
  - This act was passed in 1939 but became dormant until 2021 when the US Government announced plans to restore the National Defense Stockpile for certain minerals.

143 'International Resource Strategy - National Stockpiling System – Policies', IEA, 27 October 2022, https://www.iea.org/policies/16639-international-resource-strategy-national-stockpiling-system.

144 'South Korea to Increase Stockpiles of Rare Metals', Argus Media, 5 August 2021, https://www.argusmedia.com/en//news/2241424-south-korea-to-increase-stockpiles-of-rare-metals.

145 'Strategic and Critical Materials Stock Piling Act'.

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