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De Risking from China: Effects on EU's Critical Mineral Supply Chains & Net Zero Targets

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Introduction

The European Union (EU) has committed, under the Paris Agreement, to achieve net-zero emissions by the year 2050. This commitment necessitates a transition from fossil fuel-dependent technologies to clean energy alternatives, thereby escalating the demand for clean energy technologies. Critical minerals, including lithium, copper, and aluminium, play a pivotal role in the production of such technologies, encompassing electric vehicles as well as solar and wind energy systems. Anticipating a surge in clean energy production, there is a concurrent rise in the demand for these indispensable minerals.

A significant challenge arises from the geopolitical concentration of critical mineral processing, with China maintaining a dominant position in this regard. The monopolistic control exercised by China over the processing of most minerals poses a vulnerability to the supply chain of European clean energy technology. The inherent risk lies in the potential disruption of critical mineral supply in the event of political tensions between China and Western nations. Recently, we have seen the EU and other Western powers de-risk from China, shifting away from trading with China on critical minerals. Consequently, it becomes imperative for the EU to diversify its sources of critical minerals to mitigate the risk of supply chain disruption due to interference from Chinese geopolitical dynamics.

The initial segment of this report serves as the Briefing, offering readers a comprehensive overview of the broader context surrounding the de-risking strategy from China, the vulnerability of the critical minerals supply chain in the EU, and the EU's Net Zero targets. Subsequently, the Insight section expands on the points raised in the Briefing, providing a deeper understanding of the underlying reasons for these dynamics. Following this, the Policy Recommendation section proposes pragmatic and innovative policies aimed at addressing the identified issues from the preceding sections. Lastly, the report's conclusion provides a summary of the discussed topics and underscores the significance of proactive measures in the EU securing a sustainable green economy.

Economy & Finance briefing note

Overview

This section will highlight the issues that have come with the recent de-risking from China and a shift away from trading with them, with a focus on what this means for European critical mineral supply chains and drive to net zero.

Critical minerals such as lithium, platinum, zinc, nickel, and copper are essential for green technologies. China is the primary global supplier of critical minerals.

China's dominance in critical mineral production poses supply chain vulnerabilities for the EU and the world. As a result the EU, alongside other Western powers, are de-risking from China to avoid over-reliance.

The EU is highly dependent on China for specific critical minerals. The EU has recognized the need to diversify critical mineral sources and established the EU Raw Materials Alliance (ERMA) for this purpose. This aims to build a circular economy and reduce dependence on China for critical minerals.

The EU's net-zero emission targets require increased usage of critical minerals in clean energy industries. Supply of some critical minerals are not scaling up to meet the demands of a complete transition to Net Zero.

Increasing disruptions in the supply chain have led to price increases for critical minerals.

Supply Chain Vulnerability:

Critical minerals such as lithium, platinum, zinc, nickel, and copper are needed in the production of many green technologies. The primary global supplier is currently China.

- China has an evident monopoly over global critical mineral supplies, accounting for approximately 60% of world-wide production and 85% of processing of these minerals.[1]
- China controls 95% of production and supply for rare earth metals. These are integral for manufacturing magnets for electric vehicles.[2]
- China has also held a long term strategy in terms of 'friend-shoring' critical mineral trade and alliances with Africa, a nation rich with critical minerals. Their foothold in Africa is exemplified by the fact that China owns 15 out of 19 copper-cobalt mining concessions in the Republic of Congo.[3]

The EU historically has relied heavily on China for critical mineral supplies, and are moving to de risk from them as a result.

- The EU has an immense dependence globally on China, and for certain materials, they have been completely dependent on China, for example China provides 100% of the EU's supply of heavy rare earth elements.[4]
- As said by president of the European Commission Ursula von der Leyen, 98% of the rare earth metals used in the production of green technologies (including lithium, platinum and silicon metal) come from China.[5]
- As described in a press release from the European Commission, the EU Critical Raw Materials Act enforced in March 2023 outlines the primary goal for 2030 to ensure 10% of annual consumption of critical minerals to be extracted, 40% to be processed and 15% to be recycled within Europe.[6]

[1] Economist, 2023, China controls the supply of crucial war minerals
[2] Rajagopal, D., 2023, Western miners target China's rare earth metals grip
[3] New York Times, 2021, A Power Struggle Over Cobalt Rattles the Clean Energy Revolution
[4] Consilium, 2023, Infographic - An EU critical raw materials act for the future of EU supply chains
[5] EIT, 2021, European Raw Materials Alliance contributes to Europe's industrial resilience
[6] European Commission (2023) Critical Raw Materials: ensuring secure and sustainable supply chains for EU's green and digital future

Supply disruptions or price volatility can impede the EU's ability to meet its climate goals.

- Inconsistent quality control, challenges in scaling up mining operations and scrutiny of non-sustainable mining operations are impeding the production of critical minerals, causing prices to be more volatile.

- In 2021, worldwide prices for lithium and cobalt saw a twofold surge, while copper, nickel and aluminium experienced a 25% to 40% increase, negatively impacting industries reliant on these minerals in various importing nations.[7]
- Price volatility concerns are aggravated by a combination of factors including a lack of transparency in specific critical mineral markets, asymmetrical information between market participants and observants and disruptions in the supply chain.[8]

[7] IEA, 2021, The Role of Critical Minerals in Clean Energy Transitions
[8] Ibid.

Diversification Efforts:

The EU has recognized the need to diversify its critical mineral sources to mitigate the risks associated with overreliance on a single supplier and create a more secure supply chain.

- This is particularly evident in the context of green technology production. For instance, producing an electric vehicle (EV) takes six times as many critical mineral inputs as a typical car, while creating a wind power-plant takes nine times as many as a gas-powered one.[9]
- Initiatives such as the EU Raw Materials Alliance (ERMA) have been established to secure access to these minerals from alternative global suppliers, aiming to enhance supply security.
- The alliance includes organisations from both the private and public sectors that provide resources across every stage of the supply chain. There are currently over 450 partners in the alliance from a range of firms, industries, and countries.[10]
- The partner network is divided into four sectors: primary raw materials, advanced materials and intermediate products, final products, and recycling.[11]
- Each organisation in the partner network is further categorised by their respective contributions to a stage of the value chain: exploration, mining, processing, recycling, and substitution.[12]

The priority lies in transitioning towards a circular economy involving sustainable resource management.

- Historically, the EU has been successful in recycling some critical minerals, such as copper; recycled copper covers over 50% of the supply. Closely behind are tungsten at 42% and cobalt at 22%.[13]
- However for other minerals such as neodymium, commonly used in producing electronics, less than 1% is being recycled.[14]

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[9] IEA, 2022, Role of Critical Minerals in Clean Energy Transitions
[10] EIT, 2021, European Raw Materials Alliance Contributes to Europe's Industrial Resilience
[11] ERMA, n.d., European Raw Materials Alliance
[12] Ibid.
[13] Righetti, E. & Rizos, V., 2023, The EU's Quest for Strategic Raw Materials: What Role for Mining and Recycling?
[14] Pennington, J., 2022, The circular economy is vital for the energy transition

- Sustainable resource management involves an efficient system for collecting and sorting waste. As of 2021, the collection rate of waste electrical and electronic equipment in the EU is approximately 46.2%.[15]

Diversification efforts are largely dependent on the EU's geopolitical relations and ability to create mutually beneficial relationships with other major critical mineral suppliers.

- Chile and Australia own the largest reserves of lithium, with 9.3 million tonnes and 6.2 million tonnes respectively as found in the US Geological Survey, while Australia and Indonesia have 21 million tonnes of nickel reserves.[16]
- Australia currently supplies 6% of global critical mineral production. Previous international partnerships include the concessional financing of Mount Weld mine in western Australia by the Japanese government since 2010 following a critical mineral embargo from China.[17]
- Internal suppliers are another viable source for the EU; Sweden's major mining company LKAB discovered Europe's largest rare earth metal source in northern Sweden in January 2023.[18]

[15] European Commission, 2023, Waste statistics - electrical and electronic equipment
[16] Gordon, O., 2023, The top ten critical minerals powerhouses of the energy transition
[17] Financial Times, 2023, Can Europe Go Green Without China's Critical Minerals?'
[18] Ibid.

EU's Net Zero Targets:

The current growth trajectory of critical mineral production is inconsistent with the EU's Net Zero Goals.

- The International Energy Agency (IEA) predicts that the expected worldwide investment of essential mineral extraction until 2030 ranges from $180 billion to $220 billion. This falls short of the necessary investment which is estimated to be between $360 billion and $450 billion.[19]
- While there is no intrinsic shortage of any critical minerals, the supply of some minerals is not being scaled up to the levels required for a complete transition to Net Zero.[20]
- On average, the projected supply of critical minerals in 2040 according to current policies is 21.4% lower than the supply needed in order to achieve critical mineral production consistent with meeting the Paris Agreement Goals.[21]

Current Net Zero Actions have been labelled as "Insufficient" by the Climate Action Tracker.[22] The EU has been revising their targets as a result of much scrutiny.

- Increasing the EU Emissions Trading Scheme (EU ETS) emissions reduction goal from 43% to 62% below 2005 levels by 2030.
- Raising the emissions reduction target within the Effort Sharing Regulation from 30% to 40% below 2005 levels by 2030.
- Strengthening the renewable energy target, elevating it from a 32% share to 42.5% by 2030, accompanied by an additional 2.5% "indicative" target.[23]

[19] IEA, 2022, The Role of Critical Minerals in Clean Energy Transitions
[20] Janardhanan et al., 2023, Critical Minerals for Net-Zero Transition: How the G7 can Address Supply Chain Challenges and Socioenvironmental Spillover
[21] IEA, 2022, The Role of Critical Minerals in Clean Energy Transitions
[22] Climate Action Tracker, 2023, Climate Action Tracker
[23] Council of the EU, 2023, Renewable energy: Council adopts new rules

As the EU moves towards reaching Net Zero, there has been a steady transition towards clean energy sources and technologies - and securing critical minerals supply chains will play a huge role in this.

- As of November 2022, 140 countries have pledged to reach net zero, which covers 90% of the world's greenhouse gas emissions.[24] Some of the EU's key net zero targets include reducing greenhouse gas emissions by 55% by 2030 compared to 1990 levels, and for renewable energy to increase from 32% to 42.5% of the overall share of energy usage.[25]
- Minerals like lithium, cobalt, nickel, and others have gained growing importance owing to their application in electric vehicle batteries. Notably, lithium plays a crucial role as a primary element in the manufacturing of lithium-ion batteries, which find widespread use in electric vehicles.
- Clean energy industries are set to be the main source of total demand for many of these minerals, including 73% of the total demand for Lithium by 2040.[26]

[24] Climate Action Tracker, 2022, CAT net zero target evaluations
[25] European Commission, 2023, 2030 climate & energy framework
[26] IEA, 2021, The Role of Critical Minerals in Clean Energy Transitions

Insights

Overview

In the briefing, three critical issues were addressed in regards to the EU's critical mineral supply and net zero targets. The following section will dive deeper into the fundamental reasons for the problem's occurrence.

The grounds of these issues will be broken down into three different themes. First, the inadequate growth of supply in the clean energy sector, analysing factors such as challenges in scaling production and the lack of investment. Next, we will look into the economic implications of geopolitical conflicts such as Sino-Western tensions to the Russia-Ukraine war which trigger volatility in supply chains. Finally, we will observe how fragile dynamics within the European Union and external trade partners are impacting the growth of the clean energy industry.

Inadequate growth of supply in the clean energy sector.

The number of electric vehicles sold annually has increased from 0.5 to 3.6 million vehicles between 2017 and 2023[27] with forecasts predicting that annual sales will reach 62 million by 2050.[28] Mineral demand for use in EVs and battery storage grows nearly tenfold in the STEPS and around 30 times in the SDS over the period to 2040.[29] Other clean energy industries such as Solar PV and wind energy sectors are expecting increases in mineral demand of approximately 240% and 300% respectively.[30] Electricity networks currently contribute to 70% of mineral demand.[31] However, their proportion is decreasing over time due to the rapid growth of other technologies, particularly electric vehicles (EVs) and storage solutions. The rapid increase in the production of clean energies puts upwards pressure on the demand for critical minerals.

While there is substantial projected growth in the production of clean energy technologies, the current trajectory is still below that required by the climate goals set in the Paris Agreement. According to the Sustainable Development Scenario the clean energy sector will be responsible for 90% of the global demand for Lithium, 70% of the total demand for Cobalt, 61% of the demand for Nickel, 43% of total Copper demand and 42% of the demand for Rare Earth Elements (REEs).[32] These numbers are considerably higher than the Stated Policies Scenario, indicating that there is a need to ramp up production of critical minerals to meet a demand greater than that of the projected growth in clean energy technologies.

Due to several factors, critical mineral producers face a formidable challenge in scaling production to the levels mentioned above. Projections of mineral demand face considerable uncertainty due to varying levels of climate ambition and diverse technological development paths. To illustrate, the demand for lithium in 2040 might be 13 times higher if vanadium redox flow batteries rapidly enter the market under a Sustainable Transition Energy Pathway (STEPS).[33] Alternatively, it could be 51 times higher if all-solid-state batteries commercialise faster than expected in a Sustainable Development Scenario (SDS).[34] These scenarios underscore the significant impact of technological developments and adoption rates on future mineral demand. Furthermore,

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[27] International Energy Agency, 2023, Electric Vehicles
[28] Wood Mackenzie, 2021, 700 Million Electric Vehicles Will Be on the Roads by 2050
[29] IEA, n.d., Mineral requirements for clean energy transitions
[30] IEA, 2023, Electric Vehicles
[31] IEA, n.d., Mineral requirements for clean energy transitions
[32] Ibid.
[33] IEA, n.d., Mineral requirements for clean energy transitions
[34] Energy Transitions Commission, 2023, Scale-Up of Critical Minerals and Resources Required for Energy Transition

developing mines is a heavily time consuming and expensive process, taking approximately 16 years to start production on a mine from discovery.[35] The diminished financial support for companies with lower ratings may hinder production, introducing an additional potential bottleneck in the supply chain. If critical mineral producers are unable to match the rising demand, clean energy technology industries reliant on them are unlikely to raise production to the levels required by Net Zero goals.

There is a further concern about the lack of public investment in clean energy, obstructing the industry's growth in the EU. The EU announced an investment of €10 billion via the European Sovereignty Fund to catalyse the development of clean energy sectors in response to the United States Inflation Reduction Act of €340 billion.[36] Another related issue is inadequate private funding for investments in metals and mining. Producing one tonne of nickel and copper emits 12-78 tonnes and 4 tonnes of Carbon Dioxide, respectively.[37] Increasing investor emphasis on environmental, social, and governance criteria, commonly known as ESG, reduces private investment in the clean energy sector and critical mineral manufacturing. There is, therefore, a significant discrepancy between the EU's climate goals as established by the SDS and its investment in clean energy, which, when combined with low private investment due to investor preferences, further obstructs EU's Net Zero goals by limiting the growth of the clean energy sector.

[35] IEA, 2023, Electric Vehicles
[36] Transport and Environment, 2023, No New EU Money for Green Tech in Latest Budget Review
[37] Carbon Trust, n.d., Digging Net Zero Pathways for Mining Green Tech Metals with IFC

Economic implications of geopolitical conflicts.

The production of critical minerals is highly geographically concentrated. China is responsible for the processing of a majority of critical minerals, including 58% of all global processing of lithium, 40% of copper processing, 37% of nickel processing, 64% of cobalt processing and approximately 90% of REE processing.[38] The heavy reliance of clean energy industries on Chinese critical mineral manufacturers makes the supply of clean energy products susceptible to Sino-Western political tensions. Thus, reshaping the supply chain through de-risking from China poses significant economic risks and challenges to the EU, particularly due to its effects on international trade. Nonetheless, by maintaining such a strong dependence on China's critical mineral supplies, the EU may be left vulnerable in the case of escalating geopolitical tensions. Ursula von der Leyen, President of the European Commission, explains risks of China exploiting the dependency of the EU, and issues of the government prioritising national security and economic outcomes over political and civil rights.[39] The divergence of interests means the goals of the two parties may create further conflicts. De-risking ensures a transition towards higher national security as well as the ability to enforce higher quality standards to avoid risks when handling the minerals further in production.

The protectionist approach to acquiring critical minerals also comes with some economic risks. Naturally, there is a misallocation of resources when the EU attempts to source its own critical minerals as China is the most efficient supplier with large amounts of critical minerals available to mine combined with low labour costs, hence why it has retained its market leadership. Furthermore, China may retaliate by imposing its own trade protective measures against EU countries. This has previously been the case such as in August 2023 when China implemented export restrictions on gallium and germanium, two critical minerals used primarily in producing semiconductors and electronics.[40] As China controls 98% of global gallium production and 67% of germanium production, this will inevitably have significant supply chain issues in EU countries, again proving the need to de-risk.[41]

Out of the top 3 importers of gallium, two are in the EU - Germany and the Netherlands. Members of the European Commission as well as Germany's Minister for Economic Affairs Robert Habeck, among others, expressed concerns at this move; particularly looking at the future, expanding these export controls to more prominent minerals such

[38] Energy Transitions Commission, 2023, Scale-Up of Critical Minerals and Resources Required for Energy Transition
[39] Dempsey, J., 2023, Europe's Dangerous Dependence on China
[40] CSIS, 2023, Innovation Lightbulb: Critical Minerals and the U.S.-China Chip War
[41] Ibid.

as lithium would provide significant challenges.[42] The move was partly seen as a response to the Dutch ban on semiconductor exports to China introduced in March 2023, alongside their proposed alliance with the US and Japan exploring similar bans in the interest of national security.[43] Such retaliation can in the worst case lead to a trade war and the weaponisation of trade, creating strained geopolitical relations and worse outcomes for all parties involved.

Furthermore, price volatility of metals and critical minerals is a major economic concern which could destabilise the expansion of clean energy industries. The ongoing invasion of Ukraine by Russia has underscored the susceptibility of concentrated commodity supply chains and the dangers associated with excessive reliance on specific nations. The impact of the Russia-Ukraine conflict on Lithium prices raises concerns about the potential impacts of a political conflict between the West and China on the stability of the supply and prices of critical minerals. Notably, the price of nickel on the London Metal Exchange (LME) experienced a surge of more than 270 percent within a span of three trading days in March 2022.[44] Numerous mining activities faced temporary interruptions due to the impact of COVID-19. Additionally, the transportation of bulk materials encountered a ten-year peak in freight rates, attributed to congestion in vital ports, quarantine constraints, persistent challenges in staffing shipping crews, and a resurgence in fuel prices from the significant lows experienced in the spring of 2020. These factors collectively contributed to an increase in the overall cost of metals. This creates a need for European firms to diversify their sources of critical minerals to mitigate the risks posed by the high degree of Chinese market power in the critical mineral industry.

Overall, due to the reasons described in this section, it is important that effective and sustainable policies are designed in de-risking the EU's critical mineral supply chain from China. This will allow for less volatility in the supply chain allowing the growing demand for greener technology to be met, while maintaining mutually beneficial trade relations and the most economically efficient outcomes.

[42] Euractiv, 2023, Companies Race to Secure Supplies After China Restricts Gallium, Germanium Exports
[43] Reuters, 2023, Dutch to Restrict Semiconductor Tech Exports to China, Joining US Effort'
[44] Gov.UK, 2023, UK Critical Minerals Strategy

Supply dynamics of critical minerals within the European Union and establishing external trade partners.

Critical Minerals have been extremely topical within the European Union and have been the source of recent scandals. The recent resignation of Portuguese Prime Minister António Costa, amidst a corruption investigation linked to lithium mining concessions in the northern region of the country, has further hindered Brussels' efforts to broaden its sources of raw materials essential for green and digital technologies.

In addition to investigations into a green hydrogen mega-project and a data centre, the lithium extraction initiatives, constituting a total investment of €23.5 billion that Costa aimed to secure, are facing investigation. Portugal's lithium deposits are considered crucial to the bloc's strategy in securing its reserves. However, despite the reliance of nations on investments for utilising their domestic resources, the bloc's unpreparedness for its mining endeavours poses a risk for investors who may end up funding projects that may never materialise.[45]

There have been further tensions within the EU, with a historic farming village located in the Portuguese mountains resisting plans for a nearby open-pit lithium mine, intended for electric car batteries. While Portugal's lithium reserves are pivotal for the continent's surging demand for electric vehicles, villagers argue that such gains should not come at the expense of their traditional way of life.

The proposed Barroso Lithium Project has triggered a dispute over common land, with the majority owned by the village, as international mining company Savannah Resources seeks access. Despite revisions and conditional approval, strong opposition persists, with the local community expressing concerns about environmental impact. The European Union's quest to reduce reliance on foreign lithium sources adds significance to this struggle, as the outcome could influence future mining decisions across the continent.[46]

Furthermore, the European Union has been urgently working to broaden its access to raw minerals following the scandals in Portugal by securing agreements with lithium-rich countries such as Australia, Chile, or the South American Mercosur group, but these efforts have had limited success.

[45] BBC, 2023, Portuguese PM Antonio Costa Resigns Over Lithium Deal Probe
[46] BBC, 2023, Portugal's Barroso Lithium Mine Project Faces Villagers' Ire

Argentina, situated within the lithium triangle alongside Chile and Bolivia, collectively holding over half of the world's known reserves of the metal, has become a focal point. Meanwhile, Australia, the leading global lithium producer, recently experienced a dramatic breakdown in negotiations with the EU over beef and sheep quotas. Given upcoming elections on both sides, any potential deal may have to be deferred until 2025.

The stalled negotiations mean that Brussels will need to exercise patience to gain access to Australia's reserves, while Canberra cannot rely on European investments in the sector. Australia had initially hoped to attract EU investments to extract these valuable minerals, seeking to diversify away from dependence on China. Meanwhile, negotiations between the EU and the Mercosur countries—Brazil, Argentina, Uruguay, and Paraguay—are encountering obstacles. The Commission recently conceded the possibility of reopening the trade deal, initially agreed upon at a political level in 2019, potentially causing further delays to the long-anticipated trade pact that has been in the works for decades.

The South American nations are adamant about shifting away from extractive relationships. Gustavo Martínez Pandiani, Argentina's chief representative to Switzerland and a key adviser to Sergio Massa, the current economy minister, emphasised their desire for a partnership rather than being mere suppliers of raw materials. According to Pandianil, there's a risk, even for Europe, that if they remain solely suppliers, they could seek alternative clients, such as China.[47]

[47] Yang, Y. & Nilsson, P., 2023, Western Companies Take Slow Steps Toward China 'De-Rerisking'

Conclusion:

- Inadequate public and private funding hampers clean energy growth in the EU. Despite climate goals, there's a significant disparity between clean energy investment and demand, hindering progress toward Net Zero objectives.
- The EU's protectionist approach risks misallocation of resources and potential retaliation from China. Export restrictions on critical minerals and supply chain issues underscore the need to de-risk and avoid a potential trade war.
- The EU faces hurdles in securing agreements with lithium-rich countries like Australia. Delays in negotiations pose challenges for accessing reserves, and a shift from extractive relationships emphasises the need for strategic partnerships.

Policy Recommendations

Overview

The following section will suggest three policy recommendations based on the understanding of the problem that have been developed from the briefing and insight.

Action 1: Making critical mineral production more sustainable through the reduction of carbon emissions.

Action 2: Improving recycling processes, waste management systems and regulatory requirements.

Action 3: Strengthening Friend Shoring and forming stronger trade alliances with the global south.

Action 1: Making critical mineral production more sustainable through the reduction of carbon emissions.

As previously highlighted, a major issue why investors are choosing not to invest in critical mineral producers is because of their ESG criteria. This is reducing the total investment into critical mineral production, ultimately hindering the growth of the clean energy sector. We recommend implementing a comprehensive umbrella scheme across the EU aimed at reducing Carbon Dioxide emissions from the production of critical minerals in an attempt to make critical mineral producing firms more attractive investments by helping them meet the ESG criteria of private-sector investors.

The scheme consists of two parts; the first part will involve the EU mandating Europe-based producers of critical minerals- such as Lithium producers in Portugal to implement Carbon Capture, Utilisation and Storage (CCUS) technologies at source to reduce their carbon emissions. These technologies can capture approximately 90% of the carbon emitted from factories and can hence make clean energy supply chains more sustainable.[48] Carbon capture technologies have gained traction as countries such as the USA and Sweden have begun investing in them. Utilising synthetic fuels produced from carbon emissions is a step towards a circular economy; Sweden's 'Project Air' aims to start producing 200,000 tonnes of methanol in 2025 from carbon dioxide captured from a biomass plant while Belgium has commissioned the first large-scale capture plant to convert carbon dioxide emissions from steel production to ethanol in 2022.[49] Firms may maintain the option of choosing pre-combustion carbon capture wherein they can convert the carbon-based fuel to a carbon-less option and use the remnant hydrogen as an alternative fuel; or post-combustion carbon capture wherein they can retrofit post-combustion capture equipment to existing facilities or attach them to new factories, making them implementable to a majority of existing factories. While carbon capture is becoming more popular, there is yet to be the case that firms themselves capture the emissions that they produce; by mandating firms to do so, they are held accountable for their emissions and there will also be an increase in the total amount of carbon capture facilities across Europe which will reduce the amount of carbon emissions released into the atmosphere. Due to the high initial investment and time required to modify existing manufacturing technologies, the EU can subsidise critical mineral producers and provide a buffer period of 3-5 years to enable firms to install the needed technology.

The EU currently employs cap and trade models or 'Carbon Taxes' to reduce GHG emissions caused by industries wherein firms must pay a tax on their emissions or buy

[48] C2ES, n.d.,Carbon Capture
[49] IEA, 2022, Role of Critical Minerals in Clean Energy Transitions

permits from the government which allow them to produce greater amounts of emissions; these schemes have been relatively successful as 'The Emissions Trading System' has been credited for reducing annual GHG emissions by 2-2.5%.[50] While cap and trade models are shown to be effective in reducing GHG emissions, they could hinder the growth of industries by limiting their production when the shift to sustainable production methods is not viable. In the case of critical mineral production, cap and trade models could limit the total amount produced, which would ultimately decelerate the growth of the clean energy sector.

The EU can instead utilise policies to discourage firms from unsustainable production practices without keeping rigid limitations on pollution and- by extension- production levels. An example of such policy could be a carbon tax. The EU already utilises a form of this policy in the 'European Union Emission Trading System' but there could be improvements made to the scheme. For instance, only 20 of the 27 EU nations have implemented a form of carbon tax, suggesting that there exists the opportunity for a broader expansion of the scheme.[51] In order to foster sustainability in critical mineral production and propel the growth of the European clean energy sector, we propose the implementation of a centralised carbon tax by the EU. This proposed carbon tax would be specifically levied on critical mineral producers, with the provision of exempting them from their national carbon taxes. The revenues generated from the proposed EU-wide carbon tax could be directed towards the establishment of an EU investment fund. This dedicated fund would be exclusively earmarked for financing initiatives geared towards the development of the European clean energy sector. By utilising the collected funds strategically, the EU can significantly contribute to the advancement of cleaner and more sustainable energy practices. However, we acknowledge that instituting a standardised tax rate across all EU member states may present challenges, given the diverse economic landscapes and varying cost-of-living indices. To address this, we recommend the adoption of a nuanced approach, wherein tax rates are adjusted to accommodate each country's specific economic circumstances, encompassing factors such as national tax rates and cost of living. This tailored strategy aims to strike a balance between the imperative for a unified carbon tax policy and the necessity to accommodate the unique economic conditions prevalent in each EU member state.

These two policies combined form an umbrella scheme similar to the USA's Inflation Reduction Act but with a focus on critical mineral production. As the European critical mineral production industry grows from increased institutional and government

[50] European Central Bank, 2023, Benefits and Costs of the ETS in the EU, a Lesson Learnt for the CBAM Design
[51] Mengden, A., 2023, Carbon Taxes in Europe

investment, it will dominate a larger share of the global critical mineral market, reducing China's monopolistic influence in the industry and hence effectively de-risking the critical mineral supply chain.

Action 2: Improving recycling processes, waste management systems and regulatory requirements.

As sustainable production and consumption become increasingly pressing issues, a greater emphasis is being placed on recycling and reusing critical minerals rather than solely finding ways to extract more. The importance of the circular economy arises from the risks associated with overreliance on a sole supplier, as previously described, alongside the rising prices of critical minerals. Hence a solution may be to create more efficient recycling and waste management systems.

It must be noted that achieving a fully circular economy where no external supplier is required is unrealistic and there will always be some form of international dependence, due to both the EU's limited mining reserves and the difficulties in recycling some critical minerals. Although the EU has been successful in recycling some critical minerals, such as copper, the vast majority remain mostly extracted, particularly lithium, manganese and natural graphite.[52] This is partly due to certain hazards in the recycling process; around 15 of the most used critical minerals have a 1% recycling rate as they are often mixed together for producing, for instance, magnets or batteries.[53] As different minerals may involve different recycling processes, the separation of the minerals would be an additional step involving the use of hazardous chemicals and high levels of heat.[54] Furthermore, the increasing demand for critical minerals, spurred by technological advancements, means recycling alone will not suffice for meeting the EU's demand. This leads to the reason why many organisations are advocating for a circular economy, which instead focuses on designing products in a way that they can be reused and extending the use of materials to extract the maximum amount of value from them.[55] Policies oriented towards a circular economy will be more comprehensive in ensuring production is designed in a way that maximises value derived from the critical minerals and that materials are "cycled back into the economy".[56]

As an immediate transition to a fully circular economy is not feasible, the EU may implement policies to regulate how manufacturers handle their critical mineral waste. To begin, better regulatory requirements are necessary to set out how products using significant quantities of critical minerals, such as EVs and consumer electronics, must be designed. For instance, designs allowing for easier separation of different

[52] Ibid 47
[53] Ferris, N., 2023, Why recycling is no golden ticket to endless critical minerals
[54] Ibid.
[55] Deloitte, n.d., A circular economy for critical minerals is fundamental for our future
[56] Pennington, J., 2022, The circular economy is vital for the energy transition

components or critical minerals would create the possibility for easier and safer recycling. Moreover, making the products themselves more durable or easily repairable would extend the product life cycle and encourage reuse rather than further consumption.[57] As the movement towards green energy sources and resultant technological advancements does require critical minerals, designing the products in an appropriate way from the beginning would allow for more sustainable usage. These requirements could be rolled out by national governments over the course of a year, targeting specific industries tailored to the country.

While critical mineral recycling facilities do exist in the EU, the main identified issue is the lack of a systematic approach where waste is efficiently managed, collection infrastructures exist, and there are sufficient economic incentives to do so.[58] As previously highlighted, the collection rate of waste electrical and electronic equipment in the EU is 46.2% as of 2021, though this ranges from 3.96 kg/inhabitant in Cyprus to 19.96 kg/inhabitant in Norway; hence, the differences across countries may also need to be considered to create tailored solutions.[59] On a wider scale, critical mineral waste management systems need to be developed to ensure that once minerals reach the end of their life, their uses are fully reaped before being discarded. The EU Sustainable Battery Regulation, implemented in 2006 and amended in 2020, introduced requirements for the labelling and placement of batteries in products alongside a digital database of all industrial batteries on the EU market.[60] This could be extended to display information on individual companies' batteries and critical mineral waste percentages, particularly the largest companies contributing most to emissions, to create accountability and incentivise them to adapt production systems.

Altogether, this could create a comprehensive plan, similar to the EU Waste Framework Directive of 2008 but rather with a specific emphasis on critical mineral waste. Through such policies, the EU can maintain a sufficient supply of critical minerals internally. With proper recycling and waste management systems, the overreliance on China will be gradually reduced, de-risking in an efficient manner.

[57] Schröder et al., 2023, Europe's pursuit of securing critical raw materials for the green transition
[58] Righetti, E. & Rizos, V., 2023, The EU's Quest for Strategic Raw Materials: What Role for Mining and Recycling?
[59] European Commission, 2023, Waste statistics - electrical and electronic equipment
[60] IEA, 2022, EU Sustainable Batteries Regulation

Action 3: Strengthening friendshoring and forming stronger trade alliances with the global south.

As many of the Western countries are derisking from China due to overreliance, we have seen countries such as the US mobilise themselves to obtain raw materials from 'friendly' countries with shared values to ensure security of domestic production. The term friendshoring encapsulates this growing trade strategy, which has involved directing supply chain networks towards countries recognised as both political and economic allies. This tends to be countries who are deemed as politically and economically safe, or low-risk, and takes a diversified approach to avoid the interdependence that has been seen with the EU on China.

The European Union's economic strategy recognises the importance of cooperation with allies such as the G7 and NATO members on this matter, and acknowledges that the EU will have to engage with the "broadest possible range of partners".[61] This strategy opens up the possibilities for partnerships with the global south, and for non-traditional partnerships to be formed.

It is crucial for the EU to provide a more compelling proposition than China, who have been involved with the global south for decades via strategies such as the Belt and Road Initiative. This initiative uses geopolitics and infrastructure to connect Asia with Africa, increasing trade and integration. China has also invested heavily in infrastructure within Africa which has helped them build their critical minerals monopoly, for example China spent more than $1 billion over the past two years to acquire and develop lithium projects in Zimbabwe.[62] Such investment strategies enhance long term partnerships, and the EU should focus on securing these partnerships through similar investment schemes. European Development Finance Institutions could implement preferential access to climate funding for nations engaging in critical mineral partnerships with the EU. An issue many countries in the global south are facing, is that they are being exploited for their natural resources and are not reaping the full benefits of their supplies. Thus taking this approach could prevent the risk of treating resource-rich states solely as suppliers of critical minerals, thereby contributing to the enhancement of European relations with certain African countries. Moreover, it increases the prospects of fostering alignment between the parties in the future.

[61] European Commission, 2023, An EU approach to enhance economic security *
[62] Banya, N. & Chingono, N., 2023, Zimbabwe presses miners to produce battery-grade lithium locally

This is a strategy the US is looking to pursue as well, US Treasury Secretary Janet Yellen asserted this new trade strategy last year highlighting that "Rather than being highly reliant on countries where we have geopolitical tensions and can't count on ongoing, reliable supplies, we need to really diversify our group of suppliers," and highlighted that "Friendshoring means… that we have a group of countries that have strong adherence to a set of norms and values… and we need to deepen our ties with those partners and to work together to make sure that we can supply our needs of critical materials."[63] The US has gone on to successfully forge partnerships with critical mineral rich Australia by offering preferential trade treatment by enabling critical minerals mined in Australia to be eligible for tax credits under the Inflation Reduction Act. This agreement is incredibly beneficial to Australia, as it is set to allocate billions to Australia's energy sector, and as early as 2028, the export value of Australia's lithium is projected to surpass that of its thermal coal.[64]

In conclusion, as Western countries strategically distance themselves from overreliance on China, the emerging concept of 'friendshoring' becomes pivotal in reshaping global trade dynamics and diversifying critical mineral supply chains. By emulating successful models such as US-Australia and China-Africa critical mineral partnerships, the EU stands in good stead to secure their critical mineral supplies. As the EU explores new avenues, it is clear that fostering partnerships based on shared values and long-term investment is key to securing reliable critical mineral supplies, strengthening geopolitical ties, and ensuring a sustainable and resilient economy.

[63] Fouriezos, N., 2022, Janet Yellen's message to the world: There can be no 'sitting on the fence' on Russia

[64] Innovation News Network, 2023, Inflation Reduction Act set to allocate billions to Australia's energy sector

Conclusion

In conclusion, despite the supply chain disruptions and vulnerability associated with overreliance on one country, there exist several opportunities to ease the EU's de-risking process from China. Incentivising ESG-focused private-sector investors to make investments in critical mineral mining may help with increasing the overall quantity available in EU production. Carbon capture technologies similar to those in the USA and Sweden have the potential to reduce the excessive greenhouse gas emissions from critical mineral processing facilities, making clean energy supply chains more sustainable. Recycling processes and efficient waste management systems, coupled with more stringent regulatory requirements on the labelling and processing of critical minerals could aid with reducing the overall dependence on mineral extraction rather than reusing. Ultimately moving towards a circular economy has been a central goal advocated for by the European Commission, as extending the life cycle of production inputs will help reach net zero targets. Most importantly, the issue of de-risking is one that has cross national implications since friendshoring and trade alliances are important to ensuring the EU maintains strong geopolitical relationships.

As the world moves towards a clean energy transition and the climate crisis becomes an increasingly pressing issue, the availability of critical minerals is crucial. Such policies will be invaluable in creating stable critical mineral supply chains, ultimately reaching global net zero targets.

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