UNIVERSITY OF TURKU
Turku School of Economics

Securing the EU's energy transition from strategic dependencies

The EU's Critical Raw Materials Act and contradictions with the 10% mining goal

Department of International Business

Master's thesis

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Abstract

The European Union's objective to achieve climate neutrality by 2050 has significantly increased the demand for critical raw materials (CRMs). In addition, as the global energy transition accelerates, the demand for these materials has increased significantly, reshaping traditional patterns of energy security and dependency. While the energy transition aims to promote sustainability and reduce reliance on fossil fuels, it simultaneously introduces new vulnerabilities. These are linked to concentrated and externally dependent supply chains, particularly involving countries such as China. At the same time, rapid changes in CRM governance create additional pressure for the EU to secure its own supply, as global dynamics are often driven by resource-rich countries.

Therefore, the aim of this master's thesis is to examine the extent to which the EU's Critical Raw Materials Act (CRMA) can reduce strategic dependencies, with a particular focus on its 10% domestic mining target. The theoretical framework examines structural vulnerabilities in global CRM supply chains, the role of the CRMA in addressing these vulnerabilities, and the general challenges associated with mining that affect the feasibility of the target. The framework combines Global Production Networks theory (GPN), securitization theory, and concepts of energy security and energy transition to explain how dependencies are formed and politicized, as well as addressed through policy

Empirically, the study is based on qualitative analysis using semi-structured expert interviews with Finnish diplomats, European Commission officials, and researchers. This approach allows for an in-depth examination of the phenomenon within its complex political and economic context. The findings suggest that while the CRMA is perceived as a necessary and strategically relevant policy instrument, the mining goal's effectiveness is limited by common barriers in the mining sector. These include regulatory complexity, environmental concerns, social acceptance, and economic competitiveness. In addition, the study highlights a divergence between the theoretical understanding of supply chain vulnerabilities and the perceived level of risk in practice, which affects political commitment and the ambition of policy measures.

This thesis concludes that although the CRMA's mining goal represents a step toward strengthening the EU's strategic autonomy, its impact on reducing strategic dependencies is likely to remain limited without broader institutional and political changes. Furthermore, the study emphasizes the need for more coordinated and enforceable policy measures that take into account both global supply chain dynamics and internal EU constraints.

Keywords: European Union, critical raw materials, China, mining, supply chains, Critical Raw Materials Act, strategic dependency, strategic autonomy, energy transition

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Tiivistelmä

Euroopan unionin (EU:n) tavoite saavuttaa hiilineutraalius vuoteen 2050 mennessä on lisännyt merkittävästi kriittisten raaka-aineiden kysyntää. Sen lisäksi globaalin puhtaan energiasiirtymän kiihtyessä kriittisten raaka-aineiden tarve on noussut merkittävästi muuttaen perinteisiä energiaturvallisuuden ja riippuvuuksien rakenteita. Vaikka siirtymä pyrkii edistämään kestävyyttä ja vähentämään nojaamista fossiilisiin polttoaineisiin, se samaan aikaan nostaa esiin uusia haavoittuvuuksia. Nämä ovat yhteydessä keskittyneisiin ja ulkoisesti riippuviin toimitusketjuihin, kuten Kiinaan. Toisaalta raaka-ainepolitiikan nopeat muutokset luovat paineita EU:n oman raaka-ainekysynnän turvaamiselle, kun politiikkaa ajaa lähinnä raaka-ainerikkaat maat.

Tämä pro gradu -tutkielman tavoitteena on tarkastella, missä määrin EU:n Critical Raw Materials Act (CRMA) pystyy vähentämään strategisia riippuvuuksia erityisesti sen 10 %:n kaivostoimintatavoitteen kautta. Teoreettinen viitekehys rakennetaan tarkastelemalla rakenteellisia haavoittuvuuksia globaalien kriittisten raaka-aineiden toimitusketjuissa, CRMA:n roolia näiden haavoittuvuuksien vastaisessa työssä ja kaivostoiminnan yleisten ongelmien vaikutuksia kaivostoimintatavoitteen saavutettavuuteen. Kehys yhdistää Global Production Networks -teoriaa, sekuritisaatioteoriaa sekä energiaturvallisuuden ja puhtaan energiasiirtymän konsepteja vastaamaan, kuinka riippuvuudet muodostuvat ja politisoituvat. Lisäksi kuinka politiikalla reagoidaan näihin dynamiikkoihin.

Empiirisesti tämä tutkimus perustuu laadulliseen analyysiin käyttäen puolistrukturoituja eksperttihaastatteluita suomalaisten diplomaattien, Euroopan unionin komission virkamiehen ja tutkijoiden kanssa. Tämä mahdollistaa ilmiön tarkastelun sen monimutkaisessa poliittisessa ja taloudellisessa kontekstissa. Löydökset osoittavat, että vaikka CRMA on laajasti tunnettu tarpeelliseksi ja strategisesti ajankohtaiseksi politiikkatyökaluksi, kaivostoimintatavoitteen onnistuminen kohtaa vaikeuksia kaivostoiminnan lisäämisessä EU:n sisällä. Näihin sisältyy sääntelyn monimutkaisuus, ympäristöllinen vastustaminen, sosiaalinen hyväksyntä ja taloudellinen kilpailukyky. Lisäksi tutkimus tuo esiin eron teoreettisesti tunnistettujen toimitusketjuhaavoittuvuuksien ja käytännössä koetun riskin välillä, mikä vaikuttaa poliittiseen sitoutumiseen ja toimenpiteiden kunnianhimoon.

Tutkimus osoittaa, että vaikka CRMA:n kaivostoimintatavoite edustaa askelta kohti EU:n strategisen autonomian vahvistamista, sen vaikutus strategisten riippuvuuksien vähentämiseen jää rajalliseksi ilman laajempia institutionaalisia ja poliittisia muutoksia. Tulokset korostavat tarvetta paremmin yhteensovitetuille ja täytäntöönpanokelpoisemmille politiikkatoimille, jotka huomioivat sekä globaalien toimitusketjujen dynamiikan että EU:n sisäiset rajoitteet.

Avainsanat: Euroopan Unioni, Kriittiset raaka-aineet, Kiina, Kaivostoiminta, Toimitusketjut, Critical Raw Materials Act, strateginen riippuvuus, strateginen autonomia, energiasiirtymä

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LIST OF FREQUENTLY USED ABBREVIATIONS

EU	European Union
CRMA	Critical Raw Materials Act
CRMs	Critical Raw Materials
GPN	Global Production Networks
NIMBY	Not in my backyard
REE	Rare Earth Elements
U.S.	United States

1 Introduction

1.1 Background of the study

The transformation of Europe's energy system has become one of the defining challenges of our time. The 2022 energy crisis revealed just how exposed the European Union (EU) remains to external shocks, especially its dependence on Russian fossil fuels. In the aftermath, the EU accelerated its push toward renewable energy, presenting the energy transition not only as a tool to tackle climate change but also as a way to build a more independent and resilient energy system (The Finnish Government Oct.20, 12.2025; Siddi 2023, 8; Karjalainen & Iso-Markku 2026, 11.)

However, moving away from fossil fuels does not automatically resolve dependency risks. Instead, the transition has created new forms of reliance, particularly on critical raw materials (CRMs) such as lithium, cobalt, and rare earth elements (REE). These inputs are essential for technologies like solar panels, wind turbines, and battery storage, yet their extraction and processing are highly concentrated in a small number of countries. This raises the question of whether Europe, while reducing its exposure to Russian energy, may be entrenching other forms of dependencies (Findeisen & Wernert 2023, 3; GTK 23.5.2024). When considering the EU risks, the risks become evident, especially with actors such as China, which dominates many stages of the global CRM supply chain. (European Commission 2024; Mouel & Poitiers 2023, 5.)

This dilemma is compounded by geopolitical tensions. Russia's use of energy as a political weapon during the war in Ukraine shocked the world by showing how vulnerable global supply chains are to disruptions if a dominant actor decides to cut off the supply. Furthermore, it demonstrated how interdependence can be leveraged for political coercion (Karjalainen & Iso-Markku 2026, 11). At the same time, shifts in transatlantic relations and growing strategic rivalry between the United States (U.S.) and China are reshaping the global political economy of CRMs. The return of Donald Trump to the U.S. presidency has reinforced a more transactional and protectionist approach to industrial and resource policy, emphasizing domestic production and unilateral measures over multilateral ones. (Möller 2026, 9; Ashford Jan. 23, 2025; Bearak Jan. 15, 2025).

This changing U.S. posture places additional pressure on the EU, which can no longer fully rely on transatlantic alignment in securing access to critical inputs for the energy transition (Möller 2026, 9). Therefore, when major economies increasingly prioritize national resilience and industrial sovereignty (Guinea & Sharma 2023, 3–4; Herranz-Surralles 2024, 1884), China's dominant position in the CRM supply chain becomes even more strategically salient, as it is considered both

an economic rival and a business partner. Therefore, if China seeks to consolidate or strategically deploy its control over key CRM supply chains to safeguard its own technological and geopolitical interests, the EU, as a dependent downstream consumer, will face difficulties responding to China's actions (Mouel & Poitiers 2023, 5; Baskaran Oct. 9, 2025.) A good example of this risk is the geopoliticisation of CRMs in 2010, where China cut off REE supply to Japan. (Theodosopoulos 2020, 2.)

Consequently, ensuring secure and diversified access to CRMs has become not only a question of environmental sustainability or economic efficiency, but a core issue of political autonomy and strategic positioning. For the EU, managing CRM dependencies is increasingly intertwined with its ability to navigate great power competition, maintain industrial competitiveness, and preserve decision-making independence in an era of heightened geopolitical fragmentation. (Theodosopoulus 2020, 2; BOFIT 2025)

To strengthen the resilience of the CRM supply chains, the EU introduced a new industrial policy, the 2023 Critical Raw Materials Act (CRMA), as a response to mounting geopolitical and security pressures. The Act seeks to secure access to materials essential for key industries and the clean energy transition by promoting domestic extraction, processing, recycling, and diversification. Among these pillars, 10% increase in domestic mining occupies a particularly sensitive and contested position, as it lies at the intersection of strategic autonomy, environmental sustainability, social acceptance, and regulatory complexity. (European Commission 2023a.) The objectives of the regulation are highly demanding in light of the EU's structural position in the previously highlighted global CRM supply chains. For instance, the EU accounts for over 20% of the CRMs consumed in the world and only sources a small part itself (GTK 23.5.2024).

This imbalance between demand and production underscores the strategic vulnerability at the heart of the EU's energy transition. As the demand for CRMs intensifies globally, the EU's dependence on external suppliers exposes it to both market volatility and geopolitical leverage. At the same time, the EU's aspiration to expand domestic extraction through the CRMA highlights the tension between environmental ambition, social legitimacy, economic competitiveness, and strategic autonomy (Wien 2024, 12). These dynamics position the CRM question not only as a matter of industrial policy but also as a test of the EU's broader capacity to reconcile its sustainability commitments with the realities of global interdependence. Thus, the next subchapter discusses this study's relevance by linking the background introduced in this subchapter to existing research.

1.2 Research gap and relevance

While the CRMA presents domestic extraction as a cornerstone for reducing external dependencies, the practical feasibility of expanding mining activities within the EU remains uncertain. Since the mining operations are decided at the member state level, the extent to which these goals are implemented varies significantly. This is largely due to the negative aspect of mining, including long permitting procedures, public opposition, environmental concerns, and uneven geological endowments across member states (Wien 2024, 12). On the other hand, mining is the foundation upon which downstream processing, manufacturing, and recycling capacities ultimately depend. That being said, mining does not operate in isolation because its feasibility is closely tied to the broader structure of global production networks (GPNs), where production is organized according to specialization (Coe & Young 2015, 30; Gong et al. 2026, 30).

Moreover, the interaction between GPN dynamics and the securitization of CRMs further shapes how domestic mining is perceived and pursued. While securitization frames CRMs as essential for economic security and strategic autonomy, it may also conflict with the underlying market logic and thereby undermine how domestic actors accept the perceived risk. (Buzan 1998, 40; Herranz-Surralles, 2024, 1884) Therefore, this thesis focuses specifically on the role of mining within the CRMA framework, examining how effectively the Act creates an enabling environment for domestic sourcing. In particular, this thesis seeks to identify the underlying reasons why this objective remains difficult to achieve. Lastly, by concentrating on mining as the first and most politically contentious stage of the CRM value chain, the study aims to assess whether the CRMA can realistically contribute to reducing strategic dependencies and supporting the EU's energy transition.

Existing literature has extensively examined China's dominant position in CRM markets, as well as the structural dynamics of GPNs (See e.g., Gong et al. 2026). In addition, a growing body of research has addressed the environmental and sustainability implications of mining activities (See e.g. Bastianin et al. 2026). However, there is a limited understanding of how supranational actors such as the EU attempt to implement industrial policy in this context. Especially when such efforts rely on the securitization of critical resources. More specifically, existing studies have not sufficiently explored how policy efforts interact with, and potentially contradict, the underlying logic of global markets, where production is driven by cost efficiency (Hess 2021; Coe & Yeung 2015). Therefore, this thesis addresses the gap by bringing together insights from GPN and securitization theories to examine the EU's attempt to promote domestic mining despite structural

and economic constraints. In doing so, it contributes to a more nuanced understanding of the challenges with governing CRM supply chains, where political objectives and market dynamics do not fully align.

1.3 Purpose of the study

From the context outlined in subchapters 1.1 and 1.2, this master's thesis examines how the European Union's energy transition, moreover, the Critical Raw Materials Act, shapes the EU's geopolitical position and energy security. Moreover, the analysis places particular focus on the effectiveness of CRMA's domestic mining objectives as a tool for reducing external dependencies. The research is guided by the main research question (RQ): *To what extent can the EU's Critical Raw Materials Act reduce strategic dependencies on critical raw materials through its domestic mining ambitions?* To deepen the analysis, this main question is explored through three sub-questions (SQ):

SQ1: Why are global critical raw materials supply chains structurally vulnerable to supply disruptions?

SQ2: How does the Critical Raw Materials Act seek to reduce strategic dependencies and strengthen the security of supply in the context of the clean energy transition?

SQ3: What internal institutional, economic, environmental, and societal factors may hinder the implementation of the CRMA's domestic mining objectives within the EU?

Each sub-question serves a distinct purpose in building a comprehensive understanding of the research problem. The first sub-question establishes the broader strategic context by explaining why global CRM supply chains are inherently vulnerable to disruptions. Drawing on the perspective of geographical specialization and midstream dependencies that create exposure to external shocks. The second sub-question shifts the focus from structure to policy response by examining how the CRMA seeks to reduce the EU's strategic dependencies and strengthen supply security in the context of energy transition. The aim is not to focus on the energy transition itself, but rather this framing clarifies why CRMs have become securitized as a strategic concern and how the EU attempts to respond through an industrial policy instrument that sets the EU against the existing market logic. The third sub-question addresses the implementation gap by analyzing the structural, institutional, and societal constraints that hinder the feasibility of the CRMA's domestic mining objective. It focuses on the EU's internal dynamics, such as environmental consideration and long-permitting timelines, that shape how and to what extent these goals can be achieved in practice.

2 Energy security and energy transition

This chapter examines the relationship between energy security and the energy transition within the EU context. It explores how efforts to decarbonize the energy systems intersect with concerns over dependency as well as introduces different dimensions to energy security.

2.1 The four A's framework of energy security

Energy security has long been a central concern for the EU, shaping its economic policies, external relations, and internal integration (see Osicka & Gernoch 2022). Traditionally, it is defined as "the uninterrupted availability of energy sources at an affordable price" (IEA 2020). More recently, after the energy market has increasingly focused on sustainability and supply security, energy security has formed a multidimensional approach. The current dimensions surround four A's, which include the previously mentioned affordability, but also accessibility, availability, and acceptability (Cherp & Jewel 2015, 416).

Affordability refers to the ability to keep energy prices at levels that support economic competitiveness and social stability (IEA 2020). For example, high and volatile energy prices can undermine industrial competitiveness, particularly when compared to major global economies such as the U.S. and China, where energy costs remain structurally lower. At the household level, price spikes disproportionately affect vulnerable consumers and can intensify social inequalities. (Mertens et al. 2024, 6.) From the CRM perspective, the prices of these products have an enhanced risk of price fluctuations that also result in fast and wide changes in world trade (Krugman 2017, 124). This dimension and CRM supply chain also relates to the GPN logic that will be covered in subchapter 3.1.

In addition*, Accessibility* refers to the ability of all citizens to have equitable access to energy resources. While accessibility partly concerns the development and maintenance of reliable infrastructure such as transmission networks, interconnectors, and storage capacity to guarantee a stable energy supply to end users, in practice, it is often considered in socioeconomic terms. (APEC 2007, 31) Ensuring accessibility means keeping energy prices affordable and reducing fuel poverty, thereby ensuring that energy remains available to all segments of society without creating economic hardship (Jones & Dodds 2017, 23). This is a critical dimension for the CRMA's mining goal, as the high energy prices also limit how capable the EU is at promoting CRM extraction when the costs directly affect energy transition and energy security (Righetti & Rizos 2024, 12). Within the EU, unequal infrastructure development and differing national capacities risk creating internal

asymmetries, where some regions benefit from secure and flexible energy systems while others remain vulnerable, for example, to unfavorable partnerships with suppliers (Tagliapietra 2017, 6).

On the other hand, *availability* concerns whether sufficient energy resources exist to meet demand both now and in the future, in other words, the security of supply (Jones & Dodds 2017, 23). Historically, this dimension has been the most urgent dimension of energy security, given the EU's dependence on external suppliers. Even today, around 58,4% of the EU's total energy consumption is met through imports (Eurostat 2023). For decades, availability risks were primarily associated with fossil fuels, particularly Russian gas, Middle Eastern oil, and global competition for liquefied natural gas. These dependencies exposed the EU to geopolitical pressure, supply disruptions, and price volatility. (Groves et al. 2025, 3.) Currently, this dimension faces risks regarding the high demand for CRMs addressed in this study.

A fourth pillar often added to the energy security debate is *acceptability*, or environmental sustainability. It relates to the environmental and social impact of energy production and consumption. It emphasizes minimizing negative externalities such as pollution, greenhouse gas emissions, and ecosystem degradation to ensure that energy generation and use remain socially and environmentally acceptable. In practice, this dimension highlights the importance of aligning energy-related policies with sustainability goals and public acceptance, ensuring that energy systems are not only efficient but also ethically and ecologically responsible. (Jones & Dodds 2017, 23.) The next figure showcases the interconnected nature of the energy security framework, in which all dimensions correlate with one another. This framework can also be used to evaluate the energy transition if implemented at the center of the circle. Furthermore, the figure already brings up key terms used when evaluating the feasibility of mining activities.

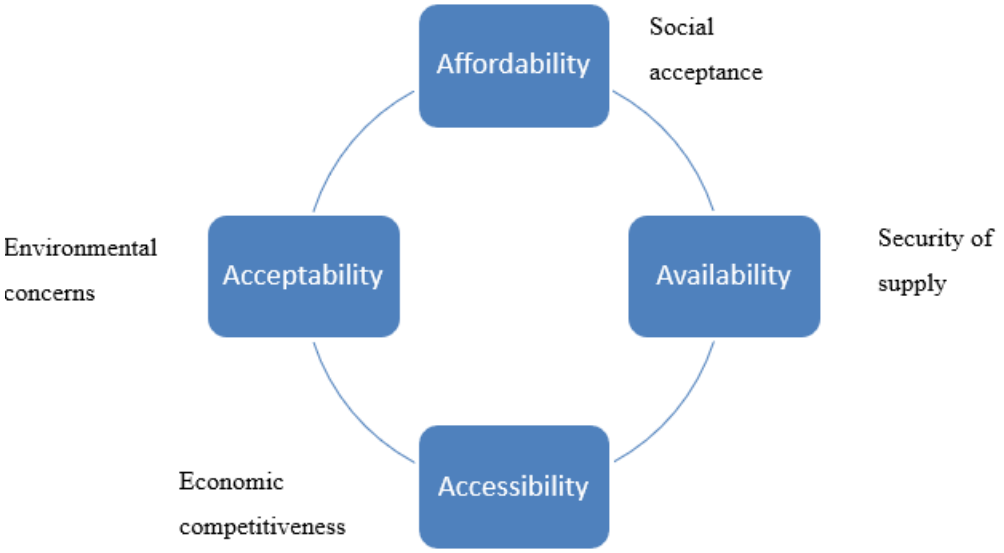

Figure 1 The four A's of energy security

Figure 1 illustrates energy security as a circular framework composed of four interconnected dimensions of availability, accessibility, acceptability, and affordability. Each segment highlights a specific aspect of energy security. The circular structure emphasizes that these dimensions are interdependent. Strengthening one dimension may weaken another. Figure: own elaboration.

Despite the criticism that the four A's framework oversimplifies the multidimensional nature of energy security and does not fit into the multiple challenges and changes faced by the energy sector, it remains a valuable analytical tool for structuring discussion and comparison. As Jerp and Jewell argue in their study, energy security means different things for everybody, and the usefulness depends on perspective and circumstances (Cherp & Jewell 2015, 416). For example, one might want to secure one dimension and focus on that in policy responses (See e.g. Hughes 2012; Schmitz et al. 2025). Furthermore, a study conducted by Ye et al. (2025) supports this view, noting that while institutions often define energy security through their own specific frameworks or priorities, their underlying goals ultimately align with the four A's. In other words, even when energy security is approached through different conceptual models, the core objectives still revolve around ensuring availability, accessibility, affordability, and acceptability.

For this study, the framework offers a more coherent and structured way to assess how the EU addresses different dimensions of its energy transition, particularly as it seeks to reduce strategic dependencies with the CRMA's mining goal while maintaining competitiveness and sustainability. Furthermore, this more "market" based view supports the EU's efficiency-seeking, where economic gain was often valued more than security. In the context of the EU, energy security is not defined by a single condition but rather by the balance between environmental goals, market stability, and geopolitical resilience. The A's provide a comprehensive lens to evaluate how these dimensions interact. For instance, availability and accessibility are directly linked to the EU's efforts to secure reliable supply chains for CRMs and reduce dependency on external actors, such as China. Affordability connects to the Union's goal of maintaining economic competitiveness and social stability while pursuing decarbonization. Finally, acceptability ties to environmental sustainability and public trust in the energy transition, which are essential for long-term industrial policy legitimacy (Pérez et al. 2018; Siddi 2023, 6). By applying the A's, this study can effectively examine how the EU's energy security framework translates into practical policy responses like the CRMA (European Commission 2023a).

2.2 The clean energy transition and its relation to mining

Energy transition refers to a broad structural shift in how societies produce, distribute, and consume energy. Historically, energy transitions have occurred when dominant energy sources are replaced by new ones, for example, the move from wood to coal in the 10th century, or later from coal to oil and gas. Today's energy transition is fundamentally different in scale and purpose, but ultimately, it considers the change of the current energy mix. It represents a deep transformation of social, economic, and political structures, altering how energy is produced, distributed, governed, and secured. (Yang et al. 2024. 1,4.)

Geopolitically, the global shift toward clean energy is reshaping long-standing patterns of power and dependency rather than eliminating them. Historically, fossil fuels produced an asymmetric geopolitical structure in which a handful of resource-rich states control supply and transit routes. Nowadays, the transition to clean energy has the potential to diffuse some of these power imbalances, but also introduces a new form of vulnerabilities, especially to the geopolitical dynamics of concentrated CRM supply chains in the introduction part. At the same time, the move toward sustainability raises important ethical and social considerations. A just energy transition demands that all communities have access to affordable, safe, and sustainable energy and are part of the decision-making processes. (Yang et al. 2024. 1,4.)

The pressures associated with the energy transition do not arise solely from the transformation of the energy mix itself, but also from the material foundations on which this transition depends. At its core, the transition is contingent on the extraction of CRMs, which constitutes the first stage of the supply chain. While supply chain dependencies have already been identified as a key concern, the projected growth in demand further intensifies the need for additional input. In this context, the CRMA's objective of strengthening domestic mining highlights the importance of viewing extraction as an integral component of the broader energy system. (Siddi 2026, 29-30; Yang et al. 2024, 8-9.)

Rather than serving as a separate analytical framework, the dimensions of energy security provide a useful point of reference for understanding how energy transition and mining are embedded within the same logic. As a part of the energy transition, domestic extraction must align with similar considerations of availability, accessibility, affordability, and acceptability. This linkage emphasizes that mining is not an isolated activity, but a bundle of trade-offs that shape the transition as a whole.

2.3 The EU's clean energy transition

For the EU, energy transition lies at the heart of climate and industrial policies, aiming to achieve climate neutrality by 2050 under the European Green Deal. Given that energy accounts for approximately 75% of the EU's greenhouse gas emissions, decarbonization of the energy sector is a prerequisite for reaching net-zero goals (European Parliament 2023). In 2021, renewable sources accounted for 21,8% of the EU energy consumption, with bioenergy, wind, hydro, and solar as the largest contributors. Currently, the overall target is 42.4% by 2030, complemented by sector-specific goals: 29% renewables share in transport, a 49% share in buildings, and annual increases in renewables for the industry and heating/cooling sectors (European Commission 2023e). These shifts, however, are materially intensive and therefore significantly increase demand for CRMs.

In the energy transition, the concept of *availability* is increasingly linked to critical raw materials. As established previously, the EU is not only dependent on foreign oil and gas but also on imports of lithium, cobalt, nickel, and rare earth elements, most of which are controlled or processed by a few suppliers such as China, the Democratic Republic of Congo, or Indonesia (European Commission 2023a; Müller et al. 2025, 11). This shifts the availability risk from hydrocarbons to CRMs essential for batteries, wind turbines, and solar panels. Ensuring availability, therefore, requires investment in domestic extraction, recycling, refining, and international partnerships to secure stable supply chains. (Guinea & Sharma 2023, 3-4.)

Building on the availability dimension, according to Siddi and Kustova (2021, 1078), states increasingly adopt a geopolitical approach in which energy and CRMs are treated as strategic assets rather than purely economic commodities. This means that policy decisions are not guided solely by market efficiency, but by broader political objectives such as security and autonomy. As a result, governments take a more active role in shaping supply chains through regulation or industrial policy, which often prioritizes control over resources at the expense of market-based outcomes.

On the other hand, *accessibility* in the EU's context has much to do with the internal dynamics of member states. While Western and Northern Europe benefit from diversified supply routes and well-developed infrastructure, many Central and Eastern European countries remain structurally constrained. This asymmetry became visible during the EU's attempt to reduce dependence on Russian gas, where landlocked states such as Hungary and Slovakia faced significantly fewer alternatives compared to coastal countries (Kravchenko et al. 2023, 7). The next picture showcases the division in the EU between energy transition ambitions. The picture shows how countries closer to Russia are grouped with countries that do not value energy transition as much, as they are more intertwined with the fossil fuel supply chain dependencies. (Siddi 2023, 6.)

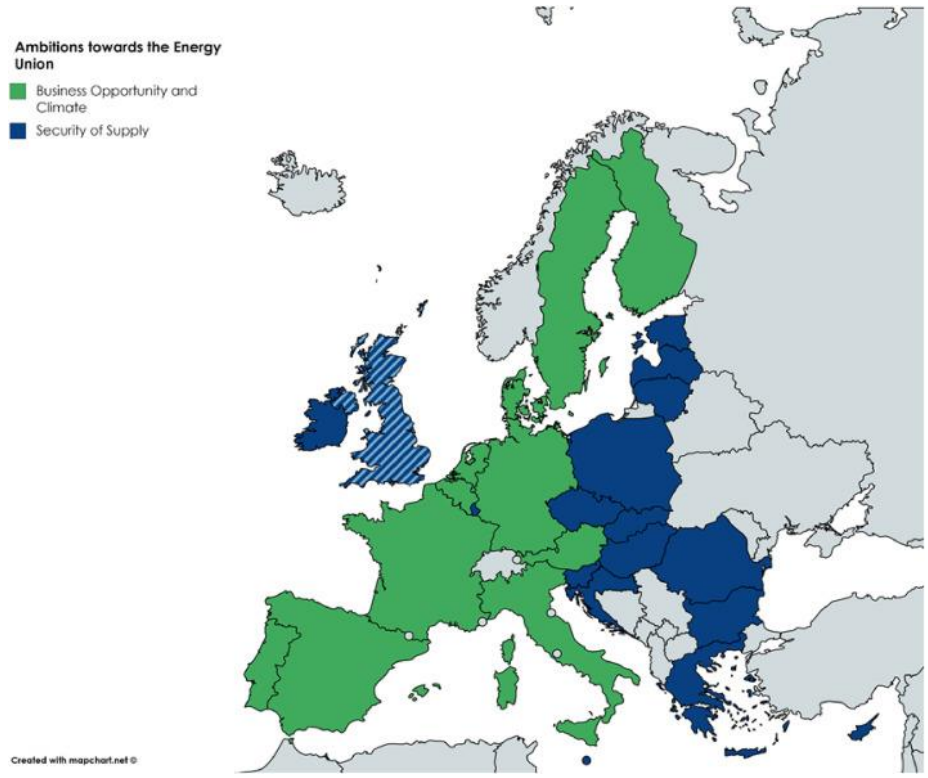

Figure 2 The EU's map showcasing the energy transition's ambitions between member states

Figure 2 shows green and blue clusters in which member states are divided in the energy transition. The blue cluster is more strongly tied to fossil fuels through dependency and infrastructure, which means the aspirations for the energy transition are not high. The green cluster covers mostly western member states that are more interested in the energy transition, as they can benefit from it due to a more advanced market towards renewables. Map from Kravchenko et al. 2023.

These structural inequalities are not only logistical but also geopolitical. Eastern member states have historically been more exposed to Russian energy influence, making them more vulnerable to supply disruptions and economic pressure. As a result, the energy transition and by extension the push for CRM extraction does not occur on a level playing field across the EU (Kravchenko et al. 2023, 9). Furthermore, Yang et al. (2024) concluded in their work that the challenges of energy

transition usually emerge because the risks of changing an institutionalized system, such as a fossil fuel-driven energy network, are not understood.

Furthermore, the *affordability* dimension highlights the economic challenges of the energy transition. Achieving climate neutrality requires substantial financial investment, with the European Commission (2021) estimating annual energy-related investments in hundreds of billions of euros. These costs are driven not only by the development of renewable technologies but also by the development of supporting infrastructure and supply chains. As Yang et al. (2024) discuss in their work, the energy transition will push countries to change their economic activity as well as deal with economic risks. Moreover, energy poverty will become a central issue. In some areas, it will be reduced, but still, in others, it will increase (Kravchenko et al. 2023, 7). Thus, the EU's funding instruments, such as the Recovery and Resilience Facility (RRF), the Just Transition Fund (JTF), and the Social Climate Fund (SCF), are crucial in mobilizing resources and ensuring that the transition remains socially equitable, particularly for regions and workers dependent on carbon-intensive industries. (European Commission 2024.) Though these instruments are aimed to cover wide areas rather than having financing in a specific sector (Siddi 2023, 6).

Regarding the *acceptability* dimension of energy security, the European Green Deal and the European Climate law (2021) established the EU's legal obligation to reach climate neutrality by 2050, alongside a binding target of reducing emissions by 55% 2030 compared to 1990 levels (European Commission 2023d). However, these dimensions also introduce trade-offs as achieving higher sustainability standards often requires layering regulation to address different concerns. This is particularly relevant in the context of mining, which is often associated with environmental degradation, land-use conflicts, and local opposition (Yang et al. 2024, 8).

Taken together, the EU's energy transition reveals that strengthening energy security is not simply a matter of replacing one energy source with another but managing a complex set of trade-offs across the four A's. While progress toward decarbonization advances climate objectives, it simultaneously introduces new pressures.

3 Critical raw materials and supply chain vulnerabilities

After having discussed a major driver for intensified CRM demand, this section turns to look at the market realities in the global CRM supply chain that create vulnerabilities for the EU. Furthermore, this section introduces dependency theories linked to the CRM countries' relationship, as well as the securitization theory that is often used to address risks associated with autonomy.

3.1 Global production networks

The organization of the CRM supply chain can be comprehensively understood through the framework of Global Production Networks (GPN). This framework emphasizes the complexity and interconnected nature of global production systems, in which firms, states, and other actors operate. Furthermore, it is widely used to highlight how economic activities are geographically dispersed (See e.g., Bridge & Faigen 2022; Coe & Yeung 2015). Importantly, GPNs are not shaped solely by market forces, but also by institutional environments and geopolitical dynamics. Strategic actions by dominant actors, such as China's restrictions on the EU on REE exports in the early 2010s (European Commission 2014), demonstrate how control over key nodes in the network can be leveraged for political purposes. Therefore, the GPN theory helps to understand the EU's position in the global supply chains in relation to China. Lastly, the theory helps explain how GPNs led by actors other than Western countries affect how dependent actors such as the EU implement their own industrial policy to regain control of the nodes (Hess 2021, 20.)

At the core of the GPN framework is the idea that production is organized according to efficiency, specialization, and comparative advantage (Krugman et al., 2017, 29). This means that countries, firms, and other actors specialize in goods in which they hold a relative advantage over others. As a result, production becomes concentrated in specific locations, and patterns of governance and competition emerge around these specialized roles within the broader system. As markets have evolved, their industries have specialized more, making them more reliant on external supply (Waltz 1979, 106.)

Typically, production networks are organized around leading actors that coordinate activities across multiple regions, linking suppliers to end markets. This top-down perspective is relevant in the context of CRMs, where China controls specific stages of the production process and determines how resources and value are distributed. When considering economic outcomes and the formation of strategic dependencies, this position as an actor plays a critical role. The configuration also reflects what Henderson et al. (2002) termed uneven embeddedness, in which the institutional and

technological capacities of certain regions grant them disproportionate influence over production outcomes.

As countries have specialized and sought efficiency over resilience, the geographical concentration of supply chains is not accidental. Still, it reflects long-term processes of industrial development, state support, and strategic positioning within global networks. Coe and Yeung (2015, 85-86) build on Henderson's initial GPN framework by emphasizing how cost-capability ratios, market imperatives, financial discipline, and risk environments shape market decisions. In the CRM supply chains, this structure has resulted in pronounced concentration of activities in certain locations due to economic gains and capabilities. For example, China holds more than 70% of the world's REEs and processes over 80% of global REE output (Müller et al. 2025, 11). From the EU's perspective, reliance is even more acute as China refines virtually all REEs consumed in the Union (European Commission 2023a). Furthermore, China refines nearly 90% of the world's graphite and plays a leading role in processing lithium and cobalt. This market configuration and market concentration risk in the CRM supply chain are shown in the next figure. This figure is also useful later, when the EU's list of CRMs and SRMs is provided.

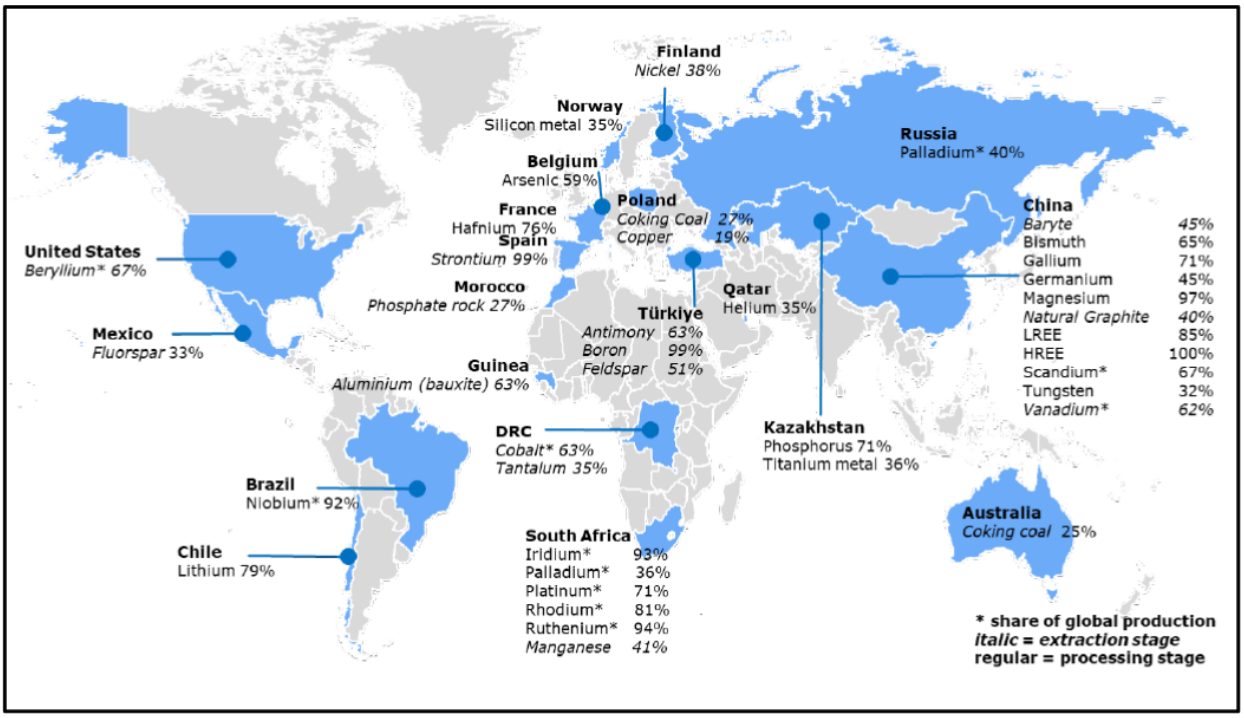

Figure 3 World map showcasing mineral deposits.

Figure 3 emphasizes the EU's own mineral deposits and the market share that China has over the CRM supply chain. Therefore, as the EU is a downstream consumer, the outsourcing and concentration risk has been amplified in the EU's relations with China. Source: European Commission 2023b.

From the GPN perspective, the EU's outsourcing reflects a concentration of capabilities within strategically important segments of the network, in this case, processing and refining CRMs. This has given rise to what can be described as "midstream dependency", where the processing stage functions as a critical bottleneck. Even though this study considers mining operations, this aspect is important insofar as even when CRMs are extracted elsewhere, such as cobalt in the democratic of Congo (European Commission 2023b; Müller et al. 2025, 11), in many cases they are still transported to China for refinement due to its technological expertise, cost advantages, and established industrial ecosystems. (Mouel & Poitiers 2023, 5.) As a result, attempts to diversify sourcing at the extraction level do not eliminate dependency, due to the GPN logic of efficiency and advantage structures. To illustrate the midstream dependency more, this configuration is showcased in Figure 4.

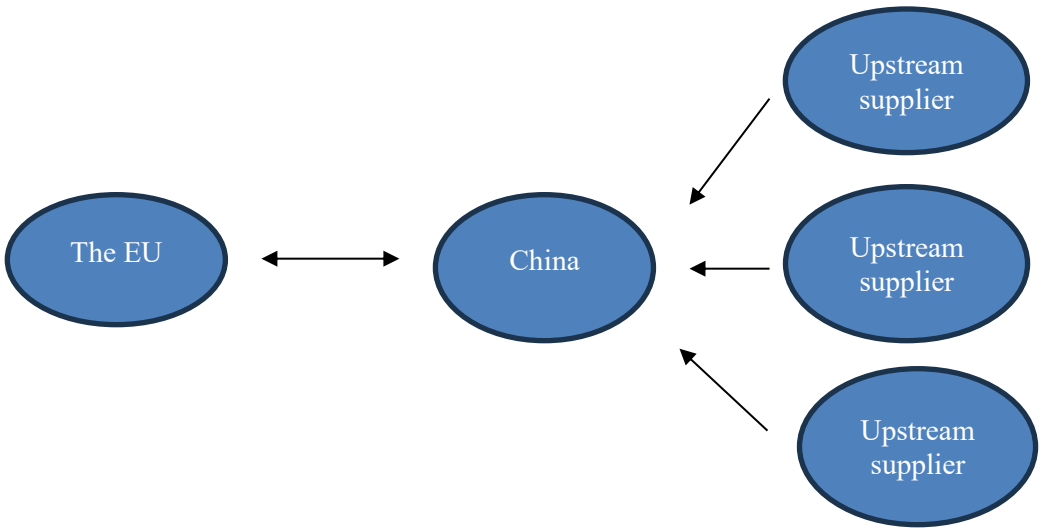

Figure 4 Midstream dependency in the CRM supply chains

Figure 4 showcases the midstream dependency described earlier. The arrow between the EU and China represents their partnership in the CRM market. The upstream suppliers represent other countries that have CRM deposits. In theory, the EU could partner up with these countries, but the midstream dependency makes it not possible, as those countries still send the minerals for processing to China. Figure: own elaboration.

Moving from the midstream dependency, the GPN framework also highlights how power operates within these networks. Power is not evenly distributed because it is shaped by the ability of certain actors to influence resource flows and market access (Coe & Yeung 2015, 16-18). In the case of China, this influence extends beyond the processing capacity. Through China's global investment strategy, particularly through the Belt and Road Initiative, it has deepened its influence over the global supply of CRMs. Mouel and Poitiers (2025) discussed that Chinese investments in resource-

rich countries often come with conditions granting Chinese firms preferential or exclusive access to mineral extraction and supply. Such investment conditionally strengthens China's monopsony power, which means that it is also a dominant buyer in global CRM markets. As a result, China's control over both supply and processing stages accentuates the concentration of CRM markets, making them more vulnerable to geopolitical disruptions and less resilient to market shocks.

Closely related to power is the concept of value capture. While value is created throughout the production process, it is not distributed evenly. Activities such as processing and refining often generate higher value-added due to technological complexity and barriers to entry. As China has concentrated these activities, it has positioned itself to capture a significant share of the economic value within the CRM supply chains. At the same time, regions that focus primarily on downstream manufacturing, such as the EU, or upstream extraction, remain dependent on China's centralized capabilities.

3.2 Securitization of critical raw materials

While the GPN framework explains the structural and institutional nature of the EU's dependency on Chinese CRMs, it does not fully capture how that dependency becomes politicized and prioritized within the EU policymaking. To address this, the concept of securitization offers a valuable complement. This theory originates from the Copenhagen School of security studies that examines how political actors, or in other words, social entities, transform ordinary policy issues into matters of security that demand exceptional measures (see Buzan, Wæver, & de Wilde 1998). Wæver (1995) further argues that the issue that is being securitized is a combination of perceived risks surrounding the matter. This means that we cannot know if the perceived risk constitutes a real risk. Therefore, securitization requires the public to accept the reasoning behind the securitization act. Once accepted, this framing legitimizes interventions that would otherwise be politically or legally difficult to justify.

Within the theory, the role of the securitizing actor is central, as it is this actor who frames a particular issue as an existential threat to a chosen object. In doing so, the actor must be recognized as a credible authority whose claims are taken seriously by the relevant audience. This authority is often derived from expertise, institutional position, or political legitimacy, which allows the actor to influence how risks are perceived and prioritized. Traditionally, securitizing actors have been associated with political leaders or governments. (Buzan et al. 1998, 40.) However, the scope of actors capable of shaping security narratives is broader. Media organizations or environmental groups can also contribute to framing certain developments as security concerns, particularly in

areas such as environmental or resource-related issues. (McDonald 2008, 575; Trombetta 2011, 138.) As a result, securitization is not limited to the formal state but emerges through a wider set of influences that shape how threats are constructed and understood.

In the context of the EU's CRM policy, securitization helps explain why the European Commission and member states have recast supply chain vulnerability as a threat to the EU's strategic autonomy. From this perspective, CRMA can be understood not only as an industrial or environmental regulation but also as the institutional expression of a broader securitization move. By declaring CRM dependency a strategic risk, policymakers justify measures that depart from the typical liberal-market logic of the EU governance (Herranz-Surralles 2024, 1884), such as moving mining in-house. As Buzan (1991, 10) argues in his work, "Economic security concerns access to the resources, finance, and markets necessary to sustain acceptable levels of welfare and state power". In this case, economic security refers more to a state's power, which can be negatively influenced, for example, by dependency, which will be explained in the next subchapter. After describing the securitization theory, this subchapter illustrates it as an hourglass model in Figure 5.

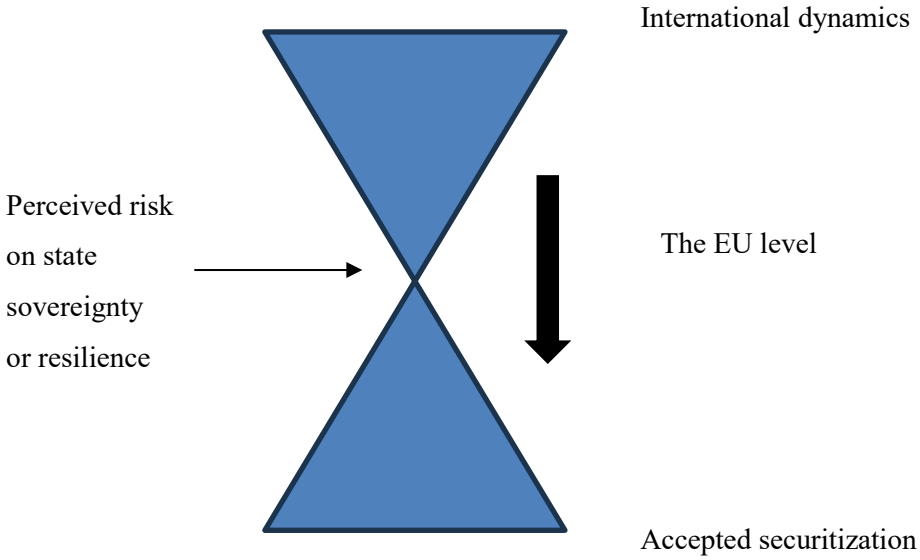

Figure 5 Hourglass model of securitization

Figure 5 applies the securitization theory (Buzan, Wæver, & de Wilde 1998) described in this section, adding the EU into this dynamic. The top part of the hourglass portrays the international dynamics, such as the GPN dynamics in the CRM supply chain. The middle part explains risks arising from international dynamics that the EU perceives as threats to the EU's sovereignty, resilience, or competitiveness. The bottom part of the hourglass functions as the accepted securitization, where the realization of the perceived risk is introduced to relevant actors, and they have accepted it. Figure: own elaboration.

When integrated with the GPN analysis, securitization theory makes it possible to link material structures and political narratives. GPNs reveal the spatial and institutional embeddedness of dependency by describing how global production networks channel value creation and control toward certain regions or firms. On the other hand, securitization analysis explains how these material dependencies are translated into political authority and policy outcomes that will be analyzed in the discussion part of this study. The two perspectives together show that the EU's mining objectives are driven not only by economic logic but also by a security narrative that constructs autonomy in resource access as essential for the survival of Europe's energy transition.

3.3 Strategic dependency

To continue from supply chain vulnerabilities and securitization, matters that lead to perceived risks on sovereignty or strategic autonomy can be, for example, dependencies as mentioned previously. Strategic dependency specifically arises when reliance on external suppliers constrains countries' ability to act autonomously or threatens access to inputs considered essential for economic and political objectives. In the context of the EU, the European Commission (2021, 11-13) emphasizes that a dependency becomes strategic when external reliance directly affects the security and safety of Europeans, constrains the EU's capacity to conduct foreign and security policy in line with its values, or threatens access to inputs and technologies. Theoretically, while international trade relations typically support resilience and competitiveness (Krugman et al. 2017, 28), dependency becomes strategically problematic when it limits the ability to analyze, decide, and act independently.

Dependencies often originate from asymmetric industrial specialization within markets. Through the mentioned GPN-related processes of specialization and cost optimization, different stages of production are concentrated in specific regions. The resulting concentration has led to highly asymmetric interdependencies, where both parties are dependent on each other but not to the same degree (Rana 2015, 291). According to Waltz (1979, 106), even though this is called interdependence between trading parties, one state is stronger than the other. Therefore, the stronger state can influence the partnership, whereas the weaker state tries to either stay on the stronger state's side or distance itself. For example, the EU is dependent on Chinese CRMs, but for China to have its market domination, it is also dependent on the EU to source from there. Still, asymmetrical interdependency according to Li & Gong (2025, 16-17) remains tilted on Chinese dominance. The next Figure draws together the definition of interdependency and strategic dependency and links it to the EU-China CRM partnership.

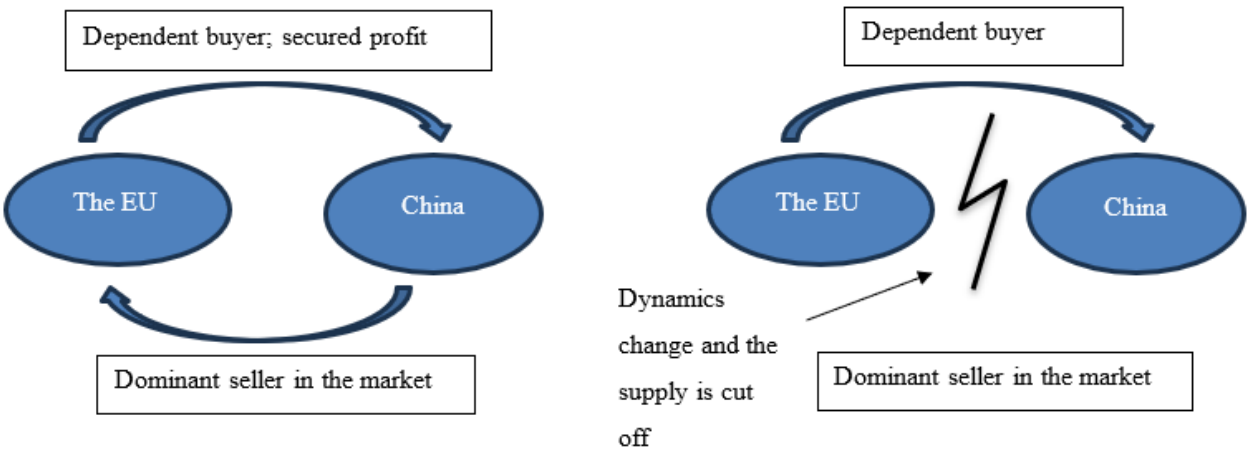

Figure 6 An illustration of asymmetric dependency

Figure 6 illustrates the EU's and China's relationship. In the CRM partnership, China has more leverage to influence its partnership. The first part shows how both are dependent on each other, with arrows pointing both ways. The second part shows how their dynamics change, leaving only one arrow towards China. This represents the EU's dependent need to buy CRMs from China. Figure: own elaboration.

When strategic dependency leaves the countries exposed to potential supply disruptions in the case of political tensions, trade restrictions, or export quotas. For instance, during previous trade disputes, China temporarily restricted REE exports, demonstrating its capacity to use CRMs as a geopolitical lever in economic warfare. Historical examples highlight this risk, for example, in 2010, China imposed production and export quotas on several REEs, including neodymium, dysprosium, and cerium. These measures led to a tenfold increase in prices and revealed how geopolitical actions can destabilize industrial supply chains. (European Commission 2014.) More recently, the transatlantic political shifts that were highlighted in subchapter 1.1. presents a new risk where China might restrict the export permits of CRMs. For example, in 2024, due to economic rivalry with the U.S., China restricted exports of some REEs. Globally, this was shown as production shortages and price spikes as upstream supply needs were not met. (BOFIT 2025.)

To address these dependencies, Waltz (1979, 106) argues that when a state decides to choose its resilience over the benefits of dependency, the reward is autonomy. This has become a growing concern for the EU, which aims to secure a resilient and sustainable supply chain for CRMs as part of its broader goal of achieving strategic autonomy and enhancing energy transition. Strategic autonomy, therefore, in the European context, carries a dual political purpose. It aims not only to strengthen the EU's capacity to influence and shape the direction of international relations and GPN

networks through its external engagements, but also to ensure that the Union retains the ability to act independently and pursue its own policy objectives when circumstances require (Beaucillon 2023, 2). The next chapter moves the focus to the CRMA itself and to what constraints can limit the success of its mining goal.

4 Critical Raw Materials Act (2023)

After describing demand drivers for CRMs and the market logic behind CRM supply chains where dependencies rise, this chapter moves to discuss the CRMA in more detail. Furthermore, this chapter situates the mining goal within the internal context in which it is to be implemented. By highlighting the main challenges associated with domestic mining, the chapter provides the necessary foundation for evaluating whether the CRMA can meet its 10% mining goal and reduce strategic dependencies in the CRM supply chain.

4.1 Content of the Critical Raw Materials Act

Due to enhanced geopolitical uncertainty in the CRM supply chain and the pressures from increased demand, the EU proposed the Critical Raw Material Act in 2023 as a legislative cornerstone of the European Green Deal Industrial Plan. Its agenda is to secure a sustainable and resilient supply of CRMs, essential, for example, to the energy transition. The initiative emerged from growing awareness that Europe's energy transition and industrial competitiveness depend on materials largely sourced or processed outside its borders. (The European Commission 2025a)

The CRMA complements other EU strategies that support the energy transition and climate agendas by securitizing CRMS from risks emerging from concentrated GPNs. Other strategies are, for example, the European Green Deal, the REPowerEU, and the Net-Zero Industry Act. While these initiatives focus primarily on the deployment of renewable energy ways, decarbonization, and industrial scale-up, the CRMA targets the security of supply that enables these objectives (European Commission 2023a; 2023e). In doing so, it also signals a broader shift in the EU's industrial policy away from exclusive reliance on open markets toward an approach that prioritizes resilience and strategic autonomy. (Hool et al. 2023, 663.)

A central component of the CRMA is the EU's classification of CRMs and strategic raw materials (SRMs). The European Commission updates the list of CRMs every three years, reflecting changes in economic relevance, supply risk, and technological demand. Since the list's introduction in 2011, the list has grown from 14 materials to 34 in 2023, underscoring the growing material intensity of the EU's economy (European Commission 2023a.) Of these materials, 24 are supplied from China, highlighting the scale of the EU's external dependence highlighted earlier.

To better distinguish materials with heightened geopolitical and industrial relevance, the CRMA introduces a subset of SRMs. These materials are deemed essential for critical technologies and

defense applications, while also being associated with a high perceived risk of supply disruption. (European Commission 2023b) This provides the core of the CRMA as it determines priority areas for policy intervention and investment (van Gaalen & Slootweg 2024, 1). To build a picture of the quantity of relevant CRMs to the EU, this study introduces Table 1, which contains the list of CRMs in black and SRMs in red.

CRMs and SRMs					
Antimony	Boron	Gallium	Lithium	Phosphate Rock	Tantalum
Arsenic	Cobalt	Germanium	Magnesium Metal	Phosphorus	Titanium Metal
Bauxite/aluminum	Coking Coal	Hafnium	Manganese	Platinum Group Metals	Tungsten
Baryte	Copper	Helium	Natural Graphite	Scandium	Vanadium
Beryllium	Feldspar	Heavy Rare Earth Elements (Ce, Nd, Pr, Sm)	Nickel-Battery Grade	Silicon metal	
Bismuth	Fluorspar	Light Rare Earth Elements (Gd, Tb, Dy)	Niobium	Strontium	

Table 1 The list of CRMs and SRMs

To secure access to these materials, the Act sets the following goals: at least 10% of the EU's annual consumption of SRMs should come from domestic extraction, at least 40% from processing within the EU, and at least 15% from recycling. Furthermore, no more than 65% of any CRMs should be imported from a single third country at any stage of the supply chain. (European Commission 2023a.)

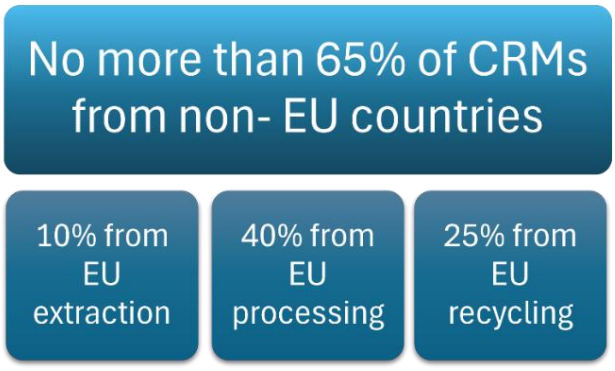

Figure 7 The CRMA's targets by 2030

In Figure 7, the top part addresses the diversification of the supply chain, and the last three parts illustrate the EU's internal goals, such as mining, processing, and recycling. Figure: own elaboration based on European Commission 2023a.

To reach these targets by 2030, the CRMA introduces several new governance and implementation mechanisms. For example, it designates certain strategic projects related to mining, processing, or recycling as projects of European interest. To help meet these goals, the EU proposes that member states accelerate permitting procedures and facilitate financing. At the same time, the Act further emphasizes sustainability, requiring strategic projects to meet high environmental and social standards while minimizing ecological harm. (European Commission 2023a.)

Institutionally, the Act establishes a European Critical Raw Materials Board tasked with coordinating implementation, including improving permitting processes, monitoring supply risks, and identifying potential strategic partnerships. For example, the permitting procedure in the EU currently is up to 27 months and is to be cut to 15 months under the CRMA. On the other hand, starting mining projects currently takes 10-15 years, and it should be cut to 23 months (Hool et al. 2023, 663; European Court of Auditors 2026, 36). In parallel, the CRMA introduces monitoring and stress-testing mechanisms for supply chains to anticipate disruptions. Thus, member states are required to collect data, assess dependencies, and prepare for potential crises. Furthermore, firms are expected to assess and report on their own vulnerabilities to track possible supply disruptions better. (European Commission 2025a.)

In addition to internal measures, the CRMA strengthens external partnerships through the Critical Raw Material Club, which is a global network of like-minded countries that aims to diversify supply chains and promote responsible mining through value chain creation in a sustainable manner. At this time, the EU has already initiated strategic partnerships with Canada, Chile, Namibia, and others to secure alternative suppliers and develop joint value chains. (European Commission 2025b; Van den Hende 2024.) To conclude, the overarching goal is to create a unified, forward-looking system that anticipates market shocks and promotes investment confidence in Europe’s emerging green industries.

4.2 Barriers to domestic mining

Shifting the focus from the broader objectives of the CRMA to its 10% domestic mining target. According to the theory, mining governance within the EU is characterized by fragmented decision-making, complex permitting procedures, and strong environmental and social safeguards that vary considerably across member states (See e.g. Bastianin et al. 2026; Wien 2024). While these aspects reflect the legitimate concerns related to sustainability, public participation, and regional autonomy, they also risk slowing or constraining the development of new extraction projects. As a result, the feasibility of the CRMA’s mining objective depends not only on geological potential and market

incentives but also on the EU's ability to reconcile strategic goals with existing institutional structures. This section, therefore, examines the key factors that may limit the realization of the CRMA's 10% domestic mining target.

4.2.1 Industrial policy and state capacity in the mining sector

The revival of CRM extraction within the EU can be understood as part of a broader industrial policy turn. After several decades of liberalization and market reliance, the EU has introduced state-led coordination to reduce strategic dependencies and support the energy transition, as portrayed earlier. This is consistent with industrial policy theories, which emphasize that market forces alone rarely generate new industrial capabilities, particularly in sectors characterized by high capital intensity and uncertain returns (See e.g., Gerybadze 1992; Rodrik 2004; Bastianin et al. 2026). Thus, portraying the GPN logic introduced earlier, in which if it is more beneficial to outsource, an actor should do that and specialize in things it is more competitive in. Under these conditions, state intervention becomes necessary to offset investment risks and to provide long-term strategic direction.

Within this theoretical frame, the CRMA is best viewed as an instrument of industrial policy. Regarding the mining goal, it imposes strategic projects because the EU is at risk of not being able to supply its own interests by offering streamlined permitting as well as public investment support. With these instruments, the Act seeks to mobilize state capacity to overcome what Rodrik (2004) described as coordination failures where private actors hesitate to invest because complementary infrastructure, regulation, or legitimacy are absent. In other words, it is to help actors see past just GPN logic and to further enhance the chances of public acceptance of the securitization act mentioned in Chapter 3.

However, in the EU's context, its multilevel governance complicates industrial policy's efforts. The EU cannot directly affect land use and environmental regulation as they remain at the national decision-making level (Wien 2024, 12). As a result, the industrial policy ambitions are structurally limited by what Mecling and Nahm (2022) call fragmented state capacity, where in the EU, political authority is distributed across institutions with divergent mandates, time horizons, and accountability structures. On the other hand, according to Gerybadze (1992), industrial strategies often set broad targets, which give actors room to understand and implement them in different ways. Therefore, the lack of clarity makes it difficult to translate high-level ambitions into concrete and coordinated actions, particularly when multiple stakeholders are involved. This can be further explained with the concept of political will to regain control of something happening in one's

jurisdiction. As Archarya (2018, 37) emphasized, “Where the hegemonic power lacks the political will, their diffusion fails”. This means that risks associated with political change are greater than risks regarding the change the government wants to achieve.

4.2.2 The political economy of mining: economic barriers

Beyond institutional fragmentation, the mining literature highlights deep-seated political-economic barriers that shape extraction in advanced economies. As Bridge (2004) and Domínquez-Gomez et al. (2026) argue, mining is not merely a technical process of resource recovery but a social and political one, embedded in contested relations between capital, the state, and affected communities. In regions like Europe, decades of de-industrialization, high environmental legislation, and public skepticism toward extractive industries have created what Tiess (2018, 27-28) calls an anti-mining equilibrium, which means that political incentives to avoid extraction have outweighed those that promote it.

This equilibrium shows in many aspects when considering this study’s context. First, regulatory complexity and procedural uncertainty prolong project approval timelines, sometimes exceeding ten years. Such delays increase financial risk and discourage private investment in a sector that is already characterized by long payback periods and volatile prices. Therefore, the aim of rejuvenating public investments also brings another difficulty to the mix. A study conducted by Rumokoy et al. (2023) found that risks associated with the relationship with China affect the mining industry the most. Their study suggested that the associated risks reduce firm-level investment decisions in the mining and energy sectors. This is because firms delay major commitments until the external environment stabilizes. They concluded that firms wait up to four years until the risks have lowered.

Second, Europe’s liberalized financial system traditionally favors short-term profitability (Wulleber et al. 2026, 10). The high upfront costs and uncertain returns on mining projects conflict with these market preferences. On the other hand, Hool et al. (2023, 664) also found that even though domestic mining might be more expensive in the EU, its sustainability and transparency are better known to the public. This, in turn, makes consumers more aware of the choices when choosing CRMs, based on the market prices.

Furthermore, mining feasibility depends on access to specialized labor, infrastructure, and technological expertise, which are all areas where Europe’s capacity has eroded since the 1990s (Righetti & Rizos 2024, 6). The outsourcing of extraction and refining to lower-cost regions like

China is justified by labor and environmental considerations, taking out domestic supply chains, and institutional knowledge (Nakano 2021, 15-16). From a GPN perspective, these structural conditions create path dependencies, leaving Europe locked into the downstream role in GPNs while lacking mechanisms to reclaim upstream control. Martin (2000) emphasized that these path dependencies, where institutions want to keep the existing economic structure, are due to social practices and historical events. Krugman et al. (2017) further noted that the CRM supply chain is the trade-off for the EU, where it needs to outsource one or all stages of the supply chain to be able to produce the end product. If a market wants to be competitive, supply decisions are typically based on maximizing profits and minimizing costs.

4.2.3 Environmental and sustainability concerns in resource-rich areas

In the context of this study, environmental regulation functions as a double-edged sword. Mining activities inevitably involve land disturbance and environmental risk (Bastianin et al. 2026, 13), which puts them in potential conflict with EU environmental legislation, such as the Habitats Directive, the Water Framework Directive, and national conservation laws. The EU is also determined to restore more than 20% of the EU's areas, including sea areas. In addition, the EU's biodiversity target further tries to secure land and sea use with strict protection. (European Commission 2024.) When considering mining, the environmental projects reduce the spatial availability of land for new extractive operations. As Correia et al. (2024, 345) show, competing claims for land, renewable energy infrastructure, and nature restoration intensify the scarcity of mining space. Consequently, two pillars of energy security, environmental acceptability, and availability, are institutionally intertwined yet often contradictory.

The environmental dimension of mining barriers in Europe extends beyond regulatory compliance to encompass ecological integrity and cumulative impact concerns that fundamentally challenge the feasibility of large-scale extraction. Mining operations generate multiple environmental stressors, including groundwater contamination and particulate emissions that can persist long after extraction ceases (Bridge 2004). In theoretical terms, environmental regulation functions as both a legitimacy-enhancing mechanism and a limiting factor, reinforcing the acceptability of domestic mining while simultaneously narrowing the range of projects. As Bastianin et al. (2026, 13) concluded, environmental costs directly affect what kind of public policies governments are able to make. On the other hand, recent policy debates illustrate efforts to reconcile environmental protection and extraction through innovation and regulation. Concepts like green mining promote cleaner

technologies and waste recycling processes that align resource recovery with sustainability goals (Correia et al. 2024).

4.2.4 Social acceptance and distributive justice

The importance of public awareness and social acceptance for industrial policy success has been emphasized across multiple studies examining CRM supply chain governance. Mertens et al. (2024) demonstrated in their analysis of CRM supply chain vulnerability in renewable energy sectors that industrial policies can only achieve their objectives when implemented with explicit attention to public understanding and social legitimacy. This finding has been corroborated by broader research on extractive industries and energy transition policies (see e.g. Bastianin et al. 2026), which consistently shows that technical and economic feasibility and public opinion alone cannot support the trade-offs that resource policies inevitably require.

While the EU-level policy treats mining and downstream processing as interconnected stages of a single value chain, public perceptions across member states often draw a clear distinction between extraction and CRM activities. Commonly, mining is associated with land-use disruption and environmental degradation and is therefore more visible and contested, particularly in rural and sparsely populated regions. Processing, on the other hand, is usually located closer to population or industrial zones that tend to be perceived as conventional industrial sites operating under strict regulatory oversight. (Tost et al. 2021, 9.) Although this study does not analyze processing activities, this contrast is relevant insofar as it shapes public attitudes. This perceived separation weakens public understanding of the integrated nature of CRM supply chains and complicates efforts to justify new domestic mining projects for the energy transition (Righetti & Rizos 2024, 9; Mozzat et al. 2015, 12).

Studies show that local resistance rarely emerges from wholesale rejection of extraction but from concerns about fairness and distributive justice (see e.g. Moffat et al 2015). Communities often perceive that environmental and social burdens (i.e., noise, dust, and landscape disruption) are localized while economic benefits are externalized to corporations or distant governments. As Bastianin et al. (2026) suggested in their study, industrial policies should consider regional aspects when applying mining-related initiatives.

Despite Europe’s significant geological potential in CRMs, these reserves have been researched only to some extent. Countries such as Portugal, France, Finland, and Sweden possess considerable lithium, cobalt, and REEs, suggesting that the EU could theoretically cover a meaningful share of

its future demand through domestic extraction. (Righetti & Rizos 2024, 9; Bastianin et al. 2026, 11.) On the other hand, regions that are already economically or politically vulnerable may be expected to host extractive projects, while the benefits might be concentrated elsewhere (Moffat et al. 2015, 12). Hool et al. (2023) also raise an important question in their study of whether the CRMA considered that deposits are not located everywhere. This would mean that the negative effects of mining will not be distributed evenly among member states. The inequalities between the member states are important to build a picture of existing unfairness that might grow if the public does not accept mining as an act of securitization of CRMs.

On the other hand, Gerybadze (1992) emphasized that industrial policy interventions rarely benefit all actors equally. While some stakeholders, such as domestic industries or certain regions, may gain from the policy objectives, others, especially local communities, may perceive themselves as negatively affected. This, in turn, generates the greatest anticipated losses that can lead to resistance and complicate the implementation process, even when policies are justified at the national or supranational level. Furthermore, as Bridge (2004) argues, mineral extraction is not only an environmental act but also a moral and political project in which success depends on how societies negotiate trade-offs.

In addition, domestic mining projects are frequently constrained by the “Not in my backyard” (NIMBY) phenomenon, which reflects local opposition to projects perceived as environmentally harmful or socially disruptive (See e.g., Kovasch et al. 2025; Xu et al. 2024). Even when mining aligns with regulation or objectives, local communities may resist extraction activities due to concerns over pollution, landscape degradation, health risks, or impacts on tourism and agriculture near their place of residence. This concept is particularly useful when assessing the relationship between economic and resource aspirations with local interests. For example, a study conducted by Que et al. (2018) found that if the local community sees the economic benefits from the mining, they are more likely to accept. On the other hand, Uji et al. (2023) conclude in their study that the farther the person lives from mine, the more negatively they think about mining. Whereas the closer the person lives, the more they expect economic benefits to their area, which is why they agree to the mining. To illustrate the foundations of social acceptance in mining after describing them, Figure 8 presents three interrelated dimensions of distributional justice, procedural fairness, and confidence in governance, which together shape the trust in mining activities and influence their social legitimacy.

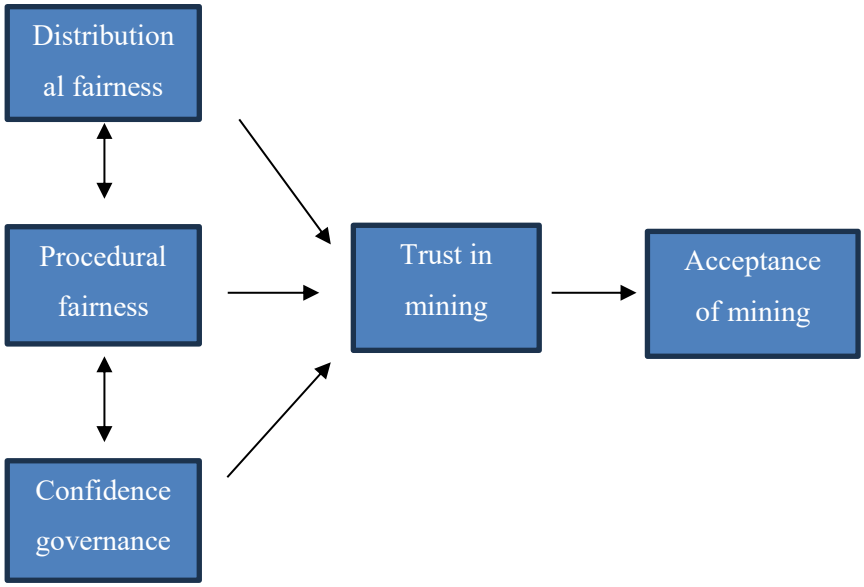

Figure 8 How mining becomes accepted

An example illustrating the above figure comes from a famous mining opposition case in Serbia, where the legitimacy of the lithium project was questioned, as it was not handled by a local actor. The accusations were directed to the Serbian government as well as to the EU. In this case, the local community felt that they were not safe from the negative effects of mining because it was not funded by local actors (Stuehlen & Anderl 2024). In other words, as presented in Figure 8, distributional fairness, procedural fairness, and confidence in governance are the factors that influence whether local communities trust in the mining projects and accept them. If not, it will show in cases like the one in Serbia. As Correra et al. (2024) concluded, rejection of mining projects happens because people fear how it is going to change their lives and the combination of environmental and social harm.

4.3 Synthesis

The theoretical part of this research has developed a layered analytical framework to explain why CRMs have emerged as a central strategic concern for the EU and why the implementation of the CRMA, particularly its domestic mining objective, faces significant internal constraints. Rather than approaching CRMs as a standalone industrial or environmental issue, the chapters situate them within the broader structure of energy security considerations, the enhanced move towards energy transition, and how CRM supply chains are built. Together, these perspectives form a coherent explanatory pathway that clarifies both the origins of the CRMA and the challenges surrounding its implementation. Furthermore, understanding China's role in this supply chain is especially important, as the supply chain structure and relations with China explain much of the EU's internal

actions and why it might not be as productive as one would hope. The idea here is that the CRM supply chain is concentrated in China, whether it is the mining or processing. That being said, the EU faces difficulties diversifying the supply chain for this reason. When it comes to mining, it was disclosed that even with the advancements in technology, it faces a lot of the same resistance as it did years ago.

At the outermost level, energy security serves as a key layer linking power relations to policy priorities. By applying the four A's framework (availability, accessibility, affordability, and acceptability), this study conceptualizes CRM dependency as an integral component of contemporary energy security rather than as a peripheral supply issue. As mentioned, the EU's energy security faced enormous risks in the latest energy crisis due to dependency on Russia. Now, as the EU decarbonizes its energy system, availability risks shift from oil and gas toward raw materials essential for renewable technologies, electrification, and energy storage. Therefore, affordability and accessibility are increasingly shaped by supply chain concentration and price volatility in CRM markets, while acceptability connects material sourcing to environmental sustainability and public legitimacy.

The next analytical layer comes from the energy transition, which operationalizes energy security concerns in concrete technological and material terms. The EU's commitment to climate neutrality by 2050 requires the rapid deployment of renewable energy systems, electric mobility, and energy-efficient infrastructure, all of which are materially intensive. Unlike previous energy transitions, the current shift is not driven by resource abundance or cost alone but by normative and regulatory imperatives linked to climate mitigation. This makes the EU particularly exposed to supply-side constraints, as demand for CRMs is largely policy-driven and time-bound. The energy transition literature, therefore, helps explain why securing CRM supply chains is not optional but foundational for strategic autonomy.

Within this transition, dependency on China emerges as a critical bottleneck that concentrates multiple risks into a single relationship due to the GPN's. China's dominant position across the extraction, processing, and refining stages of CRM supply chains reflects decades of industrial policy and cost advantages rather than mere resource endowment. From the EU's perspective, the GPN logic creates a strategic dependency in which access to essential inputs for the energy transition is vulnerable to geopolitical tensions and export restrictions. The CRM-China connection thus represents a convergence point where geopolitics, energy security, and the energy transition intersect most notably.

The next figure showcases the theoretical layers that form the context in which the CRMA operates. This onion figure is built from the layers already described in this synthesis part and is introduced to visualize the different layers and where they fit into this research.

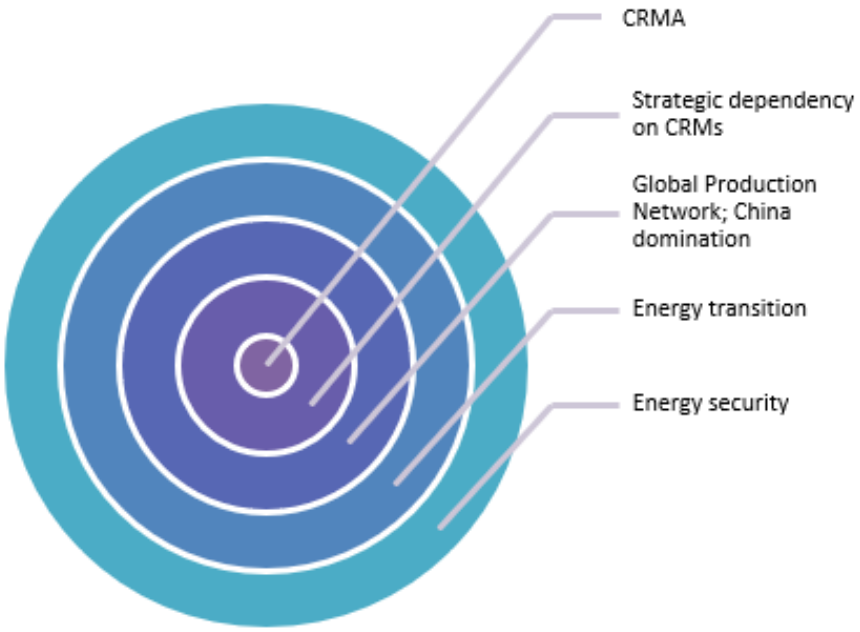

Figure 9 Layered conceptual framework linking the study's key concepts together

Figure 9 illustrates the layered conceptual framework guiding this study. The outer layers represent the broader structural context in which the EU's CRM policy operates, beginning with geopolitics and power relations, followed by energy security and energy transition. These layers shape the strategic conditions under which the CRM dependencies, particularly China, have emerged. At the core lies the CRMA, which constitutes the EU's policy response to these intersecting pressures. Figure: Own elaboration.

The CRMA can therefore be understood as the EU's strategic response to this convergence of risks. Rather than pursuing full self-sufficiency, the CRMA seeks to rebalance the EU's position in global supply chains through diversification, domestic capacity building, and enhanced resilience. Its binding targets for extraction, processing, and recycling reflect a shift in the EU's industrial policy toward strategic intervention, aligning climate objectives with supply security and competitiveness. In particular, the 10% domestic extraction target symbolizes the EU's ambition to regain a minimum level of control over the upstream segment of CRM supply chains.

However, this ambition brings the analysis to its final and most critical theoretical insight, which is that the success of the CRMA depends not only on external diversification or technological capability but on internal institutional capacity. While strategic autonomy is articulated at the EU

level, mining projects are governed by national regulatory frameworks, environmental standards, land-use planning, and local social acceptance. Institutional fragmentation, lengthy permitting procedures, divergent national priorities, and societal resistance introduce significant constraints. These internal limitations reveal a tension between supranational strategic goals and the localized nature of extractive activities. This theoretical synthesis is concluded in Figure 10 to further illustrate the relationship between chapters.

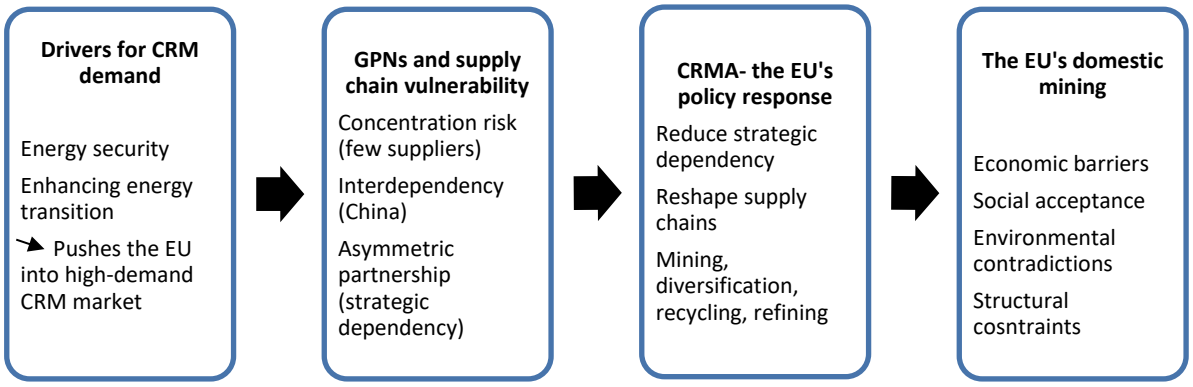

Figure 10 Interlinkages between theory concepts

The interconnections between the theoretical perspectives can be illustrated through the relationship between demand, structural dependencies, and the EU's policy response. Figure 10 summarizes how the dynamics of the energy transition generate rising material demand, how the logic of GPN shapes the EU's dependency patterns, the CRMA as a policy response to these dynamics, and constraints with mining operations that arise from the 10% mining goal. Figure: own elaboration.

By integrating supply chain theory, energy security frameworks, energy transition dynamics, and the EU's industrial policy, these chapters demonstrate that the CRMs are best understood as a response to layered and mutually reinforcing pressures. This theoretical synthesis, therefore, provides the foundation for the subsequent analysis, which examines how institutional, regulatory, and social factors shape the practical feasibility of domestic CRM mining, drawing on empirical insights from expert interviews.

5 Research design

This chapter outlines the research methodology applied in this study and provides justification for the chosen approaches. It describes the key stages of the research process, including data collection and analysis, in order to offer a clear and comprehensive understanding of how the study was conducted. Finally, the chapter addresses the research's trustworthiness and discusses the ethical considerations associated with the study.

5.1 Qualitative research approach

This study employs a qualitative research approach to investigate how the EU's CRMA aims to mitigate strategic dependencies in the energy transition. Moreover, how the mining goal can promote internal extraction, given market dynamics. A qualitative approach is particularly suitable for analyzing policy frameworks and complex governance structures, as it enables the researcher to interpret meanings, relationships, and policy intentions beyond what can be captured by numerical data. (Koskinen et al. 2005, 106.)

The purpose of this research is not to measure the quantitative impact of CRMA but to understand the underlying mechanisms, motivations, and challenges related to the mining goal. Furthermore, qualitative research is often described as interpretative and contextual, focusing on how individuals and institutions construct meaning and act within specific socio-political environments (Marković et al. 2017, 34). These are particularly important in this research when trying to showcase how, for example, risk perception affects industrial policy implementation in real life. In addition, according to Eriksson and Kovalainen (2008, 27), the characteristics of the phenomenon under investigation should determine the choice of research approach, methodological framework, and analytical strategy. This approach is thus well-suited for examining the intersections of policy, economic, and geopolitics that shape the EU's pursuit of energy transition and supply chain resilience.

In the context of this study, qualitative research allows for the integration of multiple perspectives (King 1994, 33), which means that it is suitable for a study that combines interpretations to build a holistic overview. On the other hand, a possibility was to evaluate one barrier in the mining goal. It was chosen not to because it was considered that it would not bring up the real reasons why this specific target is hard to reach. An example would be to evaluate the social aspects of mining, but it would go too deep into member states' internal dynamics, driving the focus away from evaluating the EU's ability to apply industrial policy. Therefore, as the topic remained broad the chosen

approach needs to enable analysis of narratives and discourses (Alasuutari 1996, 99) surrounding resource dependency, energy security, supply chain management, and sustainability.

Furthermore, a qualitative approach supports an interpretive and flexible research process, allowing insights to emerge progressively from the data rather than testing predefined hypotheses (Basit 2003, 143). As such, this approach enables a deeper understanding of how the CRMA effectively addresses the EU's supply chain problems and its own mining capabilities. Furthermore, what is realistically possible to achieve with the tight timeline given in the CRMA. This interpretive nature of the study aligns with the idea that knowledge about politics and economics is socially constructed and contextually embedded (Koskinen et al. 2005, 106).

It is important to note that it cannot be said which method is most suitable for qualitative research, as it is always determined by what the researcher aims to do and the resources available at the time of the process (Tuomi & Saarijärvi 2009, 43). Still, like in this and in other qualitative studies, the arguments given rely heavily on the theoretical framework constructed around the topic (Töttö 2004, 9-20). Therefore, by applying a qualitative framework, the study seeks to identify patterns of meaning according to the interviews and existing knowledge. This interpretative process forms the foundation of the thematic analysis described in the upcoming subchapters.

5.2 Data collection

As this study is qualitative in nature, it relied on expert interviews as the primary method of data collection (Alastalo & Åkerman 2010, 373–374). The interviews were conducted as semi-structured expert interviews with the purpose of getting insights into how experts see the CRMA's mining goal. Furthermore, the purpose was to gain insights into whether the CRMA can strengthen the resilience of the EU's energy transition and reduce exposure to strategic dependency over the Chinese CRM supply chain dominance. Since the research examines strategic vulnerabilities within a highly technical and policy-intensive field, experts were selected based on their professional engagement with the EU's energy policy, CRM governance, or industrial supply chain development (Alastalo & Åkerman 2010, 373-374).

The interview method was chosen because it allows experts to articulate contextualized interpretations and reflect on the emerging challenges surrounding strategic dependencies (Ma et al. 2021, 91). This was particularly important given the complexity of the topic and the limitations of finding suitable interviewees. This way, the interviewees could provide information on the phenomenon from the perspective they were most familiar with but still contribute to this study's

agenda. Furthermore, issues surrounding this topic, such as China's dominance in the processing of CRMs, the EU's fragmented internal market, and the rapid increase in demand driven by renewable energy technologies, require nuanced explanations that are not easily captured through standardized surveys or secondary literature alone.

As this study relied on interviews on a heavily opinionated topic, it was also taken into account that false information could be possible if they were used as primary empirical data (Alastalo et al. 2017, 219). Though, in the context of this research, as mentioned in subchapter 4.1, the subject is formed from socio-political environments where socially constructed matters affect, for example, how meaningful policy decisions are. Therefore, for example, regarding the securitization of the CRMs and the perceived risks, a combination of fact and opinion is insightful for the evaluation of the mining goals' feasibility. In other words, it is beneficial for this research to get different opinions from the interviewees to be able to understand how the findings differ from the theory. In this sense, there is no right or wrong information, as all the selected interviewees are experts in their fields. This approach is tied to the sampling approach (Glesne 1999, 2830) where the interviewees were selected based on the amount of value their responses would give to this study.

Access was arranged through email correspondence, where the interviewees were provided with an information sheet of the research in question, as well as a consent form. It was made evident that participation is voluntary, and they were provided with clear information regarding the academic purpose of the study. The sheet also contained information about how the data would be collected. Furthermore, interviewees were offered a chance to get their names anonymized, but regarding the topic of this study, it was considered favorable if the names and positions could be used. This was based on Platt's (1996, 9) idea that it would increase the reliability of the research as it would be relevant to know who said it and why they are qualified to say it. This is why only one interviewee was anonymized, but the credibility of the information does not suffer from it, since their position in the EU is still visible to the reader. The information sheet can be found at the end of this study as Appendix 3.

During the interviews, the semi-structured design allowed the researcher to maintain a consistent thematic structure while it gave the experts freedom to elaborate on issues they considered particularly relevant (Alastalo et al 2017, 221-224). This flexibility was essential given the interdisciplinary nature of the research, which sits at the intersection of energy policy, supply chain governance, socio-political dimensions of mining, and geopolitics. The questions for the interview were made to be open-ended to encourage reflective and conceptual responses. For instance, instead

of asking whether specific mining-related improvements are attainable, the questions invited experts to discuss the systematic challenges of increasing internal mining. This dynamic also explains why the issue of strategic dependency on China reappears in the analysis, even though it was initially introduced in the theoretical framework primarily as a structural description of supply chain vulnerability.

Each interview lasted approximately 40-60 minutes and was conducted via Microsoft Teams. During the interviews, all were audio taped with consent and transcribed for analysis. Still, even though audio taping was mentioned in the consent form, it was explained to the interviewees again at the beginning of the interview. This was done to make sure that the interviewees understood what it meant to be audio taped. The analysis part started already before all the interviewees were conducted, which helped the researcher to reframe some of the questions to get better insights into the topic (Hyvärinen 2017, 34). Throughout the interview, some of the questions were reframed five times according to the interviews that had already been conducted. The general question sheet can be found in the appendices in both English as Appendix 1 and Finnish as Appendix 2.

The following table introduces the list of all the interviewees, their positions, and their organizations. As seen from Table 2, the interviewees were from very different backgrounds, which allowed the researcher to gain more insights and find differences in their opinions. For example, the researcher could ask opinions on aspects that arose from previously conducted interviews to elaborate on key insights, such as risk perception.

Participant	Position	Organization	Interview date and place	Interview duration
Olli-Matti Mikkola	Research specialist	Natural Resource Institute Finland	24.11.2025, Teams	40min
Teo Kangaspunta	Leading Expert in Innovation and Corporate Finance. Critical Raw Materials Board	Ministry of Economic Affairs and Employment. Department of Industrial Policy Group, Telpo	27.11.2025, Teams	45min
Anonymized	Officer	European Commission	5.12.2025, Teams	30min
Carl Muth	Doctoral researcher; Resource policy and politics	University of Tampere	10.12.2025, Teams	1h 30min

Marco Siddi	Researcher, European Union and Strategic Rivalry	Finnish Institute for International Affairs	7.1.2026, Teams	60min
Toni Eerola	Director of Raw Materials Availability. Department and Board Member of GTK	Geological Research Center, GTK	8.1.2026, Teams	60min
Anne Mutanen	Counsellor, Trade Policy. Critical Raw Materials and Resources	Ministry of Foreign Affairs. Department of International Trade	9.1.2026, Teams	60min

Table 2 List of the conducted semi-structured expert interviews

It is good to note that the list contains only interviews that were possible, but the interview process took much longer than what Table 1 might suggest. The whole interview process, from email correspondence with possible candidates to the end result, is introduced in Table 3 below.

Emails sent	Email responses	Interview consent form sent after interview agreement	Possible interview dates sent	Interviews conducted
30	17	12	11	7

Table 3 Interview process showcased

As seen from Table 3, 30 interview proposals were sent to people who fit the description of the study. Of those 30 people, only 17 responded to the emails, and from that number, only 12 thought that they would have something to give to this research. After the interview proposals, 12 candidates expressed their interest in the research. They were sent an information and consent form to be filled out. After this, only one dropped out, but only seven interviewees responded to my interview time proposals, leaving the number of conducted interviews to seven from the 30 that were initially contacted.

5.3 Data analysis

To operationalize the qualitative approach, this study employs thematic analysis as the main method of data analysis. It was used to uncover underlying meanings, patterns, and structures within the collected data (Braun & Clarke 2006, 79). The primary objective of the analysis was to interpret how the CRMA seeks to promote the 10% mining goal while balancing the negative aspects of mining. On the other hand, the objective was to understand how the CRM supply chains and underlying market structures influence domestic mining, as the market logic was the foremost

reason behind outsourcing the EU's domestic mining previously. As Gavin (2008, 4) notes, thematic analysis is a useful tool for making implicit meanings explicit when qualitative data is converted into text form.

The research design follows the principle that the analytical process should be guided by the research question rather than by a rigid methodological framework (Ruusuvuori et al. 2019, 11). Accordingly, the analysis in this study was structured around the central research question: "*To what extent can the EU's Critical Raw Materials Act reduce strategic dependencies on critical raw materials through its domestic mining ambitions?* "

Furthermore, the analytical process was iterative and continuous, evolving alongside the collection and interpretation of the data. As Basit (2003, 143-145) emphasizes, qualitative analysis is not a single, isolated stage but a dynamic and creative process that begins early and develops throughout the research. For example, the transcription process was used as the first step of familiarization with the themes (Ruusuvuori et al 2019, 11). Therefore, allowing the researcher to re-engage with the material in detail, revise the theory if needed, and begin to identify early indications of how experts saw the feasibility of the mining goal.

However, the coding process started with marking the texts according to the content, but they were not put into predefined categories (Miles & Huberman, 1994, 56). The codes in this stage could be phrases, words, or whole paragraphs, such as "risk", "people will not accept", or "challenges lie". In the second phase, the initial codes were reviewed in case other codes emerged from the interview texts. In the last stage, the codes were compared to one another and reorganized into a smaller set of analytical themes that build patterns around the RQ (Braun & Clarke 2006, 79). These codes were collected into a different Word document.

Even though the interview questions were constructed around themes, the codes did not necessarily follow that rule, as those were built to be just a guide. At the end of the coding process, five themes remained: political commitments and structural constraints, economic competitiveness and the viability of domestic mining, social acceptance and nimbyism, and strategic risk perception and securitization of CRMs. These themes form the base for the analysis discussed in Chapter 6, where the subchapters are named according to the themes.

5.4 Trustworthiness

If this study had been done as quantitative research, there would be statistical data confirming the findings, but as this study is qualitative research, it relies on the concept of trustworthiness.

Trustworthiness is evaluated by the assessment of the quality of the research and the results it has provided (Eriksson & Kovalainen 2008, 290). In this study, trustworthiness is evaluated by Lincoln and Guba's (1985) framework that covers aspects of confirmability, dependability, transferability, and credibility.

Firstly, *confirmability* assesses the degree to which the results are based on the data rather than the researcher's personal views. To ensure confirmability, this study provides a transparent account of how data were analyzed and how that links to both the interview materials and theory (Eriksson & Kovalainen 2008, 294). In addition, this study used person triangulation, which meant having multiple interviewees whose data were collected. This way, the research got multiple perspectives on the same phenomenon rather than trying to interpret everything from one or two interviews, thus minimizing the risk of personal interpretations. To further improve the confirmability of the research, the data was collected from people working on different levels and in different fields while still focusing on the research topic. Furthermore, as the research is based on a fine line between opinions and facts, the researcher tried to be as conscious and transparent as possible about the conclusions drawn from the analysis. For example, using straight quotations from the interview to emphasize who said and how that relates to the analysis.

Next, t*ransferabilit*y was supported by providing deep descriptions of the research context and the policy environment in which it happens. This included describing the EU's energy transition and energy security plan, building a picture of the current dependency problem faced in the global supply chain, and the market logic surrounding it. Furthermore, the interviewees are described with enough contextual information in Table 2. This will help readers assess the relevance of their perspectives without compromising their integrity. When it comes to presenting the findings, key observations are accompanied by carefully selected verbatim quotations that illustrate how experts understand the feasibility of the CRMA's mining goal. Lastly, by linking the findings to existing literature on the EU's governance, strategic dependencies, and energy transition. It also connects it to the broader debates of the EU's strategic autonomy and industrial policy coherence. That being said, the contextual details provided allow readers to judge whether the findings may be applicable in other EU member states or similar policy settings, thereby strengthening the study's transferability. (Eriksson & Kovalainen 2008, 294.)

Credibility concerns how accurately the findings reflect the empirical reality of the research topic. (Lincoln & Guba 1985, 296). To strengthen credibility, the researcher must be familiar with the theoretical and policy context of the study (Eriksson & Kovalainen 2008, 294). In this research,

credibility was enhanced through extensive engagement with literature on the EU's energy policy, mining barriers, and critical raw material governance. This background knowledge allowed the researcher to identify meaningful patterns when analyzing how experts interpret the EU's limitations and the realistic capabilities of the mining goal. In addition, the researcher has studied a similar topic when writing her bachelor's thesis. This topic revolved around the EU's energy security compared to other strategic goals. Therefore, the researcher's background with the topic helped in identifying relevant material, interviews, and interview themes to answer the RQ.

On the other hand, *dependability* refers to the consistency and transparency of the research process (Eriksson & Kovalainen 2008, 294), meaning that conditions were created that would allow an inquiry audit. This method requires that the entire research process be documented in a systematic and traceable way so that an independent reviewer could, in principle, evaluate the coherence and logic of the study. In this research, particular attention was paid to documenting how decisions were made throughout the research process. This was done from early choices about the suitability of a qualitative research design to examine the EU's CRM dependency and how mining tries to address it, to later analytical choices about how themes were formed. The audit trail, described earlier, was organized to reflect each stage of the study and assembled in a way that would allow an external reviewer to follow the development of the work step by step. This promotes dependability, where others can follow the research process and potentially conduct research that has similar objectives (Lincoln & Guba 1985, 299).

5.5 Ethical considerations

This study followed the ethical principles of qualitative research, including voluntary participation, an informed consent form, and transparency, as well as careful consideration of participants' autonomy (Eriksson & Kovalainen 2008, 290). Before the interviews were conducted, the interviewees were informed about the aims of the research, how their responses would be used, and the specific focus of the study on CRMA and strategic dependencies in the EU's energy transition. The interviewees were given an option to decline, ask questions, or withdraw at any stage of the process. Additionally, all the saved content, such as audio tapes used, was deleted before finishing the research. This way, the only existing material would be the one referred to in this report.

As the interviewees were not private individuals but professionals accustomed to public-facing roles, anonymity was not necessary to protect them from harm. Furthermore, the research's information sheet provided information on the implications of being named and expressed explicit consent for the use of their names (Eriksson & Kovalainen 2008, 290). The risk related to visibility

was assessed to be low, as the research was only a master's thesis, meaning there was no publicity surrounding it. On the other hand, the interviews themselves were non-sensitive as they were based on experts' professional assessments of policy development rather than personal matters. Still, if the interviewee wished not to have their name published, the choice was given to them. This was the case with the interviewee with the European Commission, illustrated in Table 2.

Nevertheless, ethical attention was maintained throughout the whole research process. The statements presented in this research were described as said in the interviews, avoiding misrepresentations, and ensuring that no material could be construed as confidential or harmful. To strengthen this, interviewees were given the opportunity to review their direct quotations and clarify any phrasing that could be misunderstood. This respected the participants' voluntary participation in this research and prevented any factual errors.

Finally, AI tools were used in this study to support clarity and linguistic accuracy of the text, particularly improving academic style. However, the researcher has full responsibility for the content, interpretation, and final formulation of the text. When AI tools were used, it was conducted in accordance with the University of Turku's and Turku School of Economics ethical guidelines on the responsible use of artificial intelligence in academic writing. Consequently, the use of AI does not compromise the credibility or trustworthiness of this research. Furthermore, to remain transparent about the use of AI, the reader can find a detailed description of how those tools were used in Appendix 4. After the research design was described in this chapter, Chapter 6 starts analyzing the interview material according to the themes presented in subchapter 5.3.

6 Findings from the feasibility of the CRMA's mining goal

This chapter presents the empirical findings of this study and analyzes the factors that affect the feasibility of the EU's objective to achieve 10% domestic mining extraction of CRMs by 2030, as set out in the CRMA. The interviews reveal that the challenge of building an internal CRM supply base is shaped by several interrelated dynamics that operate across global, European, and member state levels. These dynamics can be grouped into five main categories: political commitments and structural constraints, economic and market-related barriers, social acceptance and nimbyism, and broader risk perception related to the urgency of reducing strategic dependencies. These categories will be examined in their own subchapter in this chapter.

Together, these findings show that mining feasibility in the EU is not determined alone by geology or by the main mining-related constraints presented in Chapter 4, but by the interaction of external dependencies. The final subsection focuses on risk perception, which examines whether the perceived severity of strategic CRM dependency is sufficient to motivate the political, economic, and social trade-offs required for domestic extraction.

6.1 Political commitment and structural constraints

This section examines the tension between the EU's strategic ambition to expand domestic mining and the structural realities of its multilevel governance. Political commitment refers to the degree of alignment and prioritization among EU institutions and member states, while structural constraints describe complexity, limited capacity, and regulatory fragmentation.

Many interviewees pointed to the EU's complex multilevel governance system as a barrier to the CRMA's mining objective. The Act focuses on downstream processes and introduces quantitative benchmarks for their deployment. In contrast, previous initiatives, such as the REPowerEU, have focused on upscaling the energy transition that has led to increased CRM demand and dependency. The interviewees agreed that the CRMA has acknowledged the critical issue of the supply chain network and that market outcomes alone have failed to deliver supply security. However, when examined more closely, the feasibility of these targets depends not on the EU setting a strategic direction but on the willingness of the member states to fast-track permitting, land-use decisions, and environmental assessments. This creates overlaps, delays, and inconsistencies in decision-making, as well as takes the timeline out of the EU's hands.

> The recognized aspects in the CRMA are correct, for example, the improvement of mining projects, but the time limit and the lack of funding remain a main concern. Though the

> mining objective, like any other objective, is more of a guideline for the member states. The EU will assess the success of member states' actions after the time period. (Kangaspunta Teo)

Even with setting the right priorities regarding improving upstream resilience, participants noted that the fragmentation makes it difficult to align strategic goals across governance levels. Though Kangaspunta emphasized that the start has been promising and the collaboration between member states has been constant. On the other hand, to evaluate the success of the goal throughout the process, the EU aims to evaluate the progress retrospectively, but this relies on ex-post assessment from member states' documents. The ex-post evaluation tends to capture outcomes only after policies have already been implemented, reducing the ability to make timely adjustments during the remaining four years.

Furthermore, as the CRMA introduces faster permitting procedures for strategic projects, some of the interviewees mentioned that accelerating approval at the EU level does not automatically unlock national administrative bottlenecks. One reason behind this is the lack of political will, with local politicians also having to consider issues like the next election. This will affect how fiercely they promote mining projects, as the projects are directly linked to how the politicians are seen in the eyes of the public. As Eerola emphasized, "Governments have a short lifespan, which is why they are looking to the next election". To go further, some suggested that without deeper institutional reform or stronger coordinating mechanisms, the CRMA risks creating expectations that member states cannot meet in practice.

Political support for mining, therefore, varies widely across the EU countries. In some member states, particularly those with mining traditions or active mining industries, such as Finland or Sweden, there is a greater willingness to discuss reopening or expanding extraction, as the tradition has not yet died. In others, where mining has not been or has been shut down, it remains politically sensitive, associated with environmental degradation or conflict. Serbia and Hungary were countries that were frequently mentioned in this context. Then the EU also has member states, such as France, with little to no mineral deposits but a lot of infrastructure and industrial capacity to refine or process the extracted materials. These countries are seen as pressuring countries as they want to benefit from the expected economic gain from the midstream activities they get after others have extracted the materials. Therefore, divergent priorities create uneven progress and complicate efforts to build a coherent European mining strategy.

The distributional fairness is an important question when considering political commitment. Several interviewees discussed how the act did not specify how this increase should be divided among member states with vastly different geological endowments and other capacities. It was questioned whether the burden of meeting the target would fall disproportionately on a few resource-rich countries, such as the previously mentioned Finland and Sweden, while others would primarily benefit from the outcome without bearing the costs. The absence of a clear allocation mechanism risks generating new inequalities and even dependencies inside the EU. Furthermore, this sense of solidarity can also show as member states waiting to see what other states do before acting themselves to avoid being the one carrying the risks.

> The EU does not tell member states how they are going to meet the targets and goals we have set in the EU. (European Commission officer)

> Member states do not want to open mine pits and simply do the extraction, which has limited added value. So you want to preserve your environment and have the most added value activities. This automatically leads to a position of doing it all for the EU. (Siddi Marco)

Another recurring theme was that the CRMA, despite its ambitions, has limited binding force. Interviewees observed that the Act provides targets and procedural improvements but does not compel member states to approve projects or adapt their permitting practices. Several participants also pointed to limited administrative capacity within national permitting agencies. On top of environmental modelling, mining projects also require, for example, stakeholder engagement and access to potential sites that are in private hands. Even if member states try to fast-track the start of mining operations, the governance spans multiple stages, even inside the member states. This was not emphasized in the Act enough; rather, it made it seem like the upstream supply chain can be influenced with a few changes. Interviews were consistent with this idea, where the EU did not fully understand the multiplex structure in the mining operations. The risk of the so-called domino effect remains an important question. If member states influence delicate structures, how will it propagate across the market or political environment.

> Strategy is blunt. There is an attempt to become more strategic in stating objectives, but at the same time, the EU strategy does not go into details or into specific targets that are followed through with it, for example, specific financing. It is more of a broad framework. (Siddi Marco)

Furthermore, as domestic mining has been outsourced, there is very little information available about the amount of reserves the EU holds. Therefore, before these operations can even be started,

they need to be researched first. This is further complicated by not having capable labor or know-how in the region. Some interviewees noted that the CRMA acknowledges these gaps but does not provide sufficient resources or incentives to build long-term expertise within national institutions.

6.2 Economic competitiveness and the viability of domestic mining

Beyond political commitment and structural constraints, the capacity of the CRMA to stimulate domestic mining within the EU is closely tied to how it interacts with the existing market dynamics. According to the findings, economic competitiveness constitutes a structuring condition that shapes how both policymakers and industry actors respond to the mining objective. That being said, the feasibility cannot weigh only the realities of extractive activities within the EU, because, as the interviewees emphasized, the success of the goal depends on cost differentials and the broader dynamics in the CRM supply chain, where "costs determine".

> Because of our market-based economy, companies and states have continuously sought opportunities where money is, which has meant this back-and-forth movement between those opportunities. As our priorities have been elsewhere, the EU is now trying to balance the supply chain and enhance its own extraction to secure things like energy transition. The problem lies in the fact that it is inherently more beneficial to let China produce what we need rather than open new mines in the EU. (Eerola Toni)

A central issue concerns the cost position of EU-based mining compared to external suppliers. Extractive activities within the EU are associated with higher operational and regulatory costs that did not receive cost reliefs in the CRMA. This creates a situation in which downstream industries already integrated into global supply networks face limited incentives to shift sourcing toward more expensive European alternatives. In other words, it is not beneficial for the mining industry to operate within the EU and for firms to substitute cheaper Chinese CRMs with substantially more expensive European ones. As a result, even where political support for domestic mining exists, demand-side pull remains uncertain. Furthermore, the current economic environment regarding initiatives surrounding mining is usually made to allow outsourcing rather than keeping it in-house. If the only initiative promoting CRM extraction is the CRMA's 10% goal, how will firms or governments justify the trade-offs. In other words, one initiative encourages, whereas a dozen others restrict the implementation.

> It does not make sense to extract minerals for a product needed for the clean energy transition if we can get it much cheaper from China. Who is going to pay for the mines in Europe if the labor costs, among other things, are cheaper in China. (Muth Carl)

> We are losing primary production in Europe because it is very energy-intensive, and energy is too expensive in Europe at the moment. (Siddi Marco)

The implications of this are visible in how the mining target itself is interpreted. The findings suggest that the CRMA is not seen as a transformative shift toward a more self-sufficient EU. Therefore, as the CRMA tries to address a fairly new issue in the geopolitical field, it is unlikely to meet its target, as global dynamics have not yet shifted to address it. Domestic mining is thus seen as a supplementary source of supply among the interviewees that might improve resilience with its timeframes, but it will not displace imports from China in a meaningful way. This interpretation thus suggests that the 10% target is economically constrained by the continued attractiveness of global sourcing options.

> The EU has to build up its own capacity, yes, but CRMs are cheaper in China, then we buy them from there. It is much cheaper and beneficial for the EU's economy. (Muth Carl)

> China has been good at building whole supply chains. We have a lot of catching up to do, but we have a lot of potential. (European Commission officer)

Investment considerations further reinforce this pattern. Mining projects require substantial upfront capital and operate over long-time horizons. For example, it is made to seem like it can be a way to quickly change the market, as the EU did with the last dependency on Russia, where it offered energy transition as the main tool to reduce the dependency. It is not the case here, as even with the timeline improvements introduced in the CRMA, domestic mining is still too sensitive to uncertainty. It is constrained by the current market logic and outsourcing to China, Trump's new presidential term, and the following international cooperation uncertainty. That being said, in the absence of strong and predictable industrial policy support, investors face difficulties in justifying projects that have struggled to compete under current market conditions. This is compounded further by the volatility of CRM prices, where the EU has no influence because the market is led by other actors. Therefore, the CRMA introduces additional risk that weakens the business case for domestic extraction.

In this sense, dependency is not merely a vulnerability to be corrected, but an outcome continuously reproduced by market-based decision-making. As long as external sourcing remains economically advantageous, efforts to expand domestic mining are likely to encounter persistent resistance. Not necessarily in the form of opposition, but through the absence of sufficient economic incentives by member states to drive change. In this context, the CRMA's effectiveness in achieving its mining objectives depends on broader political willingness to prioritize resilience over competitiveness

when one's own regional security is at stake because of other players in geopolitics. As long as competitiveness remains the primary organizing principle of the EU's economic and security governance, efforts to expand domestic mining are likely to face structural limitations, as economic gains can be maximized elsewhere. The interviews further highlighted this idea that the Act may improve preparedness and reduce the most acute risks by showing the public the enhanced dependency on Chinese CRMs, much of which has to do with the energy transition.

> The CRMA tries to put order and set targets. Of course, the main weaknesses are implementation and the fact that it looks like there is no new finance. (Siddi Marco)

> The CRMA is a great initiative, but money is always a question. Though we should not judge it yet, as it has only been adopted. (European Commission officer)

The EU's goals of cost efficiency and affordability also contradict the CRMA's mining goal in the fact that mining projects in the EU have been nonexistent for decades. Starting them now, when the EU faces higher costs due to, for example, higher energy costs, further complicates the situation. If domestic extraction for the next four years remains more expensive, political targets alone are unlikely to redirect capital flows at the necessary scale. In this sense, the Act presupposes that improved coordination and reduced administrative friction will be sufficient to trigger investments, without fully addressing whether the economic case is strong enough. This was also highlighted by the interviewees that more concrete action would be needed to help speed the process, as the prices inside the EU are most likely not to fall anytime soon.

6.3 Social legitimacy and nimbyism

The social legitimacy and environmental aspects introduce an additional layer of constraint, as highlighted by the interviewees. Even if the first two dimensions do not challenge the feasibility of the goal, mining needs to always take into account the environment and the society in which it operates. It also directly affects economic profitability and political ambition, such as the high environmental regulations that need to be addressed by the member state. The 10% domestic extraction target, therefore, confronts not only market dynamics but also the political ecology of European territory and whether mining can be legitimized within local and national contexts.

A central issue relates to the tension between the strategic importance of CRMs and the localized impacts of extraction that does not get support in the CRMA. The act fails to recognize that environmental and social costs are primarily borne at the local level, which means that the goal of achieving supply security and reducing dependency offers little comfort to local residents. If these

deposits are as important as the EU portrays, why is the known social resistance not addressed more in its frameworks. Therefore, because dependency is a relatively new concept to the public, they are unwilling to bear the immediate consequences of projects that serve broader, abstract policy goals.

> Often, there is also opposition to the green transition as well. Some arguments state that this is because they were financed or supported by Russia to keep the EU more fossil-fuel depended. (Siddi Marco)

In the EU, social acceptance is closely tied to trust in institutions. However, the findings indicate that formal compliance with regulatory requirements does not automatically translate into societal approval. Trust in institutions is important in this case because if local communities feel their governments are serving broader ambitions, trust declines. Moreover, if local communities feel compelled to accept the negative impacts of mining due to EU-level decisions, this may erode their trust in the EU as an institution. Such perceptions can foster the belief that the EU prioritizes its strategic objectives over the well-being of local populations. Thus, public trust helps explain why initiatives such as the CRMA, which rely on appeals to the collective good, struggle to achieve their objectives.

The social dimension is further complicated by the public's lack of knowledge about mining projects. For example, Eerola mentioned that even though mining can be fairly sustainable nowadays with advancements in technology and knowledge-building, the public is not familiar with these methods. Furthermore, the public might not even understand how deeply rooted the dependency problem actually is, to help open the mindset for mining. Because of this, even if the projects started with the CRMA meet the environmental standards, they may still face resistance due to perceived risks and historical experiences. However, environmental or social concerns might not be the cause of social resistance, because the findings indicated that economic gains might be the main cause for not wanting mining operations close to them. Therefore, the social legitimacy of mining usually operates as a continuum for the economic aspect.

> Mineral extraction is intensive and has a big environmental impact. This is bound to cause resistance to disputes concerning justice, for example, what do the local communities get. We have already seen that this plays a role, for example, Serbia. (Siddi Marco)

When it comes to the energy transition, this form of resistance does not necessarily reflect its rejection. On the contrary, it highlights the gap in knowledge between CRMs and energy transition. The benefits of clean technologies are often diffused across society, much like the European Commission official emphasized that “the EU is lucky that member states have accepted the energy

transition and the goals that come with it". On the other hand, energy transition can be seen as a way to cut down emissions and reduce dependency on fossil fuels, but people rarely understand the transition's link to CRMs. Therefore, socially, people find it hard to justify these projects because it feels like, at the same time, they are going against the sustainability goals that the energy transition tries to improve.

Nimbyism also came up in the interviews when talking about the economic benefits vs. high environmental regulation in the EU. In this context, the interviewees compared whether the economic gains were the only reason for the continued reliance on China or if there were other factors present as well. It was clear that it was not only economically beneficial, but also moving the extraction more fiercely inside the EU means also having to deal with the sustainability concerns that at this moment stay in China. Whether through its own projects or new mining partnerships, the EU must ensure that sustainability concerns are fully integrated into operations in these locations. Due to the asymmetrical dependency, the EU cannot influence how sustainability is handled in the other country but can only affect how it is handled when the partnership changes. As the EU has benefited from outsourcing extracted CRMs, often under lower environmental and labor standards, it has externalized ecological and social costs to third countries. This has allowed it to maintain a strong sustainability profile and get closer to reaching its sustainability-related objectives.

Importantly, the findings also suggest that social resistance is reinforced by nimbyism. As long as materials can be sourced abroad, the urgency of developing domestic alternatives remains limited from a societal perspective. This creates a feedback loop in which the dependency reduces the perceived need for local extraction, while local opposition, in turn, sustains that dependency. In this sense, social resistance is not only a barrier to mining but also a factor that stabilizes current supply chain structures.

Overall, social and environmental constraints highlight a fundamental contradiction at the core of the EU's approach. The transition toward a more sustainable and secure supply of CRMs requires increased extraction, yet the societal and environmental standards that define the EU simultaneously limit the extent to which such extraction can expand. This tension does not necessarily prevent mining projects from proceeding, but it contributes to delays and reduced ambition in their implementation.

6.4 Strategic risk perception and the securitization of dependency

A central question emerging from the interviews is not only whether the EU is dependent on China for CRMs or if the CRMA can promote internal extraction, but also whether this dependency is perceived as strategically dangerous enough to bring up concrete actions against it. As we covered in subchapter 6.1, supply chain vulnerability or strategic dependency does not automatically translate into political urgency. This is because securitization of a risk is not only an objective condition but also a matter of perception and prioritization that needs to happen at every affected level, which is mining in this case.

After the asymmetrical interdependence partnership changed with Russia, the whole of Europe experienced the effects of relying too much on one supplier. What was long treated as a manageable interdependence was suddenly reframed as geopolitical leverage. Still, many of the interviewees did not consider the CRM dependency to be something comparable to one that led to the 2022 energy crisis. An interesting observation is that, although the dependency is widely acknowledged at a theoretical level, it is not translated into a sense of urgency that would justify significant economic and political trade-offs. On the other hand, from a social perspective, the perception reinforces attitudes towards mining. The consequence of this is reducing pressure on policymakers and market actors to take rapid or decisive action, particularly when such action involves higher costs or societal resistance.

> The dependency on China is a risk for the EU. We have seen this example already with the gas crisis in Russia. We need to be careful not to fall into the same dependency again with China. (European Commission officer)

> It is a clear vulnerability for the EU, but how much the vulnerability actually affects the EU is a different thing. (Kangaspunta Teo)

Continuing with the interdependency, the partnership with China was seen to match that concept. Many interviewees emphasized that it benefits both parties mutually, where the EU buys from China and China can maintain its market lead. Therefore, the risk of China using the dependency as leverage was seen as distant. For example, Muth concluded that China wants to support its own market as well. It does not seek to create asymmetrical partnerships to keep the dependency as a safety mechanism if business or politics internationally do not go its way. On the other hand, some did bring up examples of how China has already used CRMs as a political weapon, such as with Japan. This shows two very different risk perceptions across the interviews. Others think about the supply chain vulnerability more commercially, whereas others in security terms.

> If China cuts the EU's supply off, the whole economy in the EU would be on its knees quickly. (Eerola Toni)

> A potential risk, but it is not imminent, especially if the EU acts as an independent actor rather than as a minor partner of the U.S. There is still room to keep a working trade relationship with China, and the risk should not be overstated. (Siddi Marco)

When considering how the CRMA aims to get to its mining goal, interviewees who believed that the dependency could quickly escalate into a strategic problem were more optimistic that accelerated permitting, among others, would help secure domestic production. Those who saw the problem as distant reflected more on managing the partnership with China and handling international dynamics. On this side, the CRMA's mining-related instruments are not seen as central strategic interventions but as incremental policy tools aimed at influencing a specific industrial sector. In this context, domestic extraction is approached in a similar manner to other policy measures, not in a security context.

> We are aware in the EU that we need to move as fast as possible because China is decades ahead of us. (European Commission officer)

> What is really important in the CRM sector, and what could be considered a risk. If it is a dependency, how can it be handled in a fair way. (Muth Carl)

Moreover, the approach to handling these vulnerabilities and accelerating mining should be slow and steady, which indicates that it is not considered an urgent risk. This was agreed on even by the interviewees, who emphasized that the EU's dependency on external suppliers is a strategic risk and saw the CRMA as an important tool that addresses the CRM supply chain vulnerability. The relative lack of urgency helps explain why more ambitious or interventionist measures are not strongly pursued. As demonstrated in the previous sections, the expansion of domestic mining faces clear economic, structural, and social constraints.

However, these constraints alone do not determine policy outcomes because they are underlying problems that stay because of the risk perception. To help conceptualize the findings presented in this section and connect them to the other subchapters, the next figure is introduced. This figure is built from the securitization theory presented in the theoretical framework, but it is taken a step further by applying it to this case. Therefore, it concerns CRM dependency risk perception, selling it to the relevant audience, and how the perception relates to other barriers that emerged from policy attempts to regain control of the supply chain.

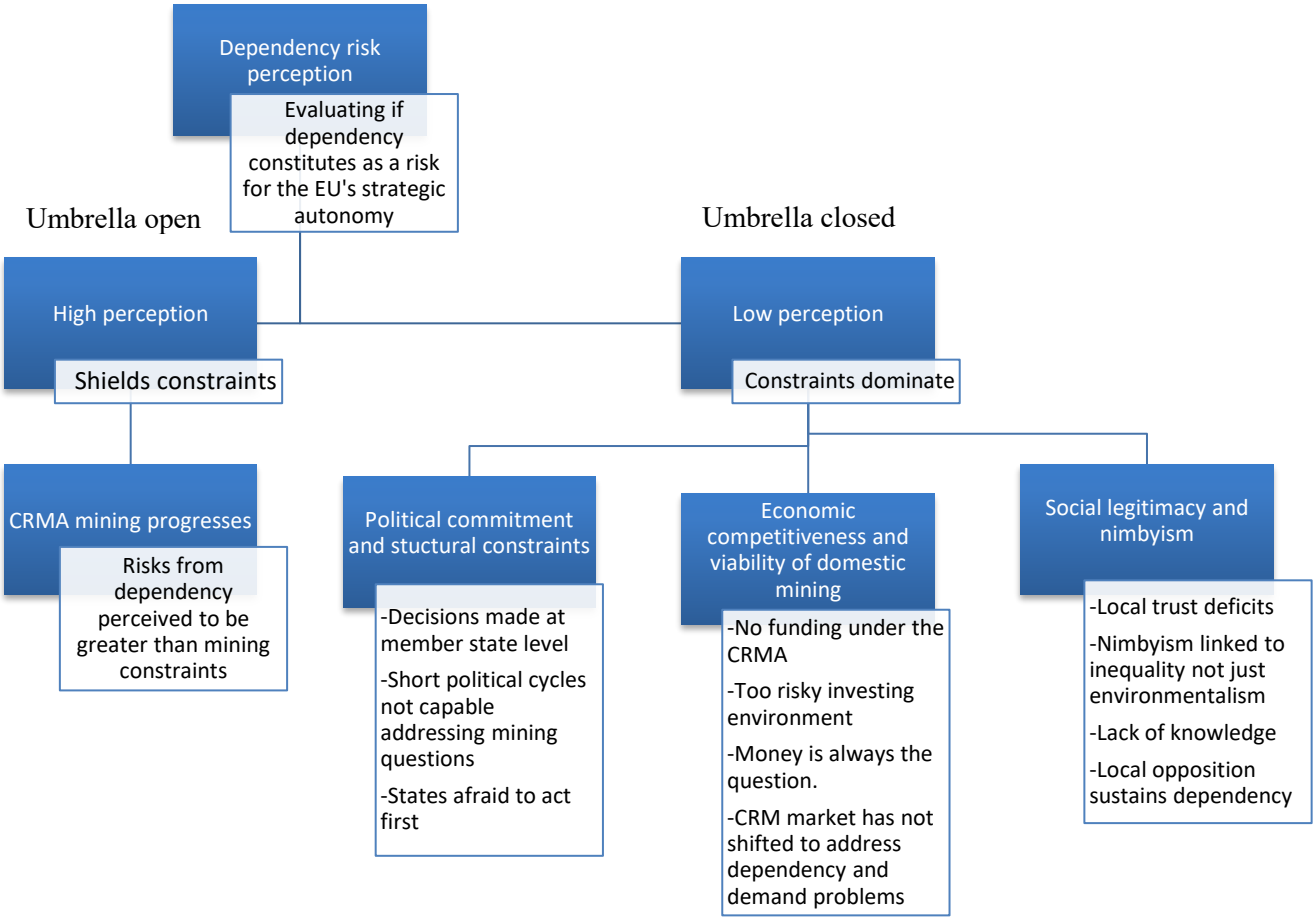

Figure 11 Dependency risk perception

Figure 11 illustrates how risk perception affects the mining goal's feasibility. At the top is the risk perception, which constitutes the first step in addressing dependency problems. Then it is divided into high perception and low perception. The high perception shields the mining efforts like an umbrella, whereas in the low perception, the umbrella is closed, leaving the constraints to dominate. The high perception shields because of the risks emerging from the dependency are anticipated to be greater than dealing with the constraints related to mining. On the other hand, in the low perception, constraints get to dominate because global dynamics are not considered to be a risk factor. Source: own elaboration.

In practice, when dependency risks are weighed with other risks, especially the risk of losing economic competitiveness, they weigh more than the theoretical situation. Furthermore, the absence of a clear sign that the dependency would be used against the EU like in the past crises, risks remain abstract for the EU, for member state governments, and for the public that resists mining. That being said, the findings emphasize that pre-emptive action in the EU regarding the CRMA's mining goal is weakened due to the risk perception. In addition, this suggests that the effectiveness of the

CRMA's mining goal depends on whether broader shifts in the geopolitical or economic environment alter how the dependency risks are perceived.

7 DISCUSSION

This study aimed to explore the extent to which the CRMA can reduce strategic supply chain dependencies and strengthen supply security with its 10% mining goal. The EU's energy transition and energy security were kept as an underlying concept because they have significantly influenced the CRMs' demand. The main research question was approached through three sub-questions addressing structural supply chain vulnerabilities, policy responses through the CRMA, and the EU's limitations affecting the implementation of the Act's mining-related objectives. In this section, the sub-questions are used as a base for linking theory to this study's findings.

7.1 Why are global critical raw materials supply chains structurally vulnerable to supply disruptions?

The first sub-question examined why global CRM supply chains are structurally vulnerable to supply disruptions. Prior research within supply chain studies and economic geography argues that globalization has prioritized cost efficiency and outsourcing, often at the expense of resilience (Christopher & Peck 2004; Coe & Yeung 2015; Gong et al. 2026). The empirical findings are consistent with that view, demonstrating that such structural features have externalized the most resource-intensive and environmentally demanding stages of production. In this case, particularly downstream and midstream operations in the CRM supply chain.

From a GPN perspective, this pattern reflects the uneven organization of value creation and actors' roles across different nodes (Henderson et al. 2002; Coe & Yeung 2015). Interviewees described how China's technological capabilities and state-led industrial policies anchor much of the global CRM network there. It is further in line with Mouel and Poitiers (2024), who show that the EU remains a downstream consumer, highly dependent on imported CRMs due to the midstream dependency. On the other hand, prior research rarely emphasizes the fact that, as the EU externalized resource-intensive stages, policy frameworks, regulatory standards, and institutional incentives were gradually built around the assumption that these activities would remain outside its territory. Thus, the "not in my backyard" concept can be observed here as well. As a result, even when new incentives are introduced to promote domestic mining, they operate within a regulatory environment that has, over time, become structurally misaligned with these activities. This confirms the argument that Europe's vulnerability is systemic rather than actor-specific, as it is embedded in the institutional and geographic nature of the CRM economy and therefore reinforces the vulnerability.

The findings also refine the earlier interdependence theory (Keohane & Nye 1977) by illustrating how asymmetric interdependence translates into bargaining power within mineral supply chains. While the EU depends on China for refined materials, China simultaneously relies on the EU as a dependent buyer. Yet, echoing Li and Gong (2025), this asymmetry remains tilted toward China due to its integrated midstream capacity and historical examples. Thus, this study suggests that what is often described as interdependency is, in practice, closer to managed dependency, where power is unevenly distributed despite mutual exchange.

A similar distinction emerges in relation to the concept of strategic dependency. Theory commonly frames strategic dependency as a security concern when access to critical inputs is at risk (Waltz 1979; Rana 2015; Guinea & Sharma 2023; European Commission 2023). However, the findings indicate that this dependency is more often interpreted through an economic lens. While interviewees recognized the concept and its relevance to CRMs, it was not consistently treated as an urgent security issue or a clear vulnerability. Therefore, in literature, when talking about strategic dependency, it should be noted that it is also a combination of perceived risks, not just a structural condition in the supply chain.

In light of the energy security's four A's framework (availability, accessibility, affordability, acceptability) proposed by Cherp and Jewel (2014), the results further clarify the multidimensional nature of CRM supply risk. Rather than availability being the main challenge increased by the energy transition (Groves et al. 2025), accessibility and affordability are also shaped by geopolitical frictions and concentrated refining capacity. At the same time, acceptability is constrained by growing environmental expectations and nimbyism. This highlights how supply risks are distributed across multiple dimensions rather than concentrated in a single factor.

An additional dimension that remains unexplored in the findings is the role of the energy transition in amplifying demand for CRMs and consequently intensifying structural dependencies. The literature widely emphasizes that the shift to renewable energy systems significantly increases demand for minerals, thereby placing additional pressure on already concentrated supply chains (Guinea & Sharma 2023; Bensalah 2024; Yang et al. 2024). However, this dynamic was only marginally reflected in the interviews. One explanation for this discrepancy is that the underlying structure of supply chains is often treated as given or self-evident, as mentioned before. This highlights what Martin (2020) proposes as path dependency, in which market structures are kept because of social practices. Therefore, this study finds that institutions move on from one vulnerability to another by implementing the same market logics, where the existing market logics

persist through established practices. As a result, increasing reliance on CRMs does not automatically trigger reassessment of supply risks, such as moving from Russian fossil fuels to CRM fueled energy transition. This reveals a gap between theory and practice. While theory identifies rising demand as a key driver of vulnerability, in real life, it is normalized.

7.2 How does the CRMA seek to reduce strategic dependencies and strengthen the security of supply in the context of the clean energy transition?

The second sub-question addresses how the CRMA seeks to reduce the vulnerabilities examined in the first sub-question and strengthen the EU's supply security. The findings indicate that the CRMA represents a significant attempt by the EU to address strategic dependencies through a combination of policy instruments. This was also agreed by Hool et al. (2023), who concluded that even with its limitations, the Act has shifted the EU's focus more concretely to address the challenges of the current era of volatile international cooperation. These include targets for domestic extraction, processing, and recycling, as well as diversifying supply chains and strengthening international partnerships (European Commission 2023a).

From a GPN perspective, these measures can be integrated as an attempt to re-embed Europe within the downstream and midstream nodes of GPNs (Coe &Yeung 2016; Gong et al. 2026). Within the broader framework of the EU's industrial policy and energy transition, the CRMA reflects a growing recognition that securing access to CRMs is necessary for maintaining competitiveness and enabling the clean energy transition (Groves et al. 2024). In this sense, the findings also support that the Act can be understood as part of a broader policy shift in which the EU increasingly combines different objectives related to strategic autonomy.

Empirically, interviewees viewed the CRMA as both a policy innovation and a signaling device. This is in accordance with Rodrik (2004) and Bastianin et al. (2026), who emphasized that market norms are too strong and embedded in economies, requiring policies if one seeks to change them. Still, the findings indicate that even with policy measures, these market structures cannot be changed without the whole world following the same pattern. Consistent with the industrial policy theories (Gerybadze 1992), the CRMA's capacity gap is often too broad a framework, making it incapable of addressing traditional industrial barriers.

From a securitization perspective (Buzan et al. 1998), the Act frames the CRM dependency as an existential economic-security threat. However, the findings indicate that this securitization process remains partial. While experts understand the dynamics in the CRM supply chain, the broader

societal audience has yet to understand the threat. As Wæver argues, dependency in this case is a mixture of perceived risks. Thus, regarding CRMs, these risks remain abstract and distant, as they are not directly visible in everyday life, unlike mining activities. As a result, disruptions in global supply chains or geopolitical tensions are not easily translated into concrete concerns at the societal level. International dynamics occurring outside Europe may therefore fail to generate a sense of urgency among the public if they do not see it in, for example, the rise of energy prices. Consequently, even these messages do not resonate widely. As Buzan et al. (1998) observe, if recognition of risk is lacking among the public and industry, the securitization remains rhetorical. Therefore, interventions do not produce the desired level of urgency either.

That being said, this study complements securitization theory by demonstrating how the recognition of risks to sovereignty can act as a catalyst for attempts to reshape existing market structures. At the same time, it identifies a critical limitation in the current literature. While securitization theory emphasizes the articulation of threats and the role of the audience in accepting them, it pays less attention to the need to position the proposed response as more favorable than competing economic or political alternatives. In other words, it is not sufficient to frame an issue as a security threat if it does not also outweigh the perceived costs of action.

This resonates with Gong et al.'s (2026) argument that the perception of vulnerability is mediated by geopolitical discourse and state-firm relations rather than being automatically recognized. In this sense, dependency is not only a material condition but also a matter of interpretation. In the case of CRMs, the findings revealed that this step remains incomplete. Although dependencies are acknowledged, the proposed solutions, such as expanding mining, are often perceived as less attractive than maintaining existing arrangements. To illustrate this dynamic, the securitization framework introduced in subchapter 3.3 is revisited and adapted to reflect the empirical findings, highlighting the current stage at which the securitization of CRMs remains.

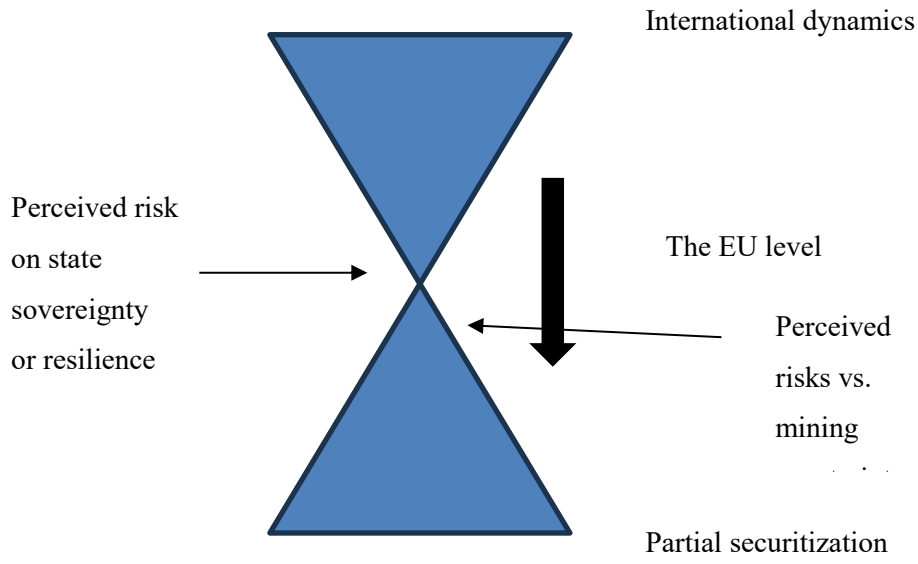

Figure 12 Revised hourglass model of securitization

Figure 12 revisits securitization theory and introduces an additional arrow on the right-hand side, pointing toward the center of the hourglass. This modification illustrates that, while the findings suggest the EU has recognized the risks associated with CRM dependency, it has been less successful in conveying this risk to the relevant audience. This leaves the securitization as partial at the bottom. Although the issue is framed as a strategic dependency, it continues to be perceived as interdependence, in which both parties rely on one another. Figure: own elaboration.

To conclude, the findings suggest that the CRMA addresses strategic dependency through a combination of material measures and strategic signaling. While it aligns with theoretical expectations regarding industrial policy responses, its effectiveness is shaped by both global market structures and the way these risks are perceived.

7.3 What internal institutional, structural, and societal factors may hinder the implementation of the CRMA's domestic mining objectives within the EU?

The third sub-question focused on the internal EU-level limitations that may hinder the implementation of the CRMA's mining-related objective. Theoretical expectations from the political economy of extraction, social acceptance, environmental concerns, and institutional governance would constitute primary barriers (Tost et al. 2021; Wien 2024; Correia et al. 2024; Bastianin et al. 2026). While the findings confirm some of these predictions, they also reveal significant departures from theoretical assumptions.

One of the clearest divergences concerns the role of environmental considerations. In the literature, environmental regulation and sustainability concerns are often presented as central obstacles to mining expansion in the EU. However, in the findings, this dimension was not as pronounced as

expected. Environmental issues were rarely discussed as independent constraints. Instead, they were embedded within other considerations. Most notably, they appeared as a factor increasing costs, complicating fast-track procedures or influencing social acceptance.

This is closely linked to findings on social acceptance. While theory often emphasizes strong local resistance to mining, the interviews suggest a more conditional dynamic. Opposition was not absolute but depended on perceived benefits. Mining projects were more likely to face resistance when local communities did not expect tangible economic gains, reflecting a “not in my backyard” logic. On the other hand, the theory of nimbyism (Xu et al. 2024; Kovasch et al. 2025) usually connects it to acceptance of environmental concerns regarding mining, but findings leaned more towards letting go of nimbyism for economic reasons. This aligns with Que et al. (2018), who show that proximity to extractive activities can increase acceptance when local benefits are visible.

The findings on institutional and structural constraints were more consistent with theory. Mining governance in the EU remains fragmented, with responsibilities divided across multiple levels and strong variation between member states. Permitting procedures are often lengthy and complex, and the introduction of EU-level objectives adds another layer to existing national systems (Wien et al 2024). However, the findings suggest that the challenge is not only administrative complexity, but also a lack of alignment between EU-level goals and national incentives, which negatively affects trust in institutions. Member states retain control over mining decisions, which means that implementation depends on their willingness to prioritize extraction within their own political and economic context, which the CRMA takes as given.

The interviews revealed three distinct categories of member states with conflicting interests regarding domestic mining expansion that, in theory, were addressed only by the first two (Moffat 2015; Hool et al. 2023). Resource-rich countries possess mineral deposits but worry about bearing disproportionate environmental and social costs for EU-wide benefits. On the other hand, countries with limited industrial capacity but resource-rich make them dependent on others for other value-added activities. Resource-poor countries support mining as they usually have more infrastructure for processing or refining. Interviews addressed worries about member state-level distributional justice, where states either wait for others to act or want to have the whole value chain to themselves. This supports earlier findings by Gerybadze (1992), who concluded that industrial policy often leaves some actors negatively affected. Furthermore, it adds to the discussion on distributional justice that the theory is often linked only to the social dimension (Moffat 2015; Righetti & Rizos 2024). However, findings linked it also to the institutional capacity.

Among all dimensions, the economic constraints emerged as the most pronounced in the findings, whereas the theory emphasized more social acceptance (Tost et al 2021; Righetti & Rizos 2024). High production costs and energy prices were consistently identified as key barriers to domestic mining. On the other hand, environmental regulation was frequently discussed through its cost implications rather than as a standalone constraint. As a result, mining within the EU is less competitive compared to imports, reinforcing existing dependencies. In this context, economic considerations tend to outweigh both environmental and strategic arguments.

To conclude, while the theoretical framework correctly identifies the main categories of constraints, the findings suggest that their relative importance differs in practice. Environmental concerns are less dominant as independent barriers, social acceptance is conditional on economic benefits, structural constraints persist as expected, and economic factors ultimately play the most decisive role. This indicates that the challenge of implementing the CRMA's mining objectives lies not only in overcoming individual barriers that were addressed in theory, but in answering how these dimensions interact and reinforce one another.

7.4 To what extent can the EU's Critical Raw Materials Act reduce strategic dependencies on critical raw materials through its domestic mining ambitions?

Taken together, to answer the main research question, the findings of this study highlight the complexity of addressing CRM dependencies as they are linked to many critical aspects inside a country, inside the EU, and the whole value chains across the world. That being said, changing or trying to influence these market dynamics that are widely based on some form of dependencies can form a rolling dice, causing more issues to deal with than staying in the initial dependency. Therefore, the limitations do not stem from a lack of policy recognition but from the interaction between structural supply chain dynamics and the way these challenges are perceived and prioritized in practice. This is also the reason why initiatives like the CRMA lack critical components because they try to comprehend market realities, other goals, member state differences, and geopolitical change.

The limitations of mining arise from the interaction of three dominant factors, according to findings. First, structural conditions within the GPNs limit the EU's capacity to rapidly reposition itself in the upstream activities. Existing supply chains affect too much in the EU's internal actions to regain control, which means they cannot be reconfigured through policy interventions alone. Second, internal EU-level constraints, such as economic disadvantages, structural constraints, and social acceptance, reduce the practical feasibility of expanding domestic mining. Together, these factors

indicate that the scale and speed of transformation required by the CRMA's extraction target exceed what can realistically be achieved within current institutional and market conditions.

However, the most critical factor influencing the outcome is risk perception. The findings reveal a clear divergence between the structural vulnerabilities identified in theory and how urgently these vulnerabilities are interpreted in practice. Although dependency on external suppliers, particularly China, is widely acknowledged, it is not consistently perceived as a security concern. Instead, the potential costs of reducing dependency, such as decreased competitiveness, regulatory burdens, social opposition, or environmental degradation, are often given greater weight in decision-making. This means that the CRMA does not offer sufficient tools to address the trade-offs, or that member states do not actively pursue domestic mining to be able to reach the goal by 2030.

From a securitization perspective, this suggests that CRM dependency has not been fully translated into a shared sense of urgency. While the EU has recent experience with the consequences of resource dependency, this has not led to a consistent framing of CRMs as a comparable strategic risk. In line with the logic developed by this study, risk perception functions as an "umbrella" condition. When dependency is perceived as a credible and immediate threat, it enables policy implementation by outweighing competing constraints. When this perception is weak or fragmented, the same constraints (i.e., economic, regulatory, and social) become dominant and hinder progress.

In this context, the CRMA is unlikely to meet its mining goal and regain control that way in the supply chain. Its impact is better understood as gradual and supportive rather than transformative. Domestic extraction may improve the use of existing resources and contribute to incremental resilience, especially when demand for CRMs continues to grow. However, core dependencies are likely to persist due to the realities portrayed earlier. Lastly, the findings suggest that reducing CRM dependency requires more than policy instruments targeting supply. It requires a shift in how these dependencies are understood and prioritized across the EU or even globally. After discussing the findings in the light of existing theory, this study moves on to concluding remarks and recommendations for further research.

8 Conclusions and recommendations

This chapter concludes the thesis by summarizing the key findings of the study and reflecting on their broader implications. Building on the theoretical framework and the empirical analysis presented in the previous chapters, this chapter first discusses how this research contributes to the research field by connecting it to theory. Then the discussions continue to outline policy implications of the findings, particularly in relation to the feasibility of the CRMA's mining objective and the governance of CRM supply chains. Finally, the chapter addresses the limitations of the study and proposes avenues for further research on CRMs, supply chain resilience, and the implementation of strategic resource policies.

8.1 Theoretical contributions

This thesis contributes to the growing academic discussion on CRMs, energy security, and supply chain governance by examining the EU's CRMA in relation to its domestic mining objectives. By linking global supply chain vulnerabilities to internal EU mining governance structures, the study bridges insights from GPN's, interdependence theory, and securitization theory within a single analytical framework.

First, the findings extend GPN literature by showing that vulnerabilities are not only embedded in the geographical concentration of production but also in institutional path dependencies within importing regions. While GPN theory emphasizes structural asymmetries, this study demonstrates how regulatory environments and policy legacies in the EU reinforce these vulnerabilities, even when strategic shifts are attempted. Second, the thesis contributes to interdependence theory by illustrating how asymmetric dependencies in CRM supply chains translate into uneven bargaining power. Rather than representing balanced interdependence, the EU-China relationship should be understood as managed dependency, where mutual reliance exists but remains structurally skewed. Third, this study refines securitization theory by highlighting the role of risk perception in shaping policy outcomes. The findings suggest that strategic dependency has to be shown concretely to translate into urgent political action rather than just relevant actors selling the perceived risks to the public. This introduces a more nuanced understanding of securitization, where partial or uneven recognition can limit the effectiveness of policy instruments such as the CRMA.

Finally, the thesis contributes to the literature on industrial policy implementation by demonstrating that structural, social, environmental, and economic constraints are not independent barriers, but interconnected dimensions shaped by both global market dynamics and domestic political choices.

This highlights the importance of considering both external network structures and internal governance conditions when assessing the feasibility of strategic policy interventions.

8.2 Policy implications

For European policymakers, the findings of this study have several implications. While the CRMA is an important step toward addressing structural vulnerabilities in global supply chains, the analysis suggests that achieving its objectives will require stronger coordination between political ambitions and the practical realities of implementation within the EU. Looking more closely at the 10% extraction goal, the gap between ambition and reality was highlighted by the low perceived risk of CRM dependency.

First, regulatory complexity within the EU appears to remain a significant challenge for the development of new mining projects. The analysis indicates that the lack of interest in mining projects, combined with lengthy permitting procedures, overlapping regulatory frameworks, and fragmented governance structures, slows down or discourages member states from fastening mining projects or discourages investment. While these frameworks reflect important environmental and social safeguards, they also slow down decision-making and reduce predictability for investors. Addressing this challenge requires not only procedural simplification but also improved coordination across governance levels and greater clarity regarding how strategic projects are prioritized within existing regulatory systems.

Second, economic viability was a major part of the findings when considering the feasibility of domestic mining initiatives. European mining projects often face higher production costs due to stricter environmental standards, labor costs, regulatory requirements, and energy costs that hinder the internal mining projects, as well as making it more beneficial to stay in dependency. As the CRMA lacks direct financial support and mining projects itself makes investments unfavorable, strategic extraction projects struggle to compete with imports. As a result, achieving the CRMA's extraction target requires stronger and more direct financial instruments, such as investment support aimed at improving the economic viability of mining within the EU.

Third, an important policy implication concerns societal acceptance of mining activities. Public resistance to new extraction projects represents a major obstacle to expanding domestic production, especially in regions where environmental or economic concerns are strong. On top of public opposition, local governments that balance between the current needs and future elections find it hard to justify mining, as it can negatively affect their public image. The findings indicated that the

opposition regarding mining comes from a lack of knowledge. This is why stakeholder engagement, and local economic benefits could help address some of these concerns. Moreover, policies that emphasize responsible mining practices, environmental safeguards, and informing the public about these practices could improve the social legitimacy of strategic mining projects.

Finally, the most alarming finding was the risk perception of the current CRM dependency on China. If these dependencies are not widely perceived as an immediate threat, political momentum for ambitious policy measures remains limited and leaves the EU at risk. This suggests that policy discussions surrounding CRMs should not focus solely on technical supply chain issues but also address strategic awareness of geopolitical risks associated with concentrated supply chains and geopolitical shifts.

Overall, these policy implications suggest that strengthening Europe's CRM supply security requires a comprehensive approach that goes beyond setting targets. It necessitates aligning political incentives, reducing institutional barriers, improving economic viability, and fostering societal support, while simultaneously addressing the underlying perceptions that shape policy prioritization. The success of the CRMA's mining objectives will ultimately depend on how effectively these interconnected challenges are managed.

8.3 Limitations of the research

This thesis contributes to the ongoing discussion on CRM governance and the risks that come from not addressing these supply dependencies fiercely enough. More specifically, the study focused on challenges that may hinder the achievement of the CRMA's target of increasing domestic extraction of CRMs. The analysis is based on semi-structured expert interviews with Finnish diplomats, EU Commission officer, and researchers in order to contextualize the findings within the broader policy and academic debate.

However, this study also contains several limitations. First, due to the complexity and geopolitical sensitivity of CRM supply chains, the analysis focused primarily on the EU's dependency on China rather than transatlantic relations. This is because theory often leans towards China's resource dominance in the supply chains over the U.S.'s resource governance. For example, the EU's previous trade disputes with China in 2011 and China's CRM dispute with Japan in 2015 were mentioned in theory. Therefore, it did not consider the U.S.'s part in the global context, even though Trump's new presidential term was addressed as a critical risk concerning resource governance by the experts. Another reason for leaving the U.S. out of this study is that adding geopolitical

dynamics more deeply to this study would have made the topic too broad to handle in the framework of a master's thesis.

Secondly, the CRMA itself is a relatively recent policy initiative, having been proposed in 2023, implemented in 2025, and reaching till 2030. As a result, its practical effectiveness cannot yet be fully evaluated. The analysis, therefore, focuses on the perceived feasibility of the mining target and the conditions that may influence its implementation according to available data and expert understanding. Future developments in the EU's industrial policy, regulatory frameworks, and member state actions may significantly shape how the CRMA's objectives are implemented in practice.

Furthermore, key limitations were found to be the constantly evolving policy field in which this study operates. For example, midway through the research process, the EU presented the ResourceEU package, which is intended to bring more tools and understanding to the subject of CRM management. This initiative is a bigger industrial policy under which the CRMA will fall. Thus, the new package addresses some limitations that were key insights in this study, but the effects and linkages could not be analyzed due to the package being introduced so late in the research process (European Commission 2025b). In addition, the ResourceEU plan only came up in two interviews with government officials who worked in CRM or energy-related teams, which means they have inside knowledge about the EU's projects. Another reason is that the package was introduced after the majority of the interviews were already conducted.

Another critical initiative the EU is preparing to publish is the reframed energy security framework, which will come out sometime in 2026. This new framework could offer new aspects to energy transition and how the CRMs are managed at the EU level (European Parliament 2026). On the other hand, G7 countries are also planning to publish a unified CRM management plan, as all G7 countries expect Japan are heavily reliant on China (Yamaziko et al. 6.1.2026; G7 2025, 1). Though this was not yet published either when this study was conducted, and for that reason was not considered.

Lastly, one major limitation was the access to possible interviewees. As presented in Chapter 5.3 in Table 3, it was extremely hard to find people willing to participate in this interview. The main reasons behind this were that many did not know the CRMA itself, did not wish to participate in the research, or knew only a small part of this study's context. Additionally, thematic saturation at least to some level was noticed. This came up as often in the interviews; the perspectives and concerns were quite similar. This, in turn, did not meet the objectives of this study, which was intended to

bring up more expressed ideas and not generalized views. The reason for this was also the mere availability of experts and the necessity to use politicians who were under an obligation not to give more radicalized opinions if their names were published.

8.4 Suggestions for further research

As this topic is complex, the playing field changes almost every day. The growing need for in-depth research is evident. Even during this research process, the geopolitical field changed multiple times, as mentioned in the previous subchapter 8.3. As the EU published several new initiatives regarding CRM governance, they were hard to analyze when the known information was still limited, and their impact on this study could only be speculated at this time. A possible improvement would be to narrow the scope of the topic, for instance, by focusing only on the dependency itself. This would allow for a more in-depth and coherent analysis, as the research would be less affected by spillover effects from newly introduced initiatives or shifts in the international landscape that could otherwise alter a significant part of the study's framework.

Furthermore, this kind of study would benefit from access to more interviews. Especially, with researchers internationally who are familiar with the topic already, rather than gathering information from experts who do not know the whole context of the study. Another interesting insight from more interviews would be how researchers and government officials perceive the situation differently. This could answer the question more precisely as to whether the political actions are too intertwined with the Western market economy, making it unwilling to react more fiercely to security-related questions.

Given that the CRMA was only adopted in 2025, future research could focus on its empirical implementation across different member states. For example, it's prospects in a resource-rich member state or a resource-lacking member state. Especially, if the EU wants to use its minerals more effectively, there is not enough research material on how national authorities implement the CRMA. This would also help to better understand how institutional diversity within the EU affects collective strategic objectives. Furthermore, this would complement this research, which has looked at the situation from a broader perspective. Also, as this thesis has examined the perceived feasibility of the mining objective, there is a need for longitudinal studies that evaluate how the Act is translated into practice over time.

On the other hand, as the economic aspect came up continuously in theory and in the analysis, further research could explore the economic dimension of domestic CRM extraction in more detail.

If the main aspect of staying in the current dependency is that it is not beneficial, then research should focus on the cost-competitiveness of the EU-based mining projects compared to global suppliers, as well as the role of state support and market initiatives in shaping investment decisions. Deepening the economic aspect of this study field would give key insights into what conditions domestic extraction becomes a viable alternative to external dependency.

In addition, as this study found that the CRMA's mining goal faces too many challenges to be met by 2030, a potential research objective could be focusing on other goals proposed by the Act. For example, processing or refining within the EU. In doing so, it would examine how the EU might bypass its midstream dependence on China by sourcing CRMs from alternative suppliers and developing its own refining capacity. This approach would provide a clearer understanding of how such dependencies can be managed, and if market conditions prove less restrictive, as well as how the EU could progressively move further in the value chain.

Finally, as one of the interviewees emphasized, the geopolitical focus of resource politics has increasingly shifted toward the role of the U.S. and its current leadership in shaping global dynamics. In this context, the U.S. can be seen as setting the strategic direction of global resource governance, with China often responding through its own trade policies. This evolving dynamic that was already highlighted in this research suggests that CRM supply chains are shaped by great power competition and strategic positioning. Building on this observation, future research should therefore examine the role of the transatlantic relationship between the EU and the U.S. in shaping CRM strategies. In particular, it would be valuable to analyze whether closer cooperation could reduce shared dependencies. At the same time, would such alignment have unintended consequences, including risking reinforcing bloc-based competition or provoking stronger countermeasures from China.

9 Summary

The EU has increasingly sought to align its energy transition objectives with broader concerns of supply security, particularly in response to the vulnerabilities exposed by the 2022 energy crisis. As the EU accelerates its shift toward low-carbon energy systems, strategic dependencies on CRMs emerge. While CRMs are essential for clean energy technologies, their supply chains are often geographically concentrated. This raises concerns about resilience and geopolitical risk.

This study examines how the EU seeks to reduce its strategic dependency on CRMs sourced from China. The evaluation tool chosen was the Critical Raw Materials Act, with a particular focus on its 10% domestic mining goal. To establish the research context, the study draws on existing literature on energy security, strategic dependency, GPN theory, mining barriers, and securitization theory.

To contribute to the academic discussion, the research employs a qualitative approach, using interviews with relevant experts in different positions. The findings suggest that progress and framing of CRM dependencies as a strategic issue remain incomplete. Moreover, translating the existing awareness into effective and coherent implementation remains a challenge. Furthermore, the EU's approach is shaped by tensions between securitization and interdependence. Although dependencies are framed as security risks, they continue to function within mutual economic relationships, making it difficult to fully reposition itself in the upstream nodes of the supply chains. Because of these dynamics, mining barriers, especially social acceptance and considerations on economic competitiveness, hinder the goal's progress.

The research also highlights several practical implications for policymakers. First, improving coordination across the EU would strengthen policy implementation. Second, reducing strategic dependencies requires a balanced approach that involves understanding what is to be gained from reducing them and what is to be lost. Third, greater attention must be paid to the economic barrier of mining that raises many of the questions on distributional justice and social resistance. Finally, the EU should continue to develop policies that not only address external vulnerabilities but also consider internal resilience in a fair and inclusive manner across member states.

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Appendices

Appendix 1 Interview questions

a. What is your background and what are you currently working on?

THEME 1: EU ENERGY SECURITY AND SELF-SUFFICIENCY

a. How do you assess the EU's ability to increase its energy self-sufficiency, considering the current level of internal production? Do you think the mining goal can improve it?

b. What factors, in your view, make the EU particularly vulnerable to strategic dependencies in the energy sector?

c. How realistic do you consider the EU's prospects of achieving energy security in the current polycrisis environment?

d. What do you see as the EU's most important tools for managing strategic dependencies in energy and raw material markets?

e. How would you evaluate the EU's ability to build geopolitically resilient and secure supply chains for critical raw materials?

THEME 2: CRITICAL RAW MATERIALS AND GLOBAL DEPENDENCE

a. Do you consider China's dominant position in critical raw material supply chains a significant risk for the EU?

b. Can you imagine a situation where China might exploit the EU's strategic dependence in a way comparable to Russia's actions during the 2022 energy crisis?

c. To what extent do you view mining as a viable pathway to meaningfully reduce CRM dependence?

d. What is, in your view, the biggest bottleneck for scaling mining inside the EU?

e. If you had to prioritize, which strategy would be most effective for reducing CRM dependency: domestic extraction, improved circularity, diversification of suppliers, or something else?

THEME 3: THE CRITICAL RAW MATERIALS ACT (CRMA)

(If the interviewee is familiar with CRMA)

a. Are you familiar with the EU's Critical Raw Materials Act?

• If yes: How do you assess CRMA's significance for managing the EU's critical raw materials?

b. Do you see particular strengths or useful measures in CRMA for securing the clean energy transition?

c. How realistic do you consider the achievement of CRMA's goals with current investment levels and internal production capacity?

d. Given current investment levels and industrial capacity, how achievable do you find the CRMA's quantitative targets for extraction?

e. Do you see CRMA more as one policy tool within the EU's broader energy and climate policy framework, or does it introduce something genuinely new?

f. What would you add to CRMA to make it more effective in reducing strategic dependencies?

THEME 4: THE MINING GOAL AND INTERNAL EU LIMITATIONS

a. What do you consider the most significant internal constraints the EU must address to advance mining?

b. To what extent do tensions between EU-level objectives and national interests hinder progress in energy policy and raw material strategies?

c. What do you see as the most important factor the EU should focus on to ensure the energy transition proceeds fairly among member states?

d. Should member state differences (e.g., faster technological development in Western Europe vs. slower implementation in Eastern Europe) be addressed differently, for example, in the context of CRMA's mining goal?

ENDING

a. Do you have any additional thoughts or comments on the topic that have not yet been discussed during the interview?

Appendix 2 Original interview questions in Finnish

TAUSTA

Mikä on taustanne ja mitä teette tällä hetkellä?

TEEMA 1: EU:N ENERGIATURVALLISUUS JA OMAVARAISUUS

a. Miten arvioitte EU:n kykyä lisätä energiaomavaraisuuttaan ottaen huomioon nykyisen sisäisen tuotannon tason? Uskotteko, että kaivostavoite voi parantaa tätä?

b. Mitkä tekijät mielestänne tekevät EU:sta erityisen haavoittuvan strategisille riippuvuuksille energiasektorilla?

c. Kuinka realistisina pidätte EU:n mahdollisuuksia saavuttaa energiaturvallisuutta nykyisessä monikriisitilanteessa?

d. Mitkä ovat mielestänne EU:n tärkeimmät keinot hallita strategisia riippuvuuksia energia- ja raaka-ainemarkkinoilla?

e. Miten arvioitte EU:n kykyä rakentaa geopoliittisesti kestäviä ja turvallisia toimitusketjuja kriittisille raaka-aineille?

TEEMA 2: KRIITTISET RAAKA-AINEET JA GLOBAALI RIIPPUVUUS

a. Pidättekö Kiinan hallitsevaa asemaa kriittisten raaka-aineiden toimitusketjuissa merkittävänä riskinä EU:lle?

b. Voitteko kuvitella tilanteen, jossa Kiina hyödyntäisi EU:n strategista riippuvuutta tavalla, joka olisi verrattavissa Venäjän toimiin vuoden 2022 energiakriisin aikana?

c. Missä määrin pidätte kaivostoimintaa toimivana keinona vähentää riippuvuutta kriittisistä raaka-aineista?

d. Mikä on mielestänne suurin pullonkaula kaivostoiminnan laajentamisessa EU:n sisällä?

e. Jos teidän pitäisi priorisoida, mikä strategia olisi tehokkain kriittisten raaka-aineiden riippuvuuden vähentämiseksi: kotimainen tuotanto, kiertotalouden parantaminen, toimittajien monipuolistaminen vai jokin muu?

TEEMA 3: KRIITTISTEN RAAKA-AINEIDEN SÄÄDÖS (CRMA)

(Jos haastateltava tuntee CRMA:n)

a. Oletteko perehtynyt EU:n kriittisten raaka-aineiden säädökseen (CRMA)?
• Jos kyllä: Miten arvioitte CRMA:n merkitystä EU:n kriittisten raaka-aineiden hallinnassa?

b. Näettekö CRMA:ssa erityisiä vahvuuksia tai hyödyllisiä toimenpiteitä puhtaan energiasiirtymän turvaamiseksi?

c. Kuinka realistisina pidätte CRMA:n tavoitteiden saavuttamista nykyisellä investointitasolla ja sisäisellä tuotantokapasiteetilla?

d. Kuinka saavutettavina pidätte CRMA:n määrällisiä kaivostavoitteita nykyisten investointien ja teollisen kapasiteetin valossa?

e. Näettekö CRMA:n enemmän yhtenä politiikkatyökaluna EU:n laajemmassa energia- ja ilmastopolitiikan kokonaisuudessa vai tuoko se jotain aidosti uutta?

f. Mitä lisäisitte CRMA:an, jotta se olisi tehokkaampi strategisten riippuvuuksien vähentämisessä?

TEEMA 4: KAIVOSTOIMINTATAVOITE JA EU:N SISÄISET RAJOITTEET

a. Mitkä ovat mielestänne merkittävimmät sisäiset rajoitteet, jotka EU:n on ratkaistava edistääkseen kaivostoimintaa?

b. Missä määrin jännitteet EU-tason tavoitteiden ja jäsenvaltioiden kansallisten etujen välillä hidastavat edistystä energia- ja raaka-ainepolitiikassa?

c. Mikä on mielestänne tärkein tekijä, johon EU:n tulisi keskittyä varmistaakseen, että energiasiirtymä toteutuu oikeudenmukaisesti jäsenvaltioiden välillä?

d. Pitäisikö jäsenvaltioiden välisiä eroja (esim. nopeampi teknologinen kehitys Länsi-Euroopassa vs. hitaampi toimeenpano Itä-Euroopassa) käsitellä eri tavoin esimerkiksi CRMA:n kaivostavoitteen yhteydessä?

LOPUKSI

a. Onko teillä muita ajatuksia tai kommentteja aiheeseen liittyen, joita ei ole vielä käsitelty tämän haastattelun aikana?

Appendix 3 Interview consent form

DESCRIPTION OF THE STUDY

Name of the research

Securing the EU's energy transition from strategic dependencies. The Critical Raw Materials Act (CRMA) and the challenge of its mining goal.

Invitation to participate in the research

The study examines the dependencies on critical raw materials during the energy transition, as well as the internal political and institutional constraints associated with these efforts. The research utilizes expert interviews to deepen the understanding of how imminent the dependency on China is, and to explore the significance of the CRMA's mining goal within this broader context. Experts in energy and raw materials policy, researchers, officials, and representatives of relevant stakeholders whose work or expertise relates to the EU's energy policy, critical raw material supply chains, or industrial strategy are invited to participate. The interviewees have been selected because they can provide in-depth, practical, or academic perspectives on the EU's internal challenges in implementing energy and raw materials policies.

It has been taken into account in the interviews that participants may have limited familiarity with the CRMA. For this reason, the interview is structured to focus on the areas corresponding to each participant's expertise.

The estimated number of interview participants is approximately 8 individuals.

Voluntary consent

Participation in this study is voluntary. You may decline to participate or withdraw your consent at any point during the study without providing a reason and without experiencing any negative consequences. If you decide to withdraw your consent, any data collected up to that point will be used for research purposes in an anonymized and confidential manner.

Please take your time to read this information. If you have any questions, you may contact the researcher using the details provided at the end of this document. If you decide to participate, you will be asked to sign a separate consent form attached at the end.

Responsible researcher

This study is conducted by Xenia Merilahti, a master's student in International Business at the Turku School of Economics, University of Turku, as part of her master's thesis.

The data controller responsible for the processing of personal data in this study is Xenia Merilahti, who ensures that the handling of personal data complies with legal requirements. In academic research, the processing of personal data is based on the university's statutory tasks and serves the public interest.

The research method

The interviews will last approximately 45–60 minutes, depending on the participant's familiarity with the topic.

The purpose of the interview is to gather expert insights on the EU's strategic dependency on China, the role of critical raw materials, the internal constraints of the clean energy transition and energy security, as well as the opportunities and limitations of the CRMA.

Interview themes include, among others:

- Objectives of the EU's energy and critical raw materials policy
- Internal mining constraints and conflicting interests among Member States
- Management of strategic dependencies
- The effectiveness of the CRMA's mining goal as a tool in the energy transition

With the interviewee's consent, the interviews will be recorded as both audio and text files.

Confidentiality and data privacy

The information provided during the interviews will be handled carefully and in accordance with ethical research principles. Participants are not anonymized in the study, as this supports the reliability and transparency of the research. However, you may request that your identity be anonymized, which will then be recorded in the consent form.

All participants will have the opportunity to review their own data before the publication of the thesis and will be offered the chance to comment on or correct the information provided.

All collected data will be handled securely throughout the research process. After the research is completed, the data will be destroyed.

Costs of research and funding

Participation in the study is free of charge. No compensation is provided, and the study does not cover any potential loss of income related to participation.

Further information

If you have any questions about the research, you may contact the researcher. You are welcome to discuss any questions or concerns that may arise during the study.

Contact information:

Xenia Merilahti

Appendix 4 Explanation of the use of AI

Generative artificial intelligence was used in the creation of this thesis to support and expedite the research process. This appendix lists all of the tools used, explains their purpose, and verifies accountability of their use.

1. **Tool: OpenAI's ChatGPT (GPT-4 and GPT-5 versions)**

    - **Stage of Use:** Ideation and Research Planning
    - **Purpose of Use**: ChatGPT was used mainly for brainstorming, making summaries, and maintaining the thought process behind every decision.
        - **Example Prompt (April 10, 2026):** I want to make a model of my findings that illustrates how one aspect protects the goal from mining obstacles, and one lets them dominate. How could I form it?
    - **Verification**: The tool suggested that I should start with the risk perception on top and then divide the road into two and go down from there, with the aspect I wanted to emphasize the most. After sketching the first try, it was decided that it would work as an illustration of my findings. To further elaborate my points, I added headings and points under the dimensions to make it easier for the reader to connect the dots.

    - **Stage of Use**: Composition, Editing, and Revision
    - **Purpose of Use**: ChatGPT read short sections or sentences of my own text to make my point clearer when it was hard to find the right words for explaining something. However, the tool was not used to proofread large segments of my text. Furthermore, it was used to translate the research questions into English.
        - **Example Prompt (October 20, 2026)**: Elaborate this idea more academically…
        - **Example Prompt (December 1, 2026)**: Translate my interview questions into English.
    - **Verification**: After AI's suggestions, the researcher carefully read the suggestions to make sure that they did not lose context in the process. This was made to ensure that the researcher had the final say and control of the text.

2. **Tool: Claude AI**

- **Stage of Use**: Ideation and Research Planning
- **Purpose of Use**: ChatGPT was used mainly for brainstorming, making summaries, and maintaining the thought process behind every decision.
    - **Example Prompt (April 15, 2026)**: My study tries to explore CRMA's mining goal and its feasibility. I have combined aspects of energy transition, energy security, strategic dependency, and common mining barriers in theory. Currently, the theory describing supply chain vulnerabilities does not fit into my research. What choices do I have from that theory field that would fit critical raw materials supply chains?
- **Verification**: The tool suggested a few different supply chain theories, among which was the GPN theory. After reading several papers about it and finding many connections to China and CRM supply chain concentration risk, it was decided to continue with that theory. After changing it, the connections between the theory became clearer. In addition, it became easier to analyze findings because the understanding of supply chain vulnerabilities had improved.

3. **Tool: Grammarly**

- **Stage of Use**: Proofreading
- **Purpose of Use**: Proofread the written text in Word to notice errors that might otherwise be unnoticed.
- **Verification**: The tool was used throughout the writing process to catch misspellings or little mistakes such as referencing errors. The researcher still made the last choice to change the text as suggested by the tool. Furthermore, the text was read through several times to make sure that the tone or context had not changed and was consistent from beginning to end.