DOI: https://doi.org/10.36250/01303_79
ORCID: https://orcid.org/0000-0002-2347-7990

Viktória Lilla Pató

Securing Critical Raw Materials in the EU: Reducing Vulnerabilities in the Middle of Geopolitical Tensions

The increasing reliance on critical raw materials (CRMs), such as rare earth elements, cobalt and lithium is a pressing challenge for the European Union (EU) mainly from the strategic sovereignty point of view. These materials are crucial for the production of advanced technologies, including digital assets, renewable energy systems, electric vehicles and defence equipment. However, the deposits of these CRMs are concentrated in a few countries, raising concerns about supply chain security and geopolitical dependencies. This paper explores the current state of policy on the European level, Hungary's national interest in the CRM sector, and proposes actionable recommendations to face the challenges. The analysis focuses on addressing economic, legal and environmental challenges associated with CRMs, including supply chain vulnerabilities, sustainable sourcing practices, cooperation and regulatory frameworks, all of which are further complicated by geopolitical pressures in the shadow of ongoing global tensions.

Introduction

The importance of the policy field

The global demand for critical raw materials has skyrocketed due to the increasing need for green technologies and digital advancements. Materials like lithium for batteries, rare earth elements for electronics and cobalt for electric vehicles are essential components for sectors such as renewable energy systems, electric vehicles, electronics and defence technologies. These industries are the backbone of the EU's plan to achieve carbon neutrality by 2050, as laid out in the European Green Deal, these materials are needed for the transition to cleaner energy and the decarbonisation of industries.[1]

[1] European Commission 2019.

CRMs are particularly vital for enabling the EU's push toward a greener economy and for the twin transition.[2] For example, lithium and cobalt are necessary for the batteries that power electric vehicles and energy storage systems – key technologies in reducing dependency on fossil fuels. Additionally, rare earth elements like neodymium and dysprosium are critical for the production of wind turbines and solar panels, which form the foundation of the EU's renewable energy goals.[3] Without secure access to these materials, the EU faces risks of delays in its green transition, jeopardising its climate commitments and industrial competitiveness.[4]

The European Commission has identified 34 raw materials as "critical" in 2023 classifying them based on their economic importance and supply risk.[5] These materials are crucial not only for achieving the EU's climate neutrality goals but also for ensuring the bloc's strategic autonomy. The CRM list includes materials like rare earths, lithium and tungsten, all of which are necessary for emerging technologies.[6]

Justification of the topic

The justification to analyse critical raw materials stems from the EU's economic and strategic vulnerabilities. The European Union relies on imports for 98% of its rare earth supply, with a significant portion of this dependency tied to China, which controls over 70% of global production. Other essential CRMs, such as cobalt are primarily sourced from the Democratic Republic of Congo (DRC), which accounts for nearly 60% of global cobalt production. This over-reliance on external sources poses substantial geopolitical risks, as the EU is vulnerable to supply disruptions, export restrictions and diplomatic tensions.[7]

The Covid-19 pandemic, combined with ongoing global tensions, such as the Russia–Ukraine war has exposed the vulnerability of global supply chains, highlighting the urgency for the EU to diversify its CRM supply chains. These challenges have underscored the importance of strengthening domestic

[2] Muench et al. 2022.
[3] Official Journal of the European Union 2023.
[4] European Commission 2023a.
[5] European Commission 2023b.
[6] Gislev–Grohol 2018.
[7] U.S. Geological Survey 2024.

sourcing capabilities, innovating, enhancing recycling technologies and securing international partnerships for sustainable CRM extraction.[8]

Beyond economic risks, there are significant environmental challenges associated with CRM extraction and processing. The mining of these materials is often linked to severe environmental degradation, including deforestation, water pollution and biodiversity loss, especially in the regions where CRMs are primarily mined. By focusing on developing sustainable mining practices, investing in recycling infrastructure and fostering innovation in material alternatives, the EU can address these environmental concerns while securing its future supply of CRMs.[9]

The importance of critical raw materials is not limited to their role in technological and industrial sectors; they are a strategic resource crucial for Europe's green transition, energy independence and economic resilience. The growing demand for CRMs, coupled with the EU's reliance on external suppliers, makes this a critical policy issue.

The 2011 Hungarian EU Presidency already highlighted energy security and resource sustainability, marking this a longstanding national and European concern.

The 2011 Hungarian EU Presidency from the policy point of view

During Hungary's EU Presidency in 2011, the country focused on shaping the European Union's political and economic agenda, driven by four main priorities: economic growth and employment, strengthening Europe, citizen-friendly governance, enlargement and neighbourhood policy.[10] Although the direct focus on critical raw materials was not prominent, their relevance can be interpreted through the emphasis on energy security, industrial competitiveness, enlargement and sustainable growth strategies, aligning with the EU's broader goals on green growth.

Hungary's presidency aimed to recover from the 2008 financial crisis through the Europe 2020 strategy, which focused on sustainable growth.[11] The security of CRMs became critical within this context, as industries like

[8] Manoochehri et al. 2021.
[9] Gislev–Grohol 2018.
[10] European Parliament 2011.
[11] European Commission 2010.

manufacturing, renewable energy and digital technologies are essential for innovation. A core theme of Hungary's presidency was energy security, aligning closely with CRM needs. One of the landmark commitments during the presidency was the February 2011 European Council conclusions, which called for the establishment of an interconnected internal energy market by 2014.[12]

Hungary also continued to advance the Raw Materials Initiative (launched in 2008), reinforcing its three pillars: sustainable sourcing from European deposits, increasing recycling efforts and securing international trade partnerships.[13]

Another key area of Hungary's presidency was its focus on enlargement, the Danube Region Strategy and the Eastern Partnership, which emphasised strengthening ties with the Western Balkans and Eastern Europe. The partnering regions are critical to the EU's CRM strategy today, particularly in securing alternative sources of raw materials. For example, Serbia has significant reserves of lithium as well as Ukraine (in the Donbas region) and titanium, but it is needed to strengthen cooperation within EU regions on this matter, mainly for finding alternatives for CRMs with research and innovation.[14]

Overall, Hungary's 2011 EU Presidency – by promoting the need for a common energy policy – played a vital role in laying the groundwork for discussions on energy security, recycling and regional partnerships, all of which are now key components of the EU's critical raw materials strategy.

State of play in the current challenges of the policy

As previously discussed, critical raw materials are vital for the EU's green and digital transition. However, securing them is complicated by geopolitical tensions, economic dependencies and regulatory challenges. To understand the current landscape, the situation can be analysed through four critical dimensions: geopolitical context, legal framework, business interests and the geographical distribution of CRM resources across EU and non-EU countries.[15]

[12] European Council 2011.
[13] European Commission 2008
[14] Bobba et al. 2020.
[15] U.S. Geological Survey 2024.

The Russia–Ukraine war and CRM disruption

The Russia–Ukraine war has dramatically impacted global CRM supply chains. Ukraine, a country rich in lithium, titanium and other critical resources, has seen its mining operations disrupted by the ongoing conflict. Prior to the war, Ukraine was poised to become a significant supplier of CRMs to Europe.[16] The war not only halts mining activities but also affects global trade routes, exacerbating supply chain vulnerabilities for Europe. Ukraine's post-war reconstruction will likely focus on resource exploitation, with the possibility of foreign, particularly American, companies controlling significant portions of Ukraine's resource-rich lands, raising concerns about sovereignty.[17] Ukrainian President Volodymyr Zelensky has opened up large tracts of land for privatisation, much of which has been purchased by American investors. These lands, rich in resources, will likely be developed for both agriculture and mining post-war. By allowing foreign ownership of its resources, Ukraine may face long-term challenges in managing its own industrial development while becoming an outsourced supplier of raw materials for European and American markets.

Additionally, there is a growing debate over whether these investments benefit the local population or simply serve the interests of global corporations looking to secure cheap and abundant resources. This dynamic is further complicated by the environmental degradation often associated with large-scale mining projects in fragile ecosystems.[18]

Business interest and neo-colonialism

A significant factor driving the EU's reliance on non-EU sources for CRMs is profit maximisation. While the EU seeks to diversify its CRM sources, a growing concern is the extraction of these materials from non-EU countries, particularly in regions where environmental and labour regulations are less stringent. These lower regulatory standards allow for cheaper extraction and processing costs, making non-EU sources more attractive despite the environmental and social costs involved. This practice has been criticised as a form of modern-day colonialism, where wealthier nations exploit the natural resources of

[16] Katser-Buchkovska 2024.
[17] Norton 2024.
[18] Mousseau–Devillers 2023.

developing countries, leaving behind environmental degradation and social unrest. For example, the Democratic Republic of Congo supplies nearly 60% of the world's cobalt, but mining conditions often involve severe human rights abuses and environmental damage.[19]

This is also seen in regions like South America, where lithium extraction has soared due to high demand from the electric vehicle industry, yet local ecosystems suffer from water depletion and pollution. Additionally, the strategic partnerships established between the EU and countries like Serbia and Ukraine provide an avenue for securing CRM supplies without having to fully comply with EU regulatory standards.[20]

Another example, in Bolivia and Chile, lithium extraction primarily occurs from brine pools located in vast salt flats. In Bolivia, the Salar de Uyuni holds the world's largest lithium reserves. The extraction process involves pumping lithium-rich brine to the surface, where the water is evaporated in large pools, leaving behind lithium and other minerals. In Chile's Salar de Atacama, similar methods are used, but the process consumes vast amounts of water, leading to severe water shortages and environmental concerns in local communities.[21]

To prevent the depletion of their raw material reserves, an increasing number of countries are enacting export restrictions. The global incidence of such restrictions on critical raw materials has surged more than fivefold in the past decade, with several nations markedly intensifying their use of these measures. In recent years, approximately 10% of the global value of critical raw material exports has been subject to at least one export restriction. China, India, Argentina, Russia, Vietnam and Kazakhstan have been the leading countries in implementing new export restrictions between 2009 and 2020. Furthermore, some of these nations represent significant sources of critical raw materials for OECD countries, underscoring their pivotal role in global supply chains.[22]

Legislative perspective and partnership

The comprehensive regulatory framework for this area traces back to Ursula von der Leyen's 2022 State of the Union speech, when she emphasised the

[19] Houreld–Bashizi 2023.
[20] European Commission 2024.
[21] Ahmad 2020.
[22] Kowalski–Legendre 2023.

importance of critical raw materials for the EU's twin transition. As demand for these materials grows, von der Leyen stressed the urgency of reducing reliance on China, which dominates the processing industry, controlling 90% of rare earths and 60% of lithium. To counter this, she announced the European Critical Raw Materials Act, aiming to secure supply chains, process CRMs within Europe and build strategic reserves.[23] Her remarks highlight Europe's determination to avoid energy dependency pitfalls, as experienced with oil and gas, by ensuring CRM sovereignty through partnerships and strategic investments, while promoting environmental standards and worker rights.[24]

China's dominance means that any geopolitical dispute with the country could disrupt the supply chain and leave Europe without essential resources for its green and digital industries.[25] This concentration of supply creates strategic vulnerabilities, particularly as tensions between global powers grow.[26]

The Act sets benchmarks for domestic CRM production, processing and recycling, with a goal of sourcing 10% of CRM needs from within the EU by 2030. Additionally, the Act aims to reduce reliance on single suppliers, particularly from outside the EU, by ensuring that no more than 65% of any material comes from one country, such as China.

The Act aligns with the EU's broader industrial strategy, which emphasises strategic autonomy – the ability to maintain self-sufficiency in critical sectors. It also coincides with the Net Zero Industry Act, which aims to boost the production of clean energy technologies and align CRM supply with the EU's climate neutrality goals by 2050.[27]

However, there are ongoing debates about balancing economic interests with environmental and social responsibilities. While the EU is pushing to develop domestic mining operations, these efforts face resistance due to strict environmental standards that increase operational costs. To overcome these challenges, the EU tries to strengthen ties with third countries through its raw materials diplomacy.[28] In 2021, the EU–Ukraine Raw Materials Partnership was established to develop Ukraine's CRM extraction capabilities, particularly for

[23] Murginski 2023.
[24] European Commission 2022.
[25] Andrews-Speed – Hove 2023.
[26] Righetti–Rizos 2024.
[27] Official Journal of the European Union 2024.
[28] The growing list of the agreements in the frame of the EU's raw material diplomacy is available at https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/raw-materials-diplomacy_en

lithium and titanium, promoting sustainable mining. Similarly, the Namibia memorandum (2022) focuses on securing cobalt and rare earth elements, while fostering local industries. The Greenland–EU Cooperation (2023) targets rare earths and uranium, emphasising environmental responsibility. Additionally, the Serbia–EU Agreement (2024) aims to tap into Serbia's lithium reserves in the Jadar Valley, essential for Europe's electric vehicle batteries.

Hungary's national interest in the policy field

Hungary shares the EU's interest in securing critical raw materials. While the European Commission has clearly outlined this priority, it raises the question of whether the EU should continue competing with China and the U.S. for resource control. In the short term, this strategy is necessary for competitiveness, but in the long run, the EU should focus on innovation and research to develop alternative materials that could eventually replace CRMs. This shift can be achieved through fostering innovation and exploring new technological pathways. Trying only to diversify value chains could lead to a decline in the EU's competitiveness, as under such circumstances it will never be able to fully compete with the U.S. and China. Third countries could remain resource-producing colonies for the major powers, further widening economic disparities globally. Therefore, it is in Hungary's and the EU's long-term interest to explore alternatives – by research and development – that can eventually replace finite critical raw material resources, ensuring greater economic sovereignty and sustainability.

Hungary's industrial base is expanding, driven by Western European companies establishing subsidiaries, particularly in the automotive and renewable energy sectors. These sectors are increasingly dependent on CRMs such as lithium, cobalt and rare earth elements, which are vital for the production of electric vehicles, solar panels and wind turbines. With the EU pushing toward its Green Deal targets, the ability to secure stable manufacturing is essential for Hungary's economic growth. The Hungarian Government has committed to increasing its share of renewable energy in line with the EU's 2030 climate goals.[29] To achieve this, Hungary must invest in infrastructure, and as part of the National Competitiveness Strategy, Hungary is also keen to boost its recycling capabilities, research and development for CRMs, which would reduce

[29] Ministry of National Development 2011.

the need for imported raw materials and promote a circular economy.[30] The Hungarian research institute Bay Zoltán Nonprofit Ltd. has been involved in several EU research projects focusing on alternative materials to rare earths and more efficient recycling processes. Hungary has already demonstrated its commitment to European research and innovation programmes, but still there are lots of possibilities to participate in directly managed EU funding programmes, too.

Automotive sector

Hungary's automotive sector is one of the cornerstones of its economy, with major global players like Audi, Mercedes-Benz and BMW establishing production plants in the country. These manufacturers are increasingly shifting toward electric vehicle (EV) production, which heavily relies on CRMs, particularly lithium for batteries and cobalt for cathodes.

Audi Hungaria, located in Győr, is one of the world's largest engine plants and has been producing electric motors since 2018. These motors rely heavily on rare earth elements like neodymium and dysprosium, critical components for permanent magnet motors used in electronic vehicles.

Additionally, BMW is constructing a new factory in Debrecen set to focus exclusively on EV production, with the facility designed to be CO_2 neutral. This shift to green manufacturing places further pressure on ensuring a stable supply of CRMs, particularly lithium, essential for battery production. Hungary's automotive industry is a significant driver of national economic growth, and the shift toward electrification highlights the critical role CRMs will play in maintaining this sector's momentum.

Regional cooperation

Hungary's location in Central Europe offers significant strategic advantages in terms of regional cooperation on CRM sourcing. The country is actively involved in the Danube Region Strategy, Visegrád 4, Three Seas Initiative that facilitate cross-border partnerships in areas such as infrastructural development, energy security, innovation and industrial development. Hungary's

[30] Ministry for National Economy 2024.

commitment to EU enlargement also reinforces the diversification of supply chains, by opening up to new markets with raw material resources. Hungary's commitment to strengthening regional cooperation between the CEE region ensures that it retains investments both within the region and domestically, bolstering economic resilience and resource security.

Battery

Hungary's role in the battery production supply chain has expanded with the establishment of SK Innovation's lithium-ion battery plant in Komárom. This facility, one of the largest of its kind in Europe, plays a critical role in supplying EV batteries to European automotive manufacturers. SK Innovation's investment in Hungary signifies the country's importance as a regional hub for lithium-ion battery production, underscoring the importance of securing a reliable supply of lithium.

Additionally, Samsung SDI, another key player, operates a battery production facility in Göd, further solidifying Hungary's position as a strategic centre for battery production in Europe.

In conclusion, Hungary's national interest in securing CRMs is largely driven by its automotive and manufacturing sectors, supported by a robust circular economy and competitiveness strategy. Through industrial collaboration, enlargement efforts, international projects, and a focus on recycling and innovation, Hungary aims to reduce its dependency on external sources.

Recommendations

Recycling: Hungary should promote the investment in recycling technologies and urban mining to recover CRMs from waste, reducing the need for newly mined materials and promoting a circular economy.

Find alternatives: Hungary must foster innovation through R&D to discover alternative materials to replace CRMs. Hungarian research institutions should leverage EU funding programs like Horizon Europe for CRMs.

Expand trade agreements in the short term: Europe must prioritise trade agreements with resource-rich countries to ensure stable CRM imports, diversify value chains while ensuring compliance with environmental standards.

Enhance cooperation in the long term: Strengthen intra-EU collaboration on CRM sourcing, innovation, processing and recycling, ensuring all Member States benefit from shared technological advancements and resources. Hungary must fill existing cooperation frameworks, such as the Three Seas Initiative and V4 with meaningful actions and projects to develop genuine partnerships. This approach would ensure that these initiatives move beyond formal agreements and actively contribute to finding alternatives to critical raw material dependency. By focusing on innovations and sustainable solutions, Hungary and its regional partners can strengthen their economic resilience and reduce reliance on external powers.

Trusted sources: The EU must enforce stricter regulations on sustainable mining practices with non-EU partners, ensuring that environmental and human rights standards are respected in CRM extraction.

CRM strategic reserves: The EU should establish strategic reserves for critical raw materials to ensure buffer stocks during supply disruptions, similar to those proposed in the Critical Raw Materials Act.

Digital innovation: Hungary should suggest the development of the digital platform to track CRM supply chains in real-time, ensuring transparency and efficiency in the extraction, processing and recycling processes.

Local mining: The EU should provide financial and technical support to encourage Member States, to develop domestic CRM extraction or raw material alternatives and processing capacities under EU environmental standards.

Educate: Invest in educational programs and workforce training for CRM-related industries to foster innovation and address labour shortages in the mining and recycling sectors.

Research: The EU must strengthen the priority pillar related to research and development on critical raw materials within its direct funding mechanisms to foster collaboration among Member States.

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