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A CRITICAL LOOK AT RAW MATERIALS CRITICALITY

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Abstract

In the eve of the proposed Critical Raw Materials Act published in March of 2023, Europe has realized that even with already predicted exponential growth in raw materials supply, the situation remains critical with regards provision of these (critical) raw materials (CRM). The various initiatives led by the EU Commission starting with the Raw Materials Initiative in 2008, the various CRM lists (2011, 2014, 2017, 2020 and 2023), the launch of several dedicated CRM task forces (e.g., ERECON), alliances (E.G., ERMA) and the objectives of the EU Green Deal mean that in a few short years, 7 in fact, the EU needs to find new sources for CRM. An impossible task.

Keywords: *Criticality, Raw Materials, EU Initiatives*

1. Introduction

Mineral raw materials are vital for economic and technological development, are essential for the sustainable functioning of modern societies, and are increasingly important for the competitiveness of industry, for innovation and for the transition to a low-carbon, circular economy. When the supply of these raw materials is in question, the concept of raw material or mineral criticality steps in. By definition, a critical mineral is therefore, a metallic or non-metallic element that has two fundamental m characteristics: a. it is essential for the functioning of our modern technologies, economies or national security and, b. there is a risk that its supply chains could be disrupted.

Mineral criticality refers to the degree of importance and vulnerability of certain minerals or elements to supply disruptions, which can realized lead to higher costs and economic instability. Factors affecting criticality are often due to geopolitical instability, limited availability, or high demand in various industries. Mineral raw materials criticality impacts economies, national security, technology, and the environment. Understanding, mapping and managing the criticality of minerals is crucial for ensuring a sustainable and resilient future.

Mineral raw materials are vital for economic and technological development, are essential for the sustainable functioning of modern societies, and are increasingly important for the competitiveness of industry, for innovation and for the transition to a low-carbon, circular economy instead of a linear economy. Additionally, raw materials are the key enablers of many critical sectors of the economy, such as the automotive, electronic, and manufacturing industries [1-2]. In general, criticality is important because of: a. Economic Significance; b. National Security; c. Energy Transition; d. Innovation and Technology; e. Environmental Concerns; f. Supply Chain Resilience; g. International Trade; h. Future Resource Availability; i. Social and Ethical Concerns; and j. Policy and Investment.

This study investigates the evolution of critical minerals and what we have achieved to minimize dependency and what still needs to be done in that aspect.

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2. EU initiatives on criticality

The EU is continually taking steps to address the issue of critical raw materials (CRM) supply security. The EU has developed a list of CRM and strengthened the cooperation between industry, research institutions, and public authorities by establishing a European Raw Materials Alliance (ERMA) to address the strategic challenges of securing a sustainable and competitive supply of CRM. The EU is also investing in research and innovation to develop new technologies and processes that reduce the use of CRMs and improve recycling and recovery.

The criticality of raw materials and the successively published lists of the critical raw materials (CRM) [3-7] and the proposed Critical Raw Materials Act [8-9] are an excellent guide for knowing the latest trends in mineral intelligence needs in Europe. They provide targets for specialized research on sourcing these mineral raw materials.

Figure 1 shows the chronology of the most important initiatives by the EU Commission with regards to mineral criticality and sustainability.

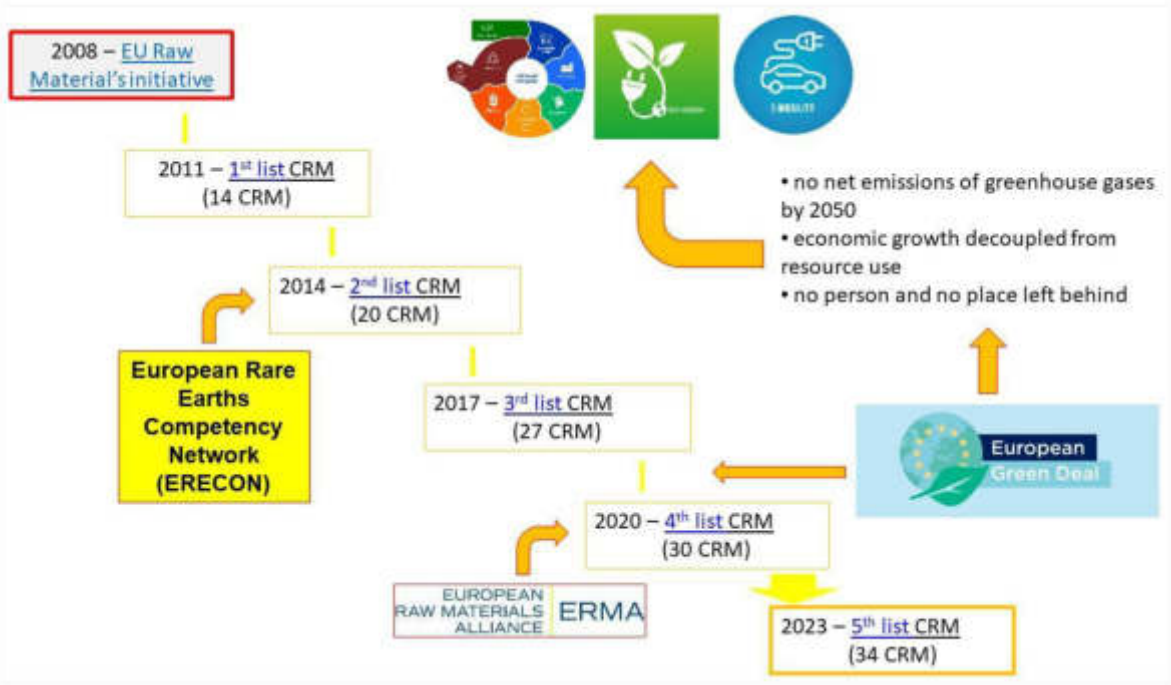

Figure 1. Diagram showing the chronology of initiatives by the EU Commission to combat criticality. The proposed Critical Raw Material Act is not shown here as it is not yet final and adopted as legislation.

2.1. The list of critical raw materials

The first list of Critical Raw Materials was published in 2011 and successive list have since then been published almost every three years resulting in a total of 5 lists; the last having been published in the first quarter of 2023 [3-7]. Figure 1 shows that the number of recognized CRM has grown from 14 to 34. Most listed CRM repeat from list to list and the practical result is that in the dozen years since the list has been published, only two CRM have left the list: chromium and indium.

2.2. ERECON

The „E-concerns" by the EU Commission dealing with rare earth elements, permanent magnets and motors, were precursored by the European Rare Earths Competency Network (ERECON), which was made up of three groups tackling the following issues: a. opportunities and roadblocks for primary supply of rare earths in Europe; b. European rare earths resource efficiency and recycling and c. European end-user industries and rare earths supply trends and challenges [10].

2.3. The EU Green Deal

The European Green Deal is a comprehensive and ambitious set of policy initiatives and strategies developed by the EU to address climate change, promote environmental sustainability, and foster economic growth and innovation. It was boldly officially introduced by the EU Commission in December 2019 as a central pillar of the EU's agenda for the next decade. The European Green Deal aims to transform the European Union into a climate-neutral, green, and circular economy by 2050. Measures accompanied with an initial roadmap of key policies range from ambitiously cutting emissions, to investing in cutting-edge research and innovation, to preserving Europe's natural environment [11].

2.4. The Critical Raw Materials Act

While demand for critical raw materials is projected to increase drastically, Europe heavily relies on imports, often from quasi-monopolistic third country suppliers. The EU needs to mitigate the risks for supply chains related to such strategic dependencies to enhance its economic resilience, as highlighted by shortages in the aftermath of the Covid-19 and the energy crisis following Russia's invasion of Ukraine. This can put at risk the EU's efforts to meet its climate and digital objectives. In 2023, the Commission proposed a comprehensive set of actions to ensure the EU's access to a secure, diversified, affordable and sustainable supply of critical raw materials [9].

The Regulation and Communication on critical raw materials adopted aims to leverage the strengths and opportunities of the Single Market and the EU's external partnerships to diversify and enhance the resilience of EU critical raw material supply chains. The Critical Raw Materials Act (CRMA) also improves the EU capacity to monitor and mitigate risks of disruptions and enhances circularity and sustainability. In specific targets, the CRMA aims to: a. at least 10% of the EU's annual consumption for extraction, b. at least 40% of the EU's annual consumption for processing, c. at least 15% of the EU's annual consumption for recycling, and d. not more than 65% of the Union's annual consumption of each strategic raw material at any relevant stage of processing from a single third country.

2.5. ERMA

In 2020 the EU launched the European Raw Materials Alliance (ERMA), which aims to build resilience and strategic autonomy for Europe's rare earth and magnet value chains. It will identify barriers, opportunities and investment possibilities in the raw materials value chain, while also addressing sustainability and social impact. Specifically, the alliance addresses the challenge of securing access to sustainable raw materials, advanced materials, and industrial processing know-how. By 2030, ERMA's activities will increase the production of raw and advanced materials and address circular economy by boosting the recovery and recycling of critical raw materials. More specifically, the alliance will a. bolster the creation of environmentally sustainable and socially equitable innovations and infrastructure; b. implement a Circular Economy of complex products like electric vehicles, clean tech, and hydrogen equipment; c. support Europe's raw materials industry capability, to extract, design, manufacture and recycle materials and d. promote innovation, strategic investment, and industrial production across specific value chains [12].

3. Discussion and conclusions

In today's interconnected and rapidly evolving world, securing a sustainable and reliable supply of critical raw materials has become a strategic imperative for Europe. Critical raw materials are essential elements and minerals that are fundamental to the continent's economic growth, technological innovation, and environmental sustainability. As Europe advances towards a greener and more digitalized future, the significance of mining critical raw materials within its borders cannot be overstated.

Our aim in identifying CRM lists is, surely, to ensure that we remove as fast as possible, raw materials from those lists. To do this it is necessary that new EU sources of these raw materials be found and exploited.

There is no doubt that to achieve any of the proposed goals outlined by the EU, consumption of raw materials is going to increase exponentially; a fact recognised in several European and rest-of-the-world fora.

To reduce greenhouse gas emissions by 55% means that ever increasing number of batteries. In the same manner, the EU electric penetration of 7 to 8 million cars annually, more batteries and more magnets will be needed to power this extra e-mobility. Lithium demand must therefore also increase, especially as the announced battery giga factories [e.g., 13-14] will predictably come on line.

According to the CRMA, by 2030 10% of the Union's consumption must be mined in the EU. Given that 2030 is a just a few, very short, 7 years away and it takes anything from 10-15 years to bring a mine into production and further adding the fact that only approximately 1% of newly discovered mineral deposits will become a producing mine, where is the EU going to fetch all the raw materials needed and achieve the 10% target?

Increasing the degree of self-sufficiency from 2-3% to 10% in 2030 means a 300-400% increase in domestic production in 7 years, which is the time that it takes to get an exploration permit. Therefore, massive efforts and an increase in investment in exploration to at least an equivalent degree are required if we are to even come close to that degree of self-sufficiency. It stands to reason that the EU cannot only focus on its primary raw materials. The secondary raw materials are going to play an ever-increasing role in combating criticality of raw materials.

Secondary raw materials have the advantage that they are sourced from (brownfield) places that have had mining before and there likely to have less social resistance to mining. However, much research needs to be carried out into the secondary raw materials. A few EU-funded projects (e.g., ProSUM [15], START [16]).

Mining critical raw materials within Europe is not merely a matter of economic expediency; it is a strategic imperative for the continent's long-term prosperity and resilience. As Europe charts a course toward a greener, more digitalized future, the importance of securing a stable supply of these materials cannot be overstated. It empowers the continent to drive economic growth, foster technological innovation, mitigate climate change, strengthen national security, and create a more sustainable and resilient future for all Europeans. Through responsible mining practices, environmental stewardship, and strategic investment, Europe can position itself as a global leader in ensuring the availability of critical raw materials for generations to come.

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