BRIEFING

European Parliament

Securing Europe's supply of critical raw materials

The material nature of the EU's strategic goals

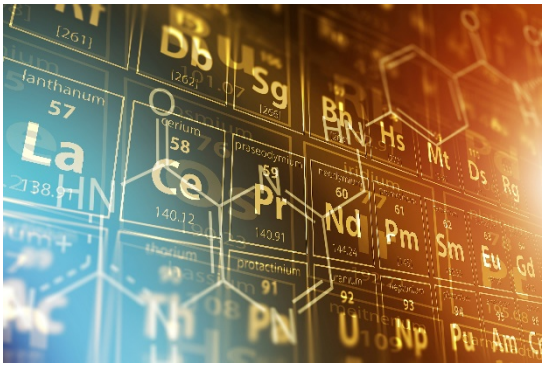
SUMMARY

Over the past centuries, humanity has used an increasing share of the known elements to foster technological innovation, in particular metals. Today, a wide range of key technologies across all industries, from chips to batteries, medical imaging to tanks, rely on the unique physical properties of some specific critical raw materials (CRMs). Demand for CRMs is projected to skyrocket in the coming years. However, as the transition to 'net-zero' and the digital age is particularly materials-intensive, it remains uncertain whether supply will keep up with the expected needs. Moreover, recent pledges for higher defence spending will also require more CRMs.

The EU's ambition to become a climate-neutral economy by 2050, and its ability to sustain the green and digital transitions and achieve strategic autonomy, all rely heavily on reliable, secure and resilient access to CRMs. CRM supply chains are global, complex, and fragile, which makes them vulnerable to a wide range of risks, including those linked to geopolitical tensions. The supply of CRMs is often more concentrated than that of fossil fuels. Furthermore, the EU's reliance on imports of CRMs is extremely high, sometimes reaching 100 % (e.g. for rare earth elements – REEs). The EU's strategic dependency in the supply of REEs is a notable example of the challenges linked to the EU's over-dependence on supply chains dominated by third countries.

Over the past few years, to avoid replacing its dependency over fossil fuels by another, on CRMs, the EU has reviewed all relevant policies to foster its security of supply, mixing industrial, research and trade policies with international partnerships. It is expected to go further with the announced proposal for a CRM act. Possible measures that could help the EU tackle these challenges include diversifying CRM primary sourcing; promoting a fully circular approach to CRM use; and implementing contingency planning, mitigating and emergency measures, including stockpiling.

The European Parliament has promoted an integrated approach throughout the CRM value chain under a European strategy for CRMs, to increase the EU's supply. It has recently emphasised that a new European Sovereignty Fund should increase European investment in the raw materials sector.



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EPRS | European Parliamentary Research Service

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PE 739.394 – March 2023

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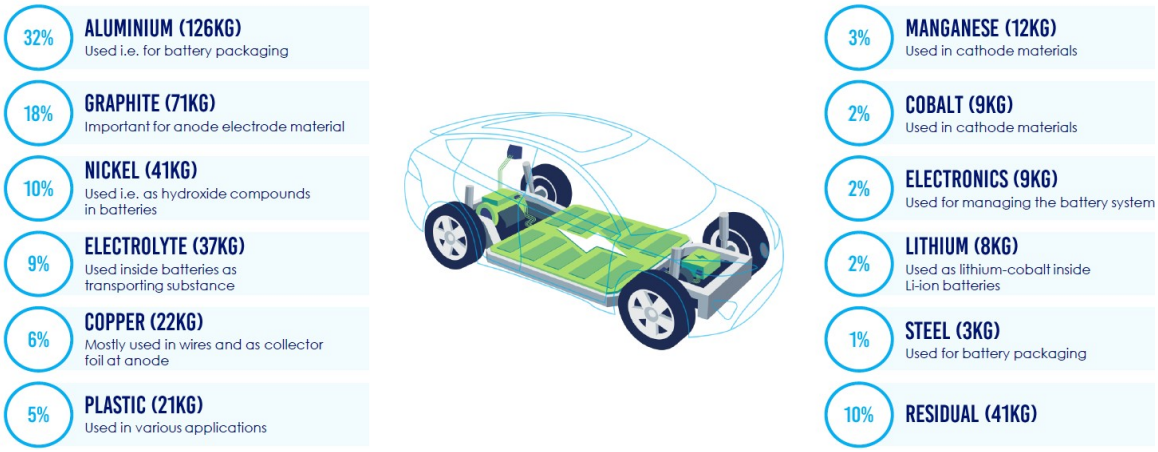
EU strategic goals: Vital role of CRMs

Over the past centuries, humanity has used an increasing share of the 118 known elements to foster technological innovation, in particular metals. Today, numerous key technologies across all industrial sectors rely on the unique physical properties of some specific raw materials. A smartphone for instance contains up to 50 different kinds of metals, such as indium in its touch screen and silicon in the many chips it contains. Permanent magnets made of rare earth elements (REEs – a family of 17 elements with exceptional magnetic properties, composed of scandium, yttrium and the lanthanides) are critical in the health sector for magnetic resonance imaging, and in low carbon technologies for generators in wind turbines and motors in electric vehicles.

The transition to the 'net-zero age' is particularly materials-intensive (Figure 1). An electric car requires on average six times the mineral inputs of a conventional car, and an onshore wind plant nine times the mineral resources of a gas-fired power plant of the same capacity.

Figure 1 – Materials needed in an electric vehicles battery (share and absolute amount)

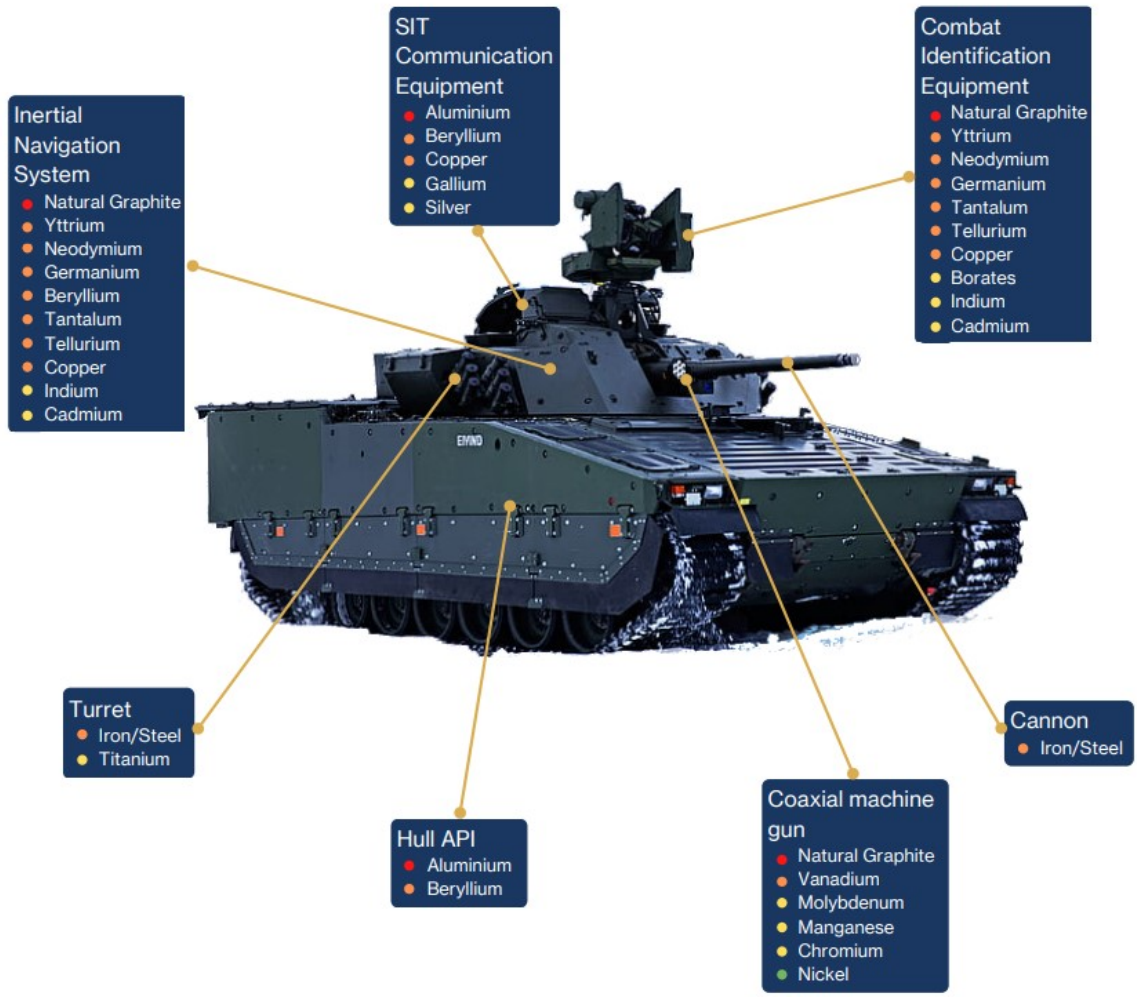


Source: How circular economy approaches can increase supply security for CRMs, Systemiq, 2022.

Demand for CRMs is likely to skyrocket in the coming years, to varying degrees depending on the CRM concerned. According to the International Energy Agency (IEA), the transition to reach net-zero globally by 2050 would require six times more minerals in 2040 than today. Concerning individual CRMs, even in a less ambitious scenario (consistent with meeting the Paris Agreement goals: climate stabilisation at 'well below 2° C global temperature rise'), the IEA estimates that demand for lithium would grow globally 42-fold by 2040 compared with today, graphite 25-fold, cobalt 21-fold and nickel 19-fold.

In 2020, the European Commission estimated that, to reach climate-neutrality by 2050 – taking into account only the renewables and e-mobility sectors – the EU would need up to 60 times more lithium and 15 times more cobalt in 2050 compared with current levels. Demand for REEs used in permanent magnets could increase 10-fold by 2050. Moreover, raw materials are of critical importance for the defence sector across the air, sea and land domains (Figure 2 below). For instance, tantalum is needed in warheads, and high-performing alloys used in fuselages of combat aircraft require niobium, vanadium and molybdenum. Recent pledges by Member States for higher spending on defence mean that more CRMs will be required.

Figure 2 – Materials used in an infantry fighting vehicle



Source: Strategic raw materials for defence. Mapping European industry needs, HCSS, 2023.

A number of still unknown new key technologies may emerge in the future, using specific CRMs. Conversely, some technologies using specific CRMs may become obsolete due to innovation. These two types of events could impact future CRM needs. It is still uncertain whether supply will keep up with the expected demand trajectories.

The EU's ambition to become a climate-neutral economy by 2050, its ability to sustain its green and digital transitions and to achieve strategic autonomy – including with regard to space and defence – all rely heavily on reliable, secure and resilient access to a wide range of raw materials: they are the foundation on which the supply chains for the key technologies needed to reach these goals are built. In its 2021 foresight report, the Commission identified securing and diversifying supply of CRMs as one of the top 10 strategic issues to be addressed to ensure the EU's freedom and capacity to act in the decades to come.

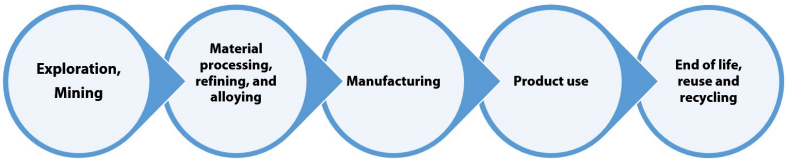
Since 2011, the Commission has drawn up every three years a list of raw materials that, owing to their considerable economic importance and very high supply risk, are considered 'critical' for the EU ('CRMs'). The most recent list, dating from 2020, includes 30 CRMs[1] (compared with 14 in 2011, 20 in 2014 and 27 in 2017), and has been used as a compass for EU action (in trade negotiations, research activities, identification of investment pipelines, etc.). It is due to be updated in 2023.

CRM supply chains features and associated risks for the EU

Global, complex, concentrated and fragile supply chains

The CRM supply chains start with mining the raw material (Figure 3). Ore is extracted using open-pit or underground mining techniques. It is then crushed and ground to a size that enables its separation into different chemical forms. The material is then smelted or refined to produce a purified powder, metal or other material in a semi-final form. Final steps include further refining, manufacturing, cutting and polishing into a semi-finished or finished product.

Figure 3 – Different stages in the CRM supply chains



Source: EPRS, based on the United States Government Accountability Office, 2022.

The EU is between 75 % and 100 % reliant on imports for most metals. Its specific import reliance for CRMs is extremely high, sometimes reaching 100 % (e.g. for borate, REEs or platinum group metals). Geographically, the EU is highly dependent on CRM imports from China (for several CRMs, in particular REE), Russia, Turkey (borate) and the Democratic Republic of Congo (cobalt). The EU currently imports all permanent magnets for wind turbines – mostly from China (an average wind turbine in the EU requires 230 kg of permanent magnet per megawatt). The EU also has strategic dependency for its supply of magnesium, a key metal used in the mobility ecosystem to lower vehicle mass. The diversity of suppliers has been decreasing globally over the past few years.

The supply of CRMs is often more concentrated than that of fossil fuels. For instance, primary supply of lithium, cobalt, graphite, REE and platinum group metals are highly concentrated, which represents a risk for market stability (Figure 4). Interestingly, the concentration of natural reserves is generally smaller than that of actual production. Dependencies on CRM imports exist at diverse stages of the supply chain, and the level of concentration can be very high at the processing step (Figure 5 below).

Figure 4 – Country concentration for some CRMs (Herfindahl-Hirschmann index – HHI)

CRM	Concentration index (HHI) for **production**	Concentration index (HHI) for **reserves**
Nickel	1 522	1 547
Lithium	3 300	2 247
Cobalt	4 713	2 998
Graphite	4 760	1 896
Rare earth oxides	4 928	2 138
Platinum group metals	5 377	8 167

Note: An HHI of more than 2 500 is considered an indicator for a highly concentrated market and a risk for market stability.

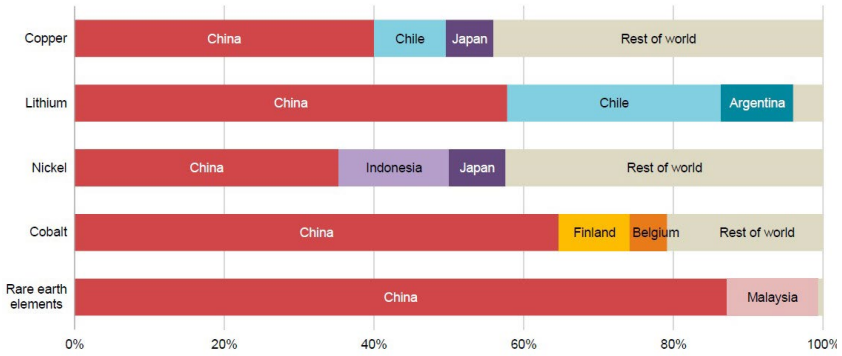
Source: Strengthening the security of supply of products containing Critical Raw Materials for the green transition and decarbonisation, European Parliament, December 2022.

Over the past few decades, as its demand for CRMs increased, China has stepped up efforts to capture the entire CRM value chain. Its rise as a major force along the whole chain has largely been fostered by its long-term industrial policies. In particular, China has a very strong market position along the entire supply chain for REEs (Figure 6 below). Where it lacked domestic supply, it has invested in mining projects for CRMs abroad, such as for cobalt in the Democratic Republic of the Congo, Papua New Guinea and Zambia.

CRM supply chains are global, complex, and vulnerable to disruptions due to natural disasters, logistical issues, unfair trade practices (export restrictions, dumping, low environmental or health and safety

standards), geopolitical tensions and armed conflicts. Because of the specificities of CRM markets, the risk of price shocks is high. They are often small compared with other bulk commodities such as steel, and supply is inelastic as investments to increase production have long lead times. In addition, CRM production-related supply-side risk includes 'co-production dependency': some CRMs are obtained as a by-product of one or more host metals from geologic ores (for instance, nearly all indium production occurs as a by-product of zinc).

Figure 5 – Share in processing volume by country for some minerals



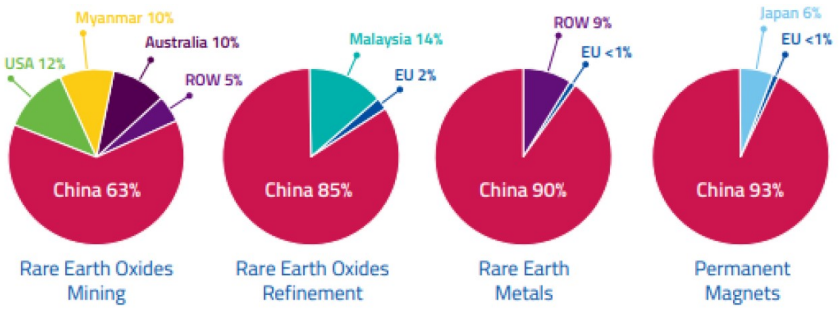
Source: International Energy Agency, 2022. Data are for 2019.

As a result, the production of CRMs generally depends on the dynamics of different and larger commodity markets. This situation contributes to the inelasticity of the CRM markets, which also lack transparency: they are characterised by a small number of participants, asymmetric information between market participants and observers, and incomplete information on production, prices, trade flows and inventories.

Another supply-side risk is related to the negative environmental, health and social effects CRM production has in many countries, which could jeopardise the necessary scaling-up of production. This is also a source of reputational risk for users of CRMs. Mining and processing require large volumes of water and raise a range of contamination risks (e.g. through wastewater discharge). Furthermore, mining and processing generate hazardous waste (for instance, REE mining involves the separation and removal of uranium and thorium, which are radioactive). Workers in the supply chain, particularly those at artisanal and small-scale mine sites, have faced health and safety issues due to poor working conditions and workplace hazards (such as exposure to toxic chemicals).

Mineral exploitation may also involve human rights issues linked to child or forced labour (for instance, children have been found to be present at about 30 % of cobalt small-scale mine sites in the Democratic Republic of the Congo). Moreover, environmental-related events such as floods, droughts and other natural disasters are a direct risk for CRM production; this risk has increased due to climate change. For instance, water scarcity may hinder the production of copper and lithium, both particularly vulnerable given their high water requirements, and over 50 % of today's lithium and copper production is located in areas with high water stress levels.

Figure 6 – China's share along the REEs permanent magnets market value chain



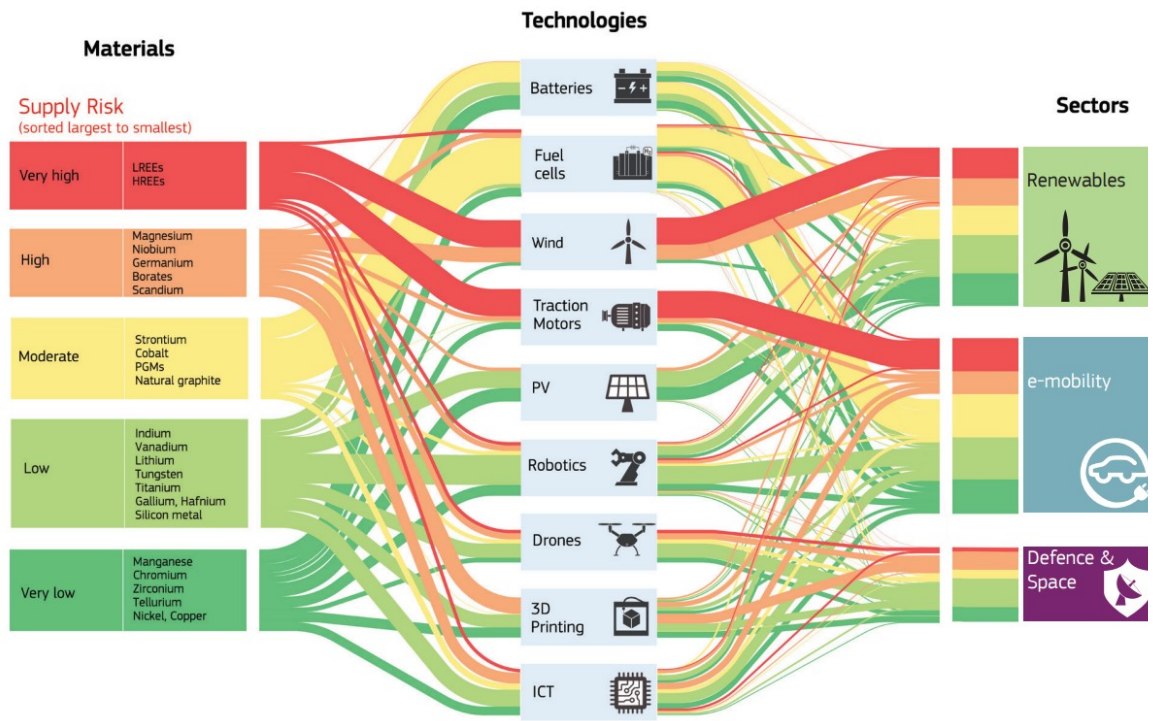
Source: EU strategic dependencies and capacities: second stage of in-depth reviews, European Commission, 2022.

The – generally negative – image of mining in Europe is a further difficulty for the launch of mining projects intended to increase domestic supply. Recent mining projects (such as lithium exploration in Portugal) have raised concerns about their potential adverse impact at the local level. Moreover, knowledge gaps regarding vulnerabilities of the CRM supply chains persist. EU-level coordination on monitoring and risk management is still insufficient to anticipate, prevent and address supply disruptions of CRMs.

Potential consequences for the EU of CRM supply disruption

While usually considered strategic 'enablers', CRMs could, on the contrary, become key bottlenecks for the EU on its way to reaching its strategic goals. CRM shortages would undermine the EU's freedom of action dramatically and slow down, or even stop, the industrial transformation needed. The EU would replace its historic reliance on fossil fuel imports from a few supplier third countries with an even stronger reliance on other CRM-producing third countries, given that many markets for CRMs are more concentrated than those for oil and natural gas. Many producing countries have imposed restrictions on exports of minerals and metals, one of the most well-known examples being the 2010 export restrictions on REEs. More recently, the Commission pointed out that in 2018, more than 70 % of global primary production of cobalt, REEs and tungsten was affected by export restrictions to secure domestic supply or support domestic downstream industry.

Figure 7 – Technologies and sectors competing for access to CRMs



Source: CRMs for Strategic Technologies and Sectors – A Foresight Study, Joint Research Centre, 2020.

Without the primary or secondary (i.e. recycled) CRMs it needs, the EU's technological and manufacturing base would be seriously weakened. The EU would miss the opportunities stemming from the transition to the 'net-zero' and digital age in terms of technological development, economic growth, jobs, climate and other environmental benefits, and industrial breakthroughs. Its economic resilience and competitiveness would be negatively affected as well. CRM supply shortages could block production lines of key goods – the 'physical inaccessibility' problem. Volatile and/or high prices could affect prices across the whole supply chain of many industries, in an already strained context marked by higher energy prices and intensifying global competition. Surging raw material prices could jeopardise the cost reductions in clean technologies obtained over the past few years thanks to innovation and economies of scale. In 2021, the rapid cost-reduction trends seen

over the past decade have already mostly reversed, from batteries to solar panels and wind turbines. This would have a major impact on the volume of investment needed for clean energy transition in the EU. As a result, some industries may have to delocalise their plants to CRM-rich countries, as the EU would lose its global attractiveness as an investment location, in particular because businesses would face a high risk of losing access to the CRMs they need. Impacts could be felt differently across Member States depending on their industrial specialisation and national action on CRM supply.

Importantly, CRM shortages would also be a source of critical military vulnerability for the EU. History has shown that, without the key materials needed for their defence industries, countries have been forced to make performance trade-offs that contributed to their defeat on the battlefield.

As other major global actors have engaged in the twin transition (and have developed specific CRM policies), and military expenditure has reached record levels, the consequences of CRM shortages could be exacerbated by fierce competition between countries and industries (usage conflicts within and between industrial sectors, see Figure 7 above) vying for access to the same CRMs, which could result in even larger problems.

EU actions to enhance security of CRM supply

In 2008, the Commission launched the raw materials initiative. Already back then, it pointed out that access to raw materials was an important factor for the EU's competitiveness, and that a shift towards a more resource-efficient economy and sustainable development was needed to reduce the EU's critical dependence on certain raw materials. The initiative put forward 10 actions, including the setting up of a list of CRMs at EU level. The first list was published in 2011. The European innovation partnership on raw materials was set up in 2012 as a platform bringing together representatives of the public sector, industry, academia and other stakeholders, providing guidance for the Commission, Member States and private actors on innovative approaches to the challenges relating to CRMs and other non-energy raw materials.

EIT RawMaterials was created in 2015 as an innovation community within the European Institute of Innovation and Technology, set up in 2008 to strengthen Europe's ability to innovate, currently funded under the 2021-2027 multiannual financial framework through Horizon Europe. Building on a network of more than 300 partners from industry, academia, research and investment, EIT RawMaterials aims to secure the supply of CRMs to European industry by driving innovation along the raw materials value chain. The raw materials supply group, an expert group involving national authorities and stakeholders, assists the Commission in preparing legislative proposals and policy initiatives, and implementing existing EU legislation, programmes and policies.

The new industrial strategy for the EU of March 2020 aimed to reinforce Europe's industrial and strategic autonomy. It proposed a set of measures to support EU industry's global competitiveness, making Europe climate-neutral by 2050 and shaping Europe's digital future. The strategy announced an action plan on CRMs, which was released in September 2020, aiming to increase EU resilience and open strategic autonomy. It put forward 10 actions to enhance resilience of industrial value chains; reduce dependency on primary CRMs (circular use of resources, more sustainable products and research); promote sustainable and responsible domestic sourcing and processing of raw materials; and diversify supply with sustainable and responsible sourcing from third countries, developing rules-based open trade in raw materials and removing distortions to international trade.

Both the new industrial strategy, proposed to develop new industry-driven alliances, and the action plan announced the setting up of a European raw materials alliance (ERMA), which was launched in September 2020. Its role is to facilitate investment in the raw materials value chain. It has focused its work on REE magnets and motors, and materials for energy storage and conversion. ERMA aims to identify barriers, opportunities and investment cases to build capacity at all stages of the raw materials value chain, from mining to waste recovery, and draw up lists of relevant investment. ERMA has pinpointed investment cases spread all across Europe for a total €1.7 billion. According to

ERMA, if these projects were realised, 20 % of Europe's needs rare-earth magnet needs by 2030 could be sourced from the EU (15 times more than today).

Russia's war on Ukraine and EU CRM supply

Among the CRMs mined in Ukraine, only titanium has a significant global share (6.4 %), while the others (coking coal, natural graphite, gallium and germanium) have global market share below 1 %. Ukraine represents 3 % of EU titanium imports.

Russia is among the 'top 3' global producers for 13 CRMs: palladium (41.9 %), vanadium (20.4 %), potash (17.7 %), antimony (17.3 %), platinum (12.2 %), coking coal (9.2 %), rhodium (9.2 %), cobalt (6.3 %), bauxite (5.8 %), germanium (5.3 %), tungsten (2.8 %), gallium (2.1 %) and niobium (0.5 %). Russia is an important sourcing country for the EU for several CRMs: vanadium (86 %), coking coal (35 %), palladium (28 %), titanium (19 %), tungsten (17 %), rhodium (11 %), bauxite (11 %) and phosphorous (11 %).

To increase awareness, acceptance and trust regarding EU CRM sourcing and sustainability, the Commission published a set of voluntary social, economic and environmental EU principles for sustainable raw materials in September 2021. These aim to align Member States' understanding of sustainable EU extraction and processing. Furthermore, the Commission announced in 2021 that it would launch a roundtable on environmentally and socially sustainable raw materials mining, gathering national and EU public authorities, industry, non-governmental organisations and social partners to foster dialogue on issues raised by CRM sourcing in the EU.

Regarding research on CRMs, between 2014 and 2020, the Commission spent €500 million on 80 raw materials research projects, and €260 million has been committed for the 2021-2022 period under Horizon Europe (Cluster 4 – Digital, industry and space). EU-funded research projects have covered, for instance:

- CRMs for information and communications technologies and robotics (FineFuture on developing new technologies to valorise fine particles from mining waste into valuable materials such as magnesite; Robominers on using a robot miner for mineral deposits that are small or difficult to access; Sea4Value on technologies for recovering minerals and metals from seawater desalination brines; SisAl Pilot on silicon production process with low environmental impact);
- CRMs for batteries and permanent magnets (Susmagpro on a recycling supply chain for permanent magnets; SecREEts on REE supply based on a sustainable extraction from European apatite sources used in fertiliser production; GoldenEye on high resolution data of the entire mine, to improve safety, environmental monitoring and overall productivity; SEArcularMine on technologies to secure EU access to magnesium, lithium and other minerals from waste brines in Mediterranean basin saltworks; CROCODILE on innovative metallurgical systems for the recovery of cobalt and the production of cobalt metal from secondary and primary EU resources);
- secure supply of primary raw materials in a sustainable and responsible way (PACIFIC on environmentally friendly and cost-efficient mineral exploration; SmartExploration on new ways to explore the subsurface; INFACT on innovative geophysical and remote sensing technologies).

The 2023-2024 work programme for Cluster 4 sets out a range of funding opportunities concerning CRMs, for instance in the call on resilient value chains (e.g. to improve technologies for extraction and processing of CRMs). It has a total indicative budget worth €213 million.

Important projects of common European interest (IPCEIs), a State-aid tool to support strategic projects, have contributed to the development of CRM-related projects as well. For instance, the IPCEI on the battery value chain (approved by the Commission in 2021) aims to set up local production capabilities for processing of lithium hydroxide, new generations of anodes (new synthetic graphites and silicon anode material types), and low cobalt-containing cathodes.

In June 2021, the EU set up a strategic partnership on raw materials with Canada, focusing on the integration of EU–Canada raw material value chains while enhancing collaboration on science,

technology and innovation, as well as environmental, social and governance criteria and standards. In July 2021, a strategic partnership on raw materials was launched with Ukraine, including activities along the entire value chain of both primary and secondary critical raw materials and batteries. In November 2022, the EU established a strategic partnership with Namibia on sustainable raw materials value chains.

The EU's investment and reforms in the context of the Recovery and Resilience Facility aim to help reinforce resilience of the EU's CRM supply chains. In particular, Member States will be able to add a new REPowerEU chapter to their national recovery and resilience plans in order to finance key investments and reforms aiming to reinforce the EU's strategic autonomy, e.g. by supporting the CRM value chains and technologies linked to the green transition. In its guidance to Member States, the Commission pointed to possible CRM-relevant projects and reforms, including: facilities for fossil-free lithium production from geothermal brines; reform encouraging the uptake of fossil-free lithium in the automotive and renewable energy sectors; reuse and recycling facilities for batteries, production of manufacturing equipment for gigafactories (battery cell plants); reform on the simplification of permitting procedures for the construction of factories; and reform establishing higher separate collection and reuse/recycle targets for e-waste.

On 1 February 2023, the Commission put forward a Green Deal industrial plan for the net-zero age, setting out a European approach to boosting the EU's net-zero industry against the backdrop of third countries adopting massive industrial support packages. The plan has four pillars. The first includes measures to improve the competitiveness of the EU's net-zero industry, including an upcoming proposal for a CRM act, expected on 14 March 2023. The second relies on measures to increase and speed-up access to public and private funding. The third includes measures to develop a suitably skilled workforce for the net-zero industry, and the fourth details measures concerning global cooperation and international trade to improve resilience of supply chains. The Commission explained that the CRM act would address the following issues: low diversification of EU supply sources; untapped potential of EU supply; weak monitoring and risk management capacity to anticipate and prevent supply disruptions of critical raw materials; adverse social and environmental impacts of production of critical raw materials; insufficient support for circularity in the existing regulatory framework; and insufficient research and innovation in the EU.

Possible options for tackling the challenges the EU is facing

For any of the countries in the global supply chain, a strategy to achieve full independence from foreign supply for all CRMs seems unrealistic, in particular owing to the mere repartition of natural CRM endowments. Mitigating the risks associated with CRM supply requires a comprehensive approach. The measures outlined below have the potential to strengthen the EU's role and resilience in the global CRM value chain. They may cover different time horizons, from short term (e.g. use of stockpiles) to longer term (e.g. exploration, substitution, or research).

Diversifying CRM primary sourcing, and thus lowering dependence on individual countries, is key to securing their supply, and could involve the promotion of 're-shoring' (developing domestic CRM supply chains). This could be done, for instance, by making permitting procedures for the CRM projects more efficient or expanding public and private (including foreign) investment at different stages throughout the EU supply chain (not only primary production but also refining or processing). In January 2023, Swedish mining company LKAB announced that it had found Europe's largest deposit of REEs in the Kiruna area. The company said that, with current rules (in particular concerning permitting), it would take 'at least 10-15 years' before mining could actually begin.

Although geopolitical alliances may change over time, another approach could be to strengthen supply relations with like-minded countries ('friend-shoring'), possibly including those that are closer geographically, to reduce logistical risks ('near-shoring').

Moreover, a dedicated EU framework, central to preventing and addressing potential CRM shortages and involving relevant stakeholders, could be set up. That could involve new market

intelligence capacities on CRM value chains and allow for the strategic, economic and technical monitoring of CRM supply chains. It could assess the EU industry's current and future CRM needs, and produce risk analysis to support investment decisions. In addition, It could coordinate national actions on CRM supply to ensure their coherence. The framework could help to improve the supply chain's transparency, and to address information gaps (e.g. on adverse supply chain events, market trends, levels of stockpiling, price developments, and level and location of investment). Specific contingency planning, mitigating and emergency measures could be designed and implemented so that the EU would be able to react decisively if shortages are forecast or identified. By way of example, in November 2022, France launched the Observatory of Mineral Resources for Industry (OFREMI), which provides the government and industry with strategic analysis on the CRM supply chain.

In this context, a system for stockpiling CRMs (or products containing them) could be considered. Reserves accumulated could be released when access to CRM is difficult or prices are high. Experts have recently proposed that EU stockpiling policy should cover 60 days of imports: based on a selection of raw materials, the possible value of CRM stockpile would reach €6.5 billion including operational costs and direct investments other than product acquisition. Based on a selection of around 300 traded product groups shaping the green and digital transition, the possible CRM stockpile value would reach €26 billion, including operational costs and direct investments other than product acquisition. In Japan, the Organisation for Metals and Energy Security (JOGMEC) has been in charge of a national rare metals stockpiling project to address short-term supply interruptions of rare metals supply. The EU could identify countries and CRMs from which it would limit dependency as a matter of priority. Possible support from EU funding for specific measures could be assessed where it adds value. Specific financial instruments could help to address risks linked to market volatility, which limit investments in the sector. The private sector could be actively involved in the EU strategy, for instance through incentives to reshape its own supply chains or stock strategic CRMs.

Boosting research and innovation is a key lever for action to secure the supply of CRMs. The potential range of research topics is considerable, and each stage may be affected positively by scientific breakthroughs (for instance, making resource-extraction or refining processes more environmentally friendly, or finding substitutes for some CRMs).

Achieving a fully circular approach to the CRM supply-chain would improve resource efficiency at all stages of the supply chain, and help reduce demand for primary CRMs. Measures could include improved rules on product design to extend product life and enhance the quality and quantity of recycling (and hence of secondary CRM supply, which is still insufficient). The potential of 'urban mining' is still untapped: 1 million mobile phones contain 24 kilogrammes (kg) of gold, 16 000 kg of copper, 350 kg of silver, and 14 kg of palladium. However, recycling alone will not be sufficient to supply the volumes of materials required for domestic consumption: even if 100 % recycling rates were achieved for a particular supply chain, increasing demand will require primary production. Experts have shown that for lithium-ion batteries, wind turbines and fuel-cell electric vehicles, setting up collection and recycling facilities in the EU can contribute to meeting future EU materials demands for them, and reduce import dependency. For instance, for lithium-ion batteries for electric mobility, recycling end-of-life batteries could help meet 52 % of the 2040 demand for lithium for new battery production, 58 % of the demand for cobalt, and 49 % for nickel in the most optimistic scenarios. Only after 2040 could recycling be the EU's major source of supply for some CRMs.

Concerning the specific case of CRMs for defence, cooperation between civil and military sectors should be strong, and the potential dual (i.e. both military and civilian) use of CRMs should be addressed. Many defence applications use the same CRMs as the civilian sector. It is important that coherence between research, industrial, EU/national security and CRM strategies be maintained.

Promoting higher environmental and social standards could be encouraged through law, guidelines (such as the principles on sustainable raw materials the EU has developed) and certification schemes. The relevance of the methodology the EU uses to revise the list of CRMs could be regularly assessed (e.g. scope covered or timeframe of demand taken into account). Securing the availability of an adequately skilled and specialised workforce, as well as preserving knowledge accumulated over time in the sector, is a further pre-condition for the EU CRM sector to thrive.

At international level, better cooperation with like-minded countries (e.g. through the G20, G7, EU–US Trade and Technology Council and CRM-specific forums) could make the supply of CRMs more secure. Promoting strategic partnerships, stable and diversified trade flows (through trade agreements) could help achieve this objective. Development assistance, for instance through the Global Gateway, could be used to invest in the CRM supply chain in some third countries. Trade policy tools (free trade agreements, generalised scheme of preferences and Everything But Arms) could be used as well, but seem to offer limited leeway, particularly as tariffs on CRMs are already quite low.

Deep-sea mining for CRMs?

Deep-sea mining is the process of exploiting mineral resources from the area of the ocean more than 200 metres below the surface. Many countries and companies are increasingly eyeing resources beneath the sea. Three main types of deposits hold the most minerals: (i) ferromanganese crusts lining the sides of ridges and seamounts, which contain manganese, iron, cobalt, copper, nickel and platinum; (ii) polymetallic nodules lying on the seabed, which are rich in manganese, nickel, copper, cobalt, molybdenum and REEs; (iii) sulfide deposits around hydrothermal vents, which contain copper, gold, zinc, lead, barium and silver. Several exploration projects are ongoing in the exclusive economic zones of Japan, Norway and Papua New Guinea.

However, there are still a number of economic, technological and environmental hurdles. Studies suggest potentially significant environmental impacts: destruction of (largely unknown) sensitive seafloor habitats and species; metal-contaminated and fine-particle sediment plumes arising from stirring up fine sediments, which can impact benthic and pelagic fauna (living at the bottom of the sea and in the open sea, respectively); changes to water properties; and increases in noise and light.

The European Parliament, in its resolution of October 2022 on strengthening ocean governance and biodiversity, reiterated its call on the Commission and the Member States to support an international moratorium on deep seabed mining. In June 2022, a joint communication on the EU's International Ocean Governance agenda stressed that the EU would continue to advocate prohibiting deep-sea mining until scientific gaps are properly filled. The International Seabed Authority is due to publish regulations on the exploitation of seabed minerals by mid-2023, after a request by Nauru in 2021.

All governance levels, from local, regional and national authorities to the EU itself, could be mobilised towards securing CRM supply. The involvement of local authorities is key to enhancing local acceptance of CRM projects.

European Parliament views

The European Parliament holds the view that an integrated approach throughout the CRM value chain, from waste collection and product design for recyclability to material recovery, is an essential strategy to increase the EU's CRM supply, as explained in its resolution of 24 November 2021 on a European strategy for CRMs. According to Parliament, an active industrial policy is needed to support the value chain, for instance for research and innovation on the recycling and substitution of CRMs or better product design for recyclability. EU support and funding is required to improve efficiency, substitution, recycling processes and closed material cycles. Parliament called on the Commission and the Member States to set up an IPCEI on CRMs to reduce criticality and dependence, covering recycling, reuse, substitution, reduction of material use and mining. The projects supported under the IPCEI should unlock the unfulfilled potential in CRM-rich EU countries. Parliament recommended that the Commission encourage Member States to carry out strategic

stockpiling as a way to reduce CRM dependencies, and propose minimum recycled CRM content targets, CRM recycling targets and a monitoring framework. Concerning CRM sourcing in the EU, Parliament supports responsible and sustainable projects, stressing that awareness of the environmental footprints of imported CRMs from third countries should be raised. The EU should also diversify its sources of supply of CRMs to reduce third-country reliance.

In its resolution of 16 February 2023 on an EU strategy to boost industrial competitiveness, trade and quality jobs, Parliament recalled the importance of secure access to CRMs as a prerequisite for the green and digital transformation, achieving the EU's climate targets, competitive value chains in Europe, and strengthening strategic independence. It highlighted the need for building up recycling and stable secondary markets, as well as for research into substitution of critical raw materials. It stressed the need for the potential of domestic resources to be exploited fully, respecting adequate standards, and noted that strategic European projects need faster and more transparent permitting, access to new funding, and a coherent policy framework. Parliament expressed the view that a new European Sovereignty Fund should strengthen the EU's open strategic autonomy and the green and digital transition in a comprehensive way, and increase European investment across the EU in key strategic sectors, including raw materials. It called on the Commission to assess current dependencies and find alternative sources to diversify Europe's supply chains for critical technologies and raw materials. Lastly, Parliament highlighted the need for better coordination, as well as for joint efforts to establish resilient supply chains that meet the EU's industrial needs.

MAIN REFERENCES

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Study on the EU's list of critical raw materials, European Commission, 2020.

The role of critical minerals in clean energy transitions, International Energy Agency, 2022.

Strengthening the security of supply of products containing Critical Raw Materials for the green transition and decarbonisation, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, December 2022.

ENDNOTE

[1] Antimony, baryte, bauxite, beryllium, bismuth, borate, cobalt, coking coal, fluorspar, gallium, germanium, hafnium, heavy rare earth elements, indium, light rare earth elements, lithium, magnesium, natural graphite, natural rubber, niobium, phosphate rock, phosphorus, platinum group metals, scandium, silicon metal, strontium, tantalum, titanium, tungsten, and vanadium.

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