Circularity and the European Critical Raw Materials Act

How could the CRMA better promote material circularity?

This briefing identifies existing gaps between the EU's legislative frameworks and levels of circularity for CRMs and the objectives of the European Critical Raw Materials Act (CRMA). A "circularity gap" analysis of the CRMA proposal is conducted in the context of the EU's ambition to become a more circular economy with the objective of identifying missing elements in the CRMA proposal that may hamper efforts to achieve the objectives of the Circular Economy Action Plan (CEAP). This briefing puts forward recommendations to realistically address these gaps with the aim of encouraging the uptake of measures to promote the greater pursuit of circularity in the future implementation of the CRMA.

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The current geopolitical context has seen tensions escalate, and most countries evaluate their dependencies on key commodities as demand for rare earth metals and other Critical Raw Materials (CRMs) is expected to increase substantially in the context of the green and digital transitions[1]. As the EU seeks to decarbonise its industry along with other developed countries, a race for specific CRMs required in clean technologies has begun at a global level.

In this context, the EU has decided to reduce its import dependency on the handful of countries with a large share of these natural resources, yet it still largely lacks developed infrastructure and natural resources to source CRMs domestically, either through extraction of domestic supply or use of secondary materials.

In March 2023, the European Commission published its proposal for a European Critical Raw Material Act (CRMA)[2] to safeguard the green and digital transition by securing a stable and strategic supply of Critical Raw Materials. The proposed CRMA aims to address the following main issues:

1. The EU's low diversification of supply sources, leading to its high dependency on specific countries, and consideration of EU domestic sourcing of CRMs through new mining activities;

2. The adverse social, environmental, and human rights impacts of CRM mining operations, currently outsourced to other countries;

3. The lack of circularity for CRMs in existing regulatory frameworks;

4. Monitoring and risk management mechanisms to anticipate and prevent disruptions in the supply of CRMs; and

5. Research & innovation to provide necessary solutions across the CRM value chain.

The CRMA proposal sets out four main targets to be achieved by 2030 concerning the share of EU consumption of strategic raw materials (SRMs) originating from:

- 10% from domestic extraction;
- 40% from domestic processing;
- 15% from domestic recycling; and
- 35% from a diversified external supply, of which no single country's supply share should exceed 65% of any SRM.

However, before anticipating any growth in EU demand for raw materials required for the green and digital transitions, there is a need for the EU to address its material footprint, which stands well above the global average, accounting for 14.5 tonnes per capita. That figure should be halved for the EU's material footprint to remain within the planetary boundaries as well as amount to an equitable share of the earth's resources[3].

Therefore, in a Paris-compatible future – guided by the Sustainable Development Goals (SDGs) – the objectives of the CRMA should be based primarily on the principles of circularity. This means reducing overall environmental impact by reducing material use and increasing resource efficiency through circular design, implementing policies for repair and reuse, creating value in waste, and ensuring CRMs are safely recovered from end-of-life products for recycling. A reduction in material use and, therefore, in material demand would also inherently alleviate the EU's reliance on imported and domestically mined CRMs and would also decrease the EU's material footprint.

As the EU aims to grow its domestic supply for CRMs, these changes will be felt throughout key value chains and ultimately affect countries that are most reliant on exporting their raw materials to the EU. Trade and trade policy plays a role in the EU's shift towards a more self-sufficient market for CRMs, and finding a balance between domestic supply, trade with like-

minded trade partners, and trade with resource-rich developing countries will be crucial. These issues will be discussed in detail in a companion briefing focusing on external and trade-related aspects of the CRMA.

The publication of the CRMA proposal thus offers a unique opportunity to assess the use of CRMs in the EU and the expected shifts in relevant supply chains that will occur in the coming years due to recent and upcoming EU legislation. Yet, the sensitivity of the EU decision-making process on access to CRMs will require robust recommendations and a long-term commitment to exchange with relevant stakeholders and institutions to meaningfully infuse policy options at the EU and Member State (MS) levels.

The top-level aim of this project and briefing is to inform EU policymakers on the use of CRMs in the EU and to put forward recommendations to bring the EU's CRM consumption within planetary boundaries. The primary ambition of this project is to better equip stakeholders and policymakers at the EU and national levels with policy options to ensure that CRMs are used sustainably in the context of the green and digital transitions.

This briefing aims to ascertain whether gaps exist between the EU's legislative frameworks and levels of circularity for CRMs and the objectives of the CRMA. A "circularity gap" analysis of the CRMA proposal is conducted in the context of the EU's ambition to become a more circular economy with the objective of identifying missing elements in the CRMA proposal that may hamper efforts to achieve the objectives of the CEAP. This briefing puts forward recommendations to realistically address these gaps with the aim of encouraging the uptake of measures to promote the greater pursuit of circularity in the future implementation of the CRMA.

This briefing will be followed by a second briefing providing an analysis of the external supply angle of the CRMA, examining the role of strategic partnerships and projects abroad to achieve the EU's objectives in the CRMA. We also aim to inform policymakers on policy options for material use reduction targets, thus contributing to the objectives of the ECRMA without relying on new primary or even secondary critical raw materials.

Circularity in the CRMA

The overarching circular economy-related target in the CRMA proposal is that by 2030, 15% of the EU's annual consumption of strategic raw materials should be met by EU recycling capacity. A key objective of the CRMA is to improve the circularity and sustainability of critical raw materials to ensure a high level of environmental protection. To this end, Chapter 5 of the proposal titled "Sustainability" sets out provisions to improve the circularity of CRMs, including provisions on due diligence certification schemes and environmental footprint declaration.

The proposal is meant to complement existing legislation on the treatment of raw materials, such as the Extractive Waste Directive, the Waste Framework Directive, the Waste Electrical and Electronic Equipment (WEEE) Directive, the End-of-Life Vehicles (ELV) Directive and the EU Batteries Regulation (which entered into force in August 2023). Therefore, the provisions on circularity do not set targets for the recovery or use of recycled content for CRMs but rather establish a new baseline for the treatment of products with high potential for CRM recovery.

The European Commission will adopt implementing acts specifying a list of products, components and waste streams that are considered to have high CRM recovery potential. The MS will then be required to increase the collection rates and improve the treatment processes of these products to maximise the recovery quantity and quality of CRMs. To improve transparency and data collection, MS are required to identify and report on quantities of components containing relevant amounts of CRMs in WEEE, and quantities recovered and provide information on the adoption of national programmes and progress on implementation of measures.

Furthermore, the proposal presents new measures for the recovery of CRMs from extractive waste and permanent magnets. The former obliges new and existing operators of extractive waste-generating facilities to assess the potential of CRM recovery and submit plans for the recovery of those CRMs to the Commission. MS will be required to establish a database of closed waste facilities, including information such as location, operator, and quantities of raw materials contained, which is to be made publicly available.

The measures on permanent magnets[4] consist of facilitating their recyclability and setting minimum recycled content requirements. Any product containing such permanent magnets must include a data carrier with information on the responsible manufacturer. This data carrier must also include information on the weight, location, and chemical composition of the magnet(s) in the product, as well as instructions enabling access to or removal of the magnets from the product. The information on this data carrier will be carried over onto the digital products passport for products also covered by the Ecodesign for Sustainable Products Regulation. Furthermore, the minimum recycled content recovered from consumer waste for permanent batteries may be determined by adopting delegated acts after the end of 2030. On transparency, the Commission also requires producers to provide the end consumer with clear and accessible information on the recycled content of the permanent batteries in the final product.

Circular economy-related principles in the CRMA are concentrated on leveraging post-consumer waste. This includes improving recycling processes and capacity and increasing both the reuse of products and secondary CRMs through the implementation of minimum recycled content requirements.

Regarding measures to tackle demand-side pressures for CRMs, the proposal mentions improving materials efficiency and substitution of CRMs where possible, though such targets are further covered under the Ecodesign legislation. However, it does not mention the role of the repair sector in increasing the life cycle of products containing CRMs. Though the CRMA proposal is meant to complement existing legislation, the absence of references to the Right to Repair legislation is discouraging.

This briefing was published during the CRMA Trilogues, in which both the EU Council and the European Parliament call for more ambitious targets. In its position on the proposed CRMA, adopted in June 2023, the EU Council calls[5] for more ambition for both domestic recycling capacity (increased to 20% from the proposed 15%) and domestic processing capacity (increased to 50% from the proposed 40%). The Council also proposes more frequent updates to the list of CRMs and SRMs (every three years rather than every four years), an increased

focus on the reuse of products with high CRM recovery potential, and incentives to recover secondary CRMs from waste.

The European Parliament's position[6], adopted in September 2023, also calls for domestic processing capacity to meet 50% of SRM consumption and for at least 45% of each SRM contained in EU waste streams to be collected, sorted, and processed (if technically and economically feasible). It also highlights the need for a stronger focus on research and innovation throughout the value chain, including on potential substitute materials and production processes, and for targeted economic incentives for production and recycling concerning CRMs.

State of play on CRMs in the EU

Well-known examples of CRMs include rare earth elements (used to manufacture permanent magnets for wind turbine motors), lithium (used in batteries), and silicon (used for semiconductors)[7]. The European Commission has predicted an "*unprecedented increase in demand for the key materials necessary to a successful twin transition*"[8] (i.e., the green and digital transitions). Examples include a 4.5-times increase by 2030 (and 5.5-times by 2050) for the rare earth metals used in wind turbines and an 11-times increase by 2030 (and 17-times by 2050) for lithium, driven in particular by the increased need for electric vehicle (EV) batteries[9].

One of the most challenging aspects of this increase in demand is the EU's current heavy reliance on a small number of suppliers for many CRMs. This exposes the EU to significant geopolitical risks, in particular in cases where the main supplying countries do not have reliable or predictable relationships with the EU. In response, the EU aims with the CRMA to both improve its domestic supply of CRMs (through better refining, processing, and recycling) and to diversify its external supply by strengthening relationships with more reliable trading partners[10].

Since 2010, the EC has been carrying out three-yearly 'Criticality Assessments' to identify lists of CRMs for the EU, based on their economic importance and supply risk. The number of CRMs on these lists has increased from 14 in 2011 to 34 in 2023, with the most recent list highlighting 16 of the CRMs as also being Strategic Raw Materials (SRMs)[11]. Table 1 below presents the latest list of CRMs for the EU, their key uses, the EU's reliance on imports, and the recycling input rate, i.e., the percentage of overall demand that can be met through secondary raw materials.

The 2023 Criticality Assessment[12] notes a few interesting changes since the previous assessment in 2020. Of the strategic raw materials (SRMs), **manganese** (used in steelmaking and batteries) saw an increase in supply risk due to a significant drop in domestic extraction, which fell from 32 tons to 10 tons, partly due to production ceasing in Bulgaria and Hungary. The EU's reliance on imports has therefore increased, notably with 41% of imports coming from South Africa and 39% from Gabon.

Table 1: The 34 Critical Raw Materials identified in 2023, uses, import reliance and EU recycling.

Raw material	Key uses	EU import reliance	EU end-of-life recycling input rate (EoL-RIR)
Aluminium/Bauxite	Lightweight structures; High-tech engineering	89%	32%
Antimony	Flame retardants; Defence applications; Lead-acid batteries	100%	28%
Arsenic	Semiconductors; Alloys	39%	0%
Baryte	Medical applications; Radiation protection; Chemical applications	74%	0%
Beryllium	Electronics and communications; Automotive, aerospace and defence components	(not available)	0%
Bismuth	Pharmaceuticals; Medical applications; Low-melting point alloys; Solid rocket propellant	71%	0%
Boron/borates (metallurgy grade)	High-performance glass; Fertilisers; Permanent magnets	100%	1%
Cobalt	Batteries; Superalloys; Catalysts; Magnets	81%	22%
Coking Coal	Coke for steel; Carbon fibres; Battery electrodes	66%	0%
Copper	Electrical infrastructure	48%	55%
Feldspar	Glass (inc. fibreglass); Ceramics	54%	1%
Fluorspar	Steel, iron and aluminium production and other metallurgy; Cooling applications	60%	1%
Gallium	Semiconductors; Photovoltaic cells	98%	0%
Germanium	Optical fibres and infrared optics; Satellite solar cells; Polymerisation catalysts	42%	2%
Hafnium	Superalloys; Nuclear control rods; Refractory ceramics	0% (EU net exporter)	0%
Heavy Rare Earth Elements: Terbium (Tb), Dysprosium (Dy), Gadolinium (Gd), Samarium (Sm) for magnets	Permanent magnets; Lighting phosphors; Catalysts; Batteries; Glass and ceramics	100%	4%
Helium	Controlled atmospheres; Semiconductors;	94%	2%

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Light Rare Earth Elements: Neodymium (Nd), Praseodymium (Pr), Cerium (Ce) for magnets	Permanent magnets; Lighting phosphors; Catalysts; Batteries; Glass and ceramics	100%	3%
Lithium (battery grade)	Batteries; Glass and ceramics; Steel and aluminium metallurgy	100%	0%
Magnesium (metal)	Lightweight alloys; Steel production	100%	13%
Manganese (battery grade)	Steel production; Batteries	96%	9%
Natural Graphite (battery grade)	Batteries; Steel production	99%	3%
Nickel (battery grade)	Batteries; Steel production; Automotive applications	75%	16%
Niobium	High-strength steel and super alloys; High-tech applications (capacitors, superconductors, magnets)	100%	0%
Phosphate rock	Mineral fertiliser; Phosphorous compounds	82%	17%
Phosphorus	Chemical applications; Defence applications	100%	0%
Platinum Group Metals	Chemical and automotive catalysts; Fuel cells Electronic applications	100%	10%
Scandium	Solid oxide fuel cells; Lightweight alloys	100%	0%
Silicon metal	Semiconductors; Photovoltaics; Electronic components: Silicones	60%	0%
Strontium	Ceramic magnets; Aluminium alloys; Medical applications Pyrotechnics	0%	0%
Tantalum	Electronics capacitors; Superalloys	99%	0%
Titanium metal	Lightweight, high-strength alloys; Medical applications	100%	19%
Tungsten	Alloys (e.g., aeronautics, space, defence, electrical); Mill, cutting and mining tools	80%	42%
Vanadium	High-strength alloys (e.g., aeronautics, space, nuclear reactors); Chemical catalysts	(not available)	1%

Notes: Adapted from Annex 1 of 2023 criticality assessment. Strategic raw materials in **bold & underlined**. Import reliance = (import-export) / (domestic production + import-export). EoL-RIR is % of overall demand that can be satisfied through secondary raw materials. The self-sufficiency rate is the remainder from import reliance out of 100%; e.g., for aluminium, the EU's self-sufficiency is 11%.

Although the EU has good supply diversification for **nickel** (used in batteries), it has been added to the SRM list due to the concentration of ownership and production capacities, which is deemed to be a potential future risk (with Indonesia (26%) and Russia (10%) as major global

producers of ores; China (33%), Indonesia (12%) and Russia (7%) as major refiners; and Russia (29%) also a major source of refined nickel to the EU). Meanwhile, **copper** (used in electrification technologies) is now deemed an SRM because it is particularly challenging to substitute, despite the EU having well-diversified sources.

In terms of CRMs, **arsenic** (used in metallurgy and semiconductors) and **helium** (used in cryogenics and semiconductors) are now deemed critical due to their increased added value in relevant economic/industry sectors. There is an increased supply risk for **feldspar** (used in glass and ceramics), in particular, due to the EU's import reliance on Türkiye, which now supplies 51% of EU demand.

Natural rubber was removed from the CRM list, at least partly due to the recycling input increasing from 1% to 5%; this is, therefore, one example of how improved recycling of CRMs can contribute to them becoming less critical. In addition, **indium** (used in flat panel displays) was removed from the CRM list since production in the EU is now higher than consumption, due to the material being used more precisely (e.g., in PV cells, batteries, semiconductors and LEDs).

In its March 2023 Communication on CRMs[13] accompanying the draft CRMA, the European Commission notes that the "*EU should make the most of its reserves and develop exploration, extraction, refining, processing and recycling activities at home in full respect of our environmental ecosystems*". It notes that most CRMs are recyclable metals, offering the potential for greater circularity whilst also contributing to improved security of supply, reduced extraction impacts and creation of economic value. The Communication also notes, however, that the recycling rates of most CRMs currently remain very low (see Table 1 above)[14]. Of the 34 CRMs identified in the 2023 criticality report, only 10 currently have 10% or more of their EU demand met through secondary raw materials, specifically copper 55%, tungsten 42%, aluminium/bauxite 32%, antimony 28%, cobalt 22%, titanium metal 19%, phosphate rock 17%, nickel 16%, magnesium 13% and platinum group metals 10%. Therefore, in several cases, there is still significant potential for increasing the recycling rates of wastes containing CRMs.

In addition, the Communication[15] also notes that domestic EU recycling capacities and technologies for CRMs are still often inadequate. It reiterates that efforts to assure "circularity of CRMs in the broad sense" both in the EU and internationally need to be stepped up, including through the CRMA's objective for the EU to ensure that 15% of its annual consumption can be met through secondary materials generated via its domestic recycling capacity. The Communication suggests that this should involve greater support to CRM recycling technologies, including through Horizon Europe and synergies with MS' research and innovation programmes. The emerging European industry for recycling battery raw materials is cited as an example to be followed (see Box 1 below).

Box 1 The example of EV batteries

EU demand for lithium for EV batteries is predicted to increase by 18 times by 2030 (and 60 times by 2050), and demand for cobalt to increase by 5 times by 2030 (and 15 times by 2050)[16]. EV batteries make up around 41% by weight of all lithium-ion batteries (LIBs) (and around 80% of industrial LIBs) placed on the EU market[17]. The EU imports cells (mainly from East Asia) to domestically produce EV battery packs and produced around 5% of nickel-cadmium (NiCd), nickel metal hydride (NiMH) and LIBs globally in 2019[18], though the EU plans to expand its capacity to produce more EV batteries domestically.

EU battery demand outstrips domestic production capacity, which was around 35 GWh per year in 2020, but the construction of new battery plants could increase capacity to 400 GWh by 2025[19]. By around 2030, Europe could fulfil 7% to 25% of the global demand for LIB (with notable production in Sweden, Germany, Poland, and Hungary)[20].

The recovery of materials such as nickel, lithium and cobalt through recycling is typically less environmentally harmful than producing the same materials through mining/extraction[21]. For example, nickel ores typically have very low nickel content, generating significant waste, whilst current lithium extraction methods consume significant amounts of energy or water[22]. The Democratic Republic of the Congo currently supplies two-thirds of the world's cobalt; however, the local mining operations are associated with concerns over workers' rights and health, and deep-sea mining alternatives also have environmental risks[23]. Around 0.7 tonnes of CO_2 equivalent emissions can be saved per tonne of LIB recycled[24]. The use of secondary raw (recycled) materials helps to address such issues, as well as reducing import dependence, supply risks and price fluctuations.

Whilst global EV battery markets are growing too quickly to be met by recycled materials alone[25], recycled material can make an important contribution to the associated material demand. For example, without battery recycling, lithium demand may exceed the currently known lithium reserves by 2050, but universal battery recycling could see recycled lithium supply exceeding total annual demand by the same year[26]. By 2030, if 65% of industrial lithium-based batteries are collected, and a 57% recycling efficiency is achieved for lithium, the value of recovered materials (lithium, cobalt, nickel and aluminium) in the EU could reach 408 million EUR[27]. Estimates also suggest that up to 5,500 tonnes of cobalt could be recycled from EV batteries in the EU by 2030, providing 10% of the cobalt used in EV batteries in the EU[28]. The global LIB recycling market could be worth 31 billion USD annually by 2040, with over half of LIBs (4.3 million tonnes) being recycled in China and with EV batteries dominating the market[29].

While there is huge potential for recovery CRMs from LIBs, the EU's recycling capacity will need to increase substantially to reap the benefits. In 2019, the EU's annual recycling capacity was only around 160,000 EV batteries[30] (with LIB recycling concentrated in Germany, and France[31]), which is inadequate to process the expected significant increase in the quantity of waste LIBs in the coming years[32].

A promising development could be the new EU Batteries Regulation[33] which should drive an increase in EV battery collection and recycling in the EU. It introduces a digital battery passport, containing information on the battery model and specific aspects including recycled content. It sets minimum recycled content targets for specific metals recovered from batteries (see Table 2), as well as minimum recycling efficiencies for specific battery types (see Table 3), and minimum levels of recovered materials for specific metals (see Table 4).

Table 2: Recycled content targets in the new EU Batteries Regulation

Metal	Minimum % recycled content after 8 years	Minimum % recycled content after 13 years
Cobalt	16	26
Lead	85	85
Lithium	6	12
Nickel	6	15

Table 3: Minimum recycling efficiencies in the new EU Batteries Regulation

Battery type	Minimum recycling efficiency % by end 2025	Minimum recycling efficiency % by end 2030
Lead-acid	75	80
Lithium-based	65	70
Nickel-cadmium	80	80
Other	50	50

Table 4: Minimum levels of recovered materials in the new EU Batteries Regulation

Metal	Minimum % recovery by end 2027	Minimum % recovery by end 2031
Cobalt	90	95
Copper	90	95
Lead	90	95
Lithium	50	80
Nickel	90	95

The Regulation should also facilitate reuse and repurposing, for example through provisions on extended producer responsibility and improved information on battery health and ownership.

Circularity gaps in the CRMA – and how to address them

On resource use in general, the 2020 **EU Circular Economy Action Plan** (CEAP)[34] recalls the goal of the European Green Deal for the EU to become a climate-neutral, resource-efficient and competitive economy, and notes that ramping up the circular economy will make a crucial contribution to this, by helping to "advance towards keeping [EU] resource consumption within

planetary boundaries, and therefore strive to reduce [the EU's] consumption footprint and double its circular material use rate in the coming decade".

On critical raw materials in particular, the CEAP does not specifically mention SRMs or CRMs. The **security of the supply** of raw materials is specifically noted only in the CEAP's discussion of the new Batteries Regulation (see Box 1 above). The **general objectives** of the CEAP include:

- Promoting sustainable products, focusing on several resource-intensive sectors with high circularity potential, including some that rely on CRMs, such as electronics and ICT, batteries, and vehicles;

- Facilitating waste reduction, including objectives to reduce overall waste generation and halve the amount of residual waste by 2030; and

- Ensuring a well-functioning **market for high-quality secondary raw materials** in the EU, including through further development of end-of-waste criteria and standards.

The CEAP also notes the need to improve **recyclability**, increase recycling efficiency and ensure **high-quality recycling**. To support the expansion of the EU recycling sector, the CEAP aims to promote an increase in **recycled content** in products, for example in the context of the planned broadening of the Ecodesign Directive, the use of EU Ecolabel criteria (which could include recycled content requirements in the future), the new Batteries Regulation, and rules on end-of-life vehicles (ELV)[35].

As noted earlier in this briefing, the main circularity-related target in the CRMA is to meet 15% of the EU's annual consumption of strategic raw materials through EU recycling capacity. This fits well with the CEAP's objectives, in particular those related to promoting recycled content in products. However, as can be seen from Table 1, the average end-of-life recycling input rate (EoL-RIR) across the 34 CRMs in the EU is only 8.3% (with some higher but many at 0%). There is, therefore, still some way to go to meet the CRMA's recycling capacity target.

The 3rd Raw Materials Scoreboard[36] notes that recycling is the "backbone" of resource efficiency, playing a key role in creating a more circular economy in the EU, which contributes to reducing import dependency, creating more secure and sustainable raw material supply, and reducing risks related to criticality. Meanwhile, Eurostat data[37] indicates that in 2022, the EU's self-sufficiency rates[38] for certain CRMs were as follows: aluminium 11%, boron/borates 0%, cobalt 19%, copper 52%, fluorspar 40%, lithium 19%, natural graphite 1%, tantalum 1%, vanadium 100%.

More needs to be done to improve the circularity – and in particular, recovery and recycling – to achieve the CRMA's recycling objective. The CRM Communication[39] notes several factors that need to be addressed to support an improvement in recycling rates, and for which common EU-wide solutions will be developed. These include designing products to enable ready removal of and/or access to CRMs to facilitate their recovery; providing information on products' material composition; better-targeted collection, treatment, and recycling of certain CRM-containing products (such as ELVs, consumer electronics and WEEE); and the economic viability of recycling operations (due to complexity of separation and small recoverable quantities). In addition, the overall high levels of resource use in the EU must be addressed, to ensure that SRMs and CRMs are used as efficiently as possible. But how well does the CRMA

address these gaps? The following sections briefly discuss five identified circularity gaps and what more could or should be done.

1. Inadequate product design for circularity

What's the problem?

Product design is vital for increasing circularity. Firstly, products should be designed with longevity in mind, so that the lifespan of products – and the materials contained within them – is as long as possible. Secondly, design should ensure that CRMs contained in a product can be accessed, removed, and recovered at the end of their life. If products are not designed to meet these objectives, it can lead to increased demand for CRMs (due to high turnover of products) and hinder the recovery and circularity of CRMs. Research, innovation, technology and skills development all play a key role in product design – and legislative clarity can also play a role by providing more certainty for investment in those areas. For example, new technologies (such as those related to permanent magnets or 3D printing) may create products that are optimised for their use phase, but not necessarily for the recovery of materials at the end-of-life stage, as acknowledged in the CRM Communication.

What's in the CRMA proposal?

Article 1 references the (proposed) Ecodesign for Sustainable Products Regulation (ESPR), noting that when Ecodesign requirements are prepared on "*durability, reusability, reparability, resource use or resource efficiency, possibility of remanufacturing and recycling, recycled content and possibility of recovery of materials*", they must be in line with the CRMA's target to produce at least 15% of the EU's annual consumption of SRMs from domestic recycling capacity. This is promising since it indicates some level of future coherence between the CRMA and the ESPR.

To support the aim of improving the circularity of permanent magnets, Article 27 requires information to be provided to enable access and removal of all permanent magnets in relevant products (this should be in the product passport, where one is required). Article 28 relates to recycled content in permanent magnets, including a provision for the Commission to set minimum recycled content targets after 2030.

What more could be done?

Whilst the CRMA already references the ESPR, more guidance on **how to consider the recovery potential of CRMs in Ecodesign requirements** would be useful, in addition to the existing provisions on permanent magnets. The CRM Communication accompanying the CRMA states that the implementation of Ecodesign legislation should systematically consider "performance and information requirements in new products and equipment, which will promote the substitution of CRMs and make sure that they can be dismantled and recycled or reused". This could be done either through amendments to the CRMA text or through delegated acts or implementing acts to encourage designing products in a way that contributes wherever feasible, to CRM circularity. For instance, products should be designed in a way that ensures their proper dismantling and disassembly so that CRM recovery can be optimised.

The CRMA should also clearly acknowledge the need to take into account **technological developments** over time, in addition to its recognition that the list of SRMs should be updated periodically. Accounting for technological developments should ensure that new and improved technologies can come to market. These new technologies should also support – or not prevent - CRM circularity. As part of considering technological changes over time, there should be regular consideration for how such changes may lead to changes in the quantities of CRMs required, as this could increase the demand for specific CRMs and require further efforts on their circularity.

Design-related provisions should systematically be included in other EU legislation related to products and waste streams with the potential to contribute to CRM circularity. Other waste and product legislation will be crucial in supporting the circularity of CRMs, implementation of the CRMA and achievement of its targets. Some examples of this already exist. The ELV Regulation proposed in July 2023 introduces measures aimed at increasing the circularity of the CRMs used in vehicles, by enabling the removal, reuse and recycling of parts and components that contain CRMs such as permanent magnets. This includes a target for vehicles to be constructed (i.e., designed) in such a way that they are 85% reusable or recyclable, and 95% reusable or recoverable. In addition, the Battery Regulation that came into force in August 2023 aims to improve the circularity of batteries, including recycled content and reuse targets for some CRMs in batteries (cobalt, copper, lithium, and nickel) and requiring battery labels to state when the battery contains more than 0.1% by weight of CRMs. Such provisions should be introduced in other relevant product and waste legislation.

2. Lack of information on product composition and materials

What's the problem?

Linked to product design is the issue of information on the composition of a product, in particular its material content, and on how to ensure proper treatment of the product at the end-of-life stage. The CRM Communication acknowledges that there is currently a lack of information on the presence and chemical composition of the components of products that contain CRMs. If this information is not made readily available by producers to consumers and/or waste processors, it can lead to the loss of useful materials – including CRMs – simply because it is not clear that the product contains valuable recoverable material.

What's in the CRMA proposal?

Article 27 requires certain products containing permanent magnets to bear a standardised label – the format of which will be determined in an implementing act – stating whether they belong to certain types (neodymium-iron-boron, samarium-cobalt, aluminium-nickel-cobalt, or ferrite), and a data carrier such as a bar code, linked to information that includes the chemical composition of all individual permanent magnets in the product.

Article 28 requires those same products to provide information on a free access website on the share of certain CRMs (neodymium, dysprosium, praseodymium, terbium, boron, samarium, nickel, and cobalt) in the product's permanent magnets that were recovered from post-consumer waste.

What more could be done?

The CRMA could note in broader terms the **value of clear product labelling and product passports** in contributing to enabling improved material circularity, including CRMs. Currently, labelling, product passports or unique product identifiers are only mentioned in the CRMA concerning permanent magnets.

Consideration could be given for all products that contain viable recoverable amounts of CRMs, to **requiring a label or product passport** making this clear to consumers and waste processors. This would be in line with the new Battery Regulation which, as noted above, requires battery labels to state when the battery contains more than 0.1% by weight of CRMs.

The CRM Communication also states that the EU will develop **common solutions to the lack of information on the presence of CRMs** in products. This will include systematically considering information requirements as part of the ESPR implementation and reviewing the information requirements of the WEEE Directive in the context of CRMs.

If these actions were extended to all CRM-containing products, this would provide greater coherence regarding information on material composition and facilitate the recovery of CRMs to contribute to their improved circularity.

3. Low collection and recycling rates

What's the problem?

Many CRMs currently suffer from low collection and recycling rates, as noted in the CRM Communication. If CRM-containing products are not collected efficiently and in sufficient quantities at the end of their life, opportunities to improve the circularity of CRMs through recycling will be missed.

What's in the CRMA proposal?

Recalling the headline target in Article 1 of the CRMA relevant to collection and recycling, which is for the EU's recycling capacity to produce at least 15% of the EU's annual consumption of SRMs by 2030. Recycling capacity is defined as the "*aggregate of the maximum annual production volume of recycling operations for strategic raw materials, including the sorting and pre-treatment of waste and its processing into secondary raw materials, located in the Union*".

Article 25 of the CRMA requires MS to adopt and implement national programmes in support of several objectives. Concerning the collection and recycling rates, they should aim to increase the collection of wastes with high CRM recovery potential and ensure they are sent to an "appropriate recycling system", to maximise the quantity and quality of CRMs available for recycling. The programmes should pay particular attention to products and wastes not currently subject to specific EU legislative requirements on collection, treatment, recycling, or reuse. For products and wastes already subject to EU legislation, coherence with that legislation should be ensured.

The Commission is required to define, in an implementing act, a list of products, components and wastes with high CRM recovery potential, accounting for the number of recoverable CRMs, whether they are already covered by EU legislation, collection and waste treatment challenges, and existing collection and waste treatment systems.

Article 25 also requires MS to adopt measures to promote CRM recovery from extractive/mining wastes, and to identify in their reporting of WEEE data the quantities of CRM-containing components removed, and the quantities of CRMs recovered from them. Article 26 requires operators of extractive waste facilities to prepare preliminary studies on the potential for recovery of CRMs from wastes both stored and generated at their facility.

What more could be done?

The CRMA includes a headline target for 15% of the EU's annual consumption of SRMs to come from EU recycling capacity by 2030. However, this is an aggregate target for all SRMs, meaning that there are no specific targets for each SRM. The Commission could consider breaking this down into **individual targets for specific SRMs**. Even if these targets were aspirational (e.g., provided in non-binding guidance rather than in the CRMA itself), this would help to provide greater clarity on where particular efforts are needed to improve circularity.

The Commission should assess whether the **funds available under EU programmes** are adequate to provide the necessary financial support to MS to achieve the CRMA's objectives. The CRMA places a considerable amount of responsibility on MS to improve collection and recycling rates for CRMs. Whilst this is fitting given their competence in waste collection, waste treatment and the use of financial instruments, MS are likely to call for EU-level financial support. The CRM Communication pledges "up to 200 million euros" to support "*ten Hubs for Circularity to substantially increase recovery and recycling of raw materials*", but this is likely a drop in the ocean of the investment needed. The legislative financial statement attached to the CRMA notes the following funds as options: Horizon Europe, the Recovery and Resilience Fund (RRF), the Innovation Fund, Regional Development and Cohesion Funds, and the Just Transition Fund.

The **CRMA's provisions should be applied consistently across different products and wastes**. The CRMA states that the MS programmes required by Article 25 should focus on products and wastes with high CRM recovery potential that are not already subject to specific EU legislation. For products and wastes already subject to EU legislation, the CRMA only requires that MS programmes should be "coherent" with that legislation. This could potentially allow MS to be less ambitious regarding the latter, which could limit the potential for the collection and recycling of CRMs from those products and wastes. The Commission should ensure a coherent approach across all CRM-containing products and waste streams, to maximise collection and recycling potential and not allow the "existing legislation clause" to result in those waste streams lagging on CRM recovery.

Whilst the CRMA may not be the appropriate place to set specific collection targets for CRM-containing products, the Commission should ensure that the **collection targets** set in other product and waste legislation are coherent with the CRMA's objectives and enable improved CRM circularity. The CRMA's objectives should therefore be taken into account during future reviews and revisions of relevant legislation. The CRM Communication suggests the Commission is starting to do this, for example by considering implications for CRM recovery in the revisions of the ELV and WEEE Directives, and by proposing to harmonise waste management rules for wastes with significant CRM recovery potential (including products not currently covered by EU waste legislation, such as wind turbines). The Communication also announces "recommendations [to MS] on measures targeting small and CRM-rich consumer

electronics, to improve the return and take-back of used and waste mobile phones, tablets and laptops", indicating that the provision of non-binding guidance is also an option to encourage improved collection rates.

4. Inadequate recycling facilities, technologies, and economic viability

What's the problem?

Optimum recycling of materials, including CRMs, requires various conditions. In addition to the collection of high-quality wastes and materials for recycling, there must be appropriate facilities, with appropriate technologies and capacity, and appropriate quantities of wastes and materials delivered for processing. If any of these aspects are missing, recycling cannot be carried out to a sufficiently high quality to contribute to material circularity. In addition, recycling processes for some CRMs are not currently economically viable, for example, due to the complexity of separating CRMs from waste products, or the small quantities of CRMs contained in products limiting opportunities for economies of scale, as noted in the CRM Communication.

What's in the CRMA proposal?

In general terms, the CRMA notes the need to strengthen EU recycling capacities, and that recycling systems and technologies are often not adapted to the specificities of CRMs. The CRMA allows recycling projects to be categorised as Strategic Projects, provided they meet the criteria, i.e., contributing to the security of SRM supply, being technically feasible, sustainable (in environmental and social terms), with benefits beyond national borders within the EU (for projects within the EU) or mutually beneficial for the EU and the third country concerned (for projects in third countries).

Article 25 of the CRMA requires MS national programmes to aim to increase the technological maturity of recycling technologies for CRMs.

What more could be done?

Similar to improving collection and recycling rates, the CRMA places significant responsibility on the MS to improve recycling technologies. Again, it would be beneficial for the Commission to **assess the available funds**, and whether they are adequate to provide the financial support needed by MS. The CRM Communication acknowledges that research and innovation (R&I) will be essential to develop "knowledge, innovative solutions and highly sustainable processes" for recycling of CRMs, and that substantial financial support will be needed for recycling projects, in particular due to their innovative nature. The CRMA's legislative financial statement highlights Horizon Europe and the Innovation Fund as having the potential to support investments in CRM recycling.

The CRM Communication notes that one of the priorities for the Annual Union Work Programme for European standardisation, adopted in February 2023, is to **develop European standards for the recycling of CRMs** and that the technical requirements for treatment of CRMs (including recovery, recycling and preparing for reuse) must be supported by standards, to ensure consistent application of technical rules across the EU. Best Available Techniques

reference documents (BREFs) or other EU-level guidance on CRM recycling technologies should also be considered, as they develop further.

On the question of economics, the CRM Communication notes that increasing availability of recyclable waste, technological improvements in recycling, new business models (see section below), rising primary raw material prices and willingness to pay for lower environmental footprints should all contribute to improved economic viability of recycling in the coming decades. However, all these elements come with a degree of uncertainty and unpredictability. The Commission should therefore also consider promoting the use of **market-based instruments** to send price signals in support of recycling and the use of secondary CRMs. This could include, for example, extended producer responsibility schemes, where producers pay a fee for placing products on the market, which is then used to finance collection and waste treatment of the products at the end of their life. The eco-modulation of fees or bonus-malus approaches – varying fees according to e.g., material content, recyclability, or recoverability of products – would be a particularly interesting aspect to explore for CRM-containing products. Product or material taxes (which could be applied at the import and/or placing on the market stage) could also be considered, e.g., by applying lower taxes to recycled material than to virgin material to promote the use of secondary CRMs. In addition, consideration should be given to how to develop economies of scale for CRM recycling, for example through – but not limited to – the funding for additional Hubs for Circularity announced in the CRM Communication.

5. High levels of resource use

What's the problem?

As noted earlier in this briefing, the EU's current use of materials is far exceeding the global average. **The consumption footprint of the EU uses between 70 and 97% of the whole world's safe operating space** in terms of climate change and resource use[40]. These high levels of material consumption contribute to adverse environmental impacts, resource scarcity, and result in import reliance. On one hand, the Commission estimates that the EU has "clearly transgressed the planetary boundaries for five impacts" including the use of mineral and metal resources[41]. On the other hand, global and EU demand for several CRMs is expected to skyrocket[42]. In this context, **addressing the EU's unsustainably high levels of resource use is central** to fulfilling the CEAP's aim to "advance towards keeping [EU] resource consumption within planetary boundaries, and therefore strive to reduce [the EU's] consumption footprint and double its circular material use rate in the coming decade".

What's in the CRMA proposal?

The CRMA sets out that "the Commission should be empowered to develop a system for the calculation of the environmental footprint of critical raw materials", highlighting that transparency on relative CRM footprint can enable for example green public procurement criteria. Additionally, recycled content should be considered in public procurement. Furthermore, it prescribes "increased reuse of CRM with high critical raw materials recovery potential", increased use of secondary CRMs, and substitution of CRMs.

The CRMA acknowledges the projected increase in demand and states that "substituting materials and increasing material efficiency and circularity can mitigate the projected rise in

demand to a certain extent, but these steps are not expected to reverse the trend" and proposes measures to "ensure the sustainability of increased raw material production".

According to the Commission, the projected growth in resource demand is not expected to continue indefinitely. Rather, "after an initial phase of rapid growth of demand for critical raw material for new technologies, where primary extraction and processing will still constitute the predominant source, recycling should become increasingly important and reduce the need for primary extraction and its associated impacts".

Though the CRMA has intentions to improve the resource efficiency of CRMs, it describes a growing demand for resources up until 2050. A more concerted effort is needed to prioritise the overarching objectives of the CEAP concerning resource use as the proposal does not specify when resource demand will be reduced, to what levels, nor how this relates to the prospect of getting the EU's resource use within planetary boundaries.

What more could be done?

The CRMA's proposed measures to increase recycling efficiency are central for advancing towards a circular economy. Yet, bridging this circularity gap requires an **absolute rather than a relative assessment of progress towards living well within the planetary boundaries**[43]. While important, relative assessment such as the percentage of recycled content alone says little about environmental impact if the overall material use continues to increase. For example, sourcing 95% of 100 kg of cobalt from primary material is roughly the same as sourcing 90% of 106 kg from primary material, i.e., increased recycling rates do not *automatically* lead to less primary resource use and associated adverse impacts. Similarly, increased reuse does not *automatically* equate less use of primary resources.

To effectively reach the goal of EU resource consumption within planetary boundaries, **serious consideration should be given to avoid rebound effects** where circular activity benefits are reduced or outpaced by increased consumption[44]. CRMs are central for decarbonising the economy through renewable energy which in turn is key in mitigating climate change. At the same time, resource extraction and processing are behind 90% of biodiversity loss and water stress[45]. A **dual focus on decarbonisation and dematerialisation** can mitigate trade-offs and enhance synergies between environmental targets while alleviating resource scarcity and reducing reliance on imports.

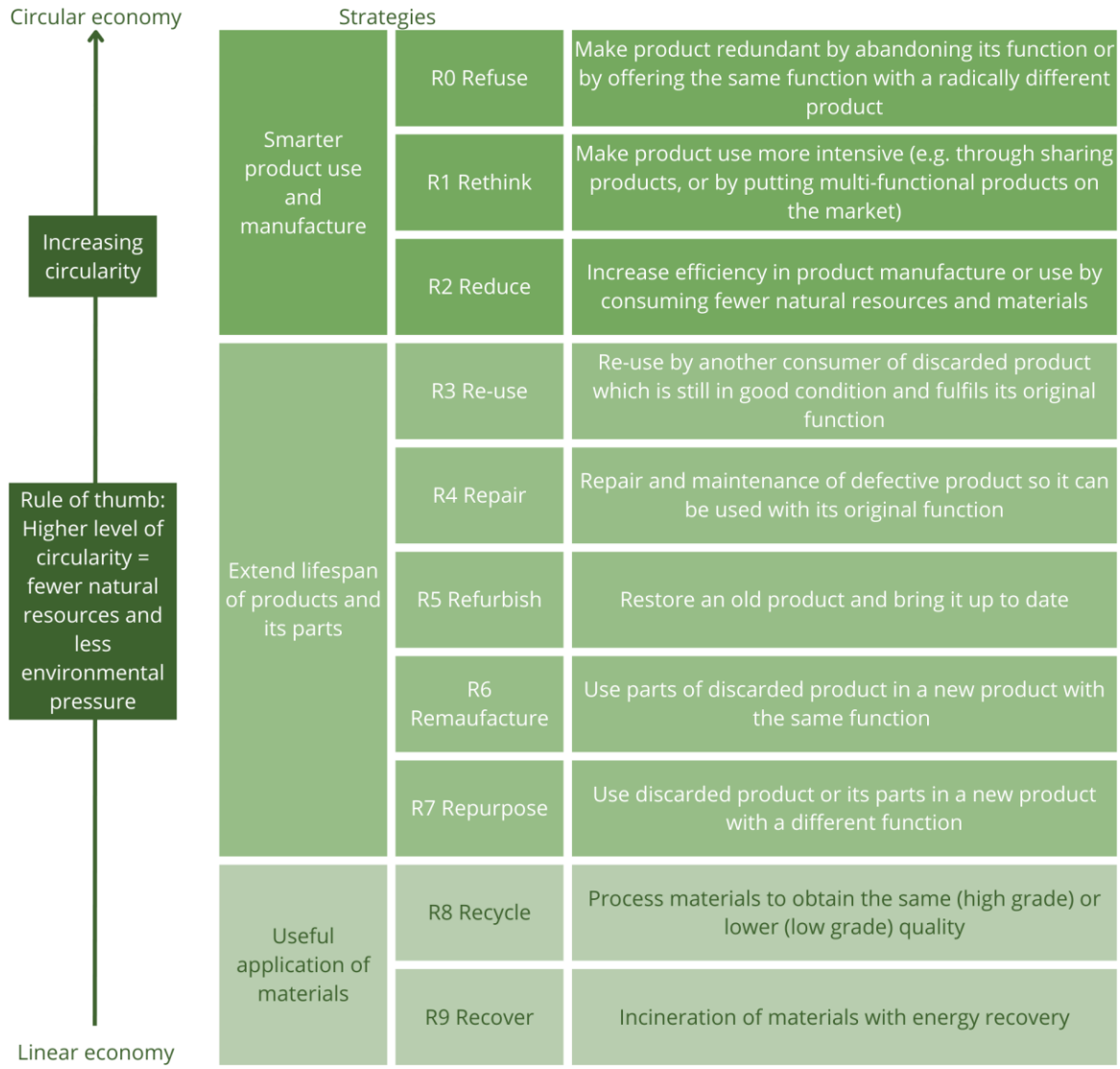
One way of doing this, which has also been requested by the European Parliament, is **establishing binding targets for primary raw material use**[46], similar to existing GHG reduction targets. CRMs are part of the EU's wider material use, therefore setting actionable targets that reflect resource use within planetary boundaries is a complex task[47] requiring consideration of equity and the contextual environmental impact of different materials. The Revised Monitoring Framework for the Circular Economy[48] is a potentially useful point of departure. The CRMA's previously mentioned call to develop a system for the calculation of the environmental footprint of CRMs is also positive in this respect.

Moreover, looking at the 9 Rs of the circular economy (see Figure 1), **"refuse", "rethink", and "reduce" strategies have received comparatively little attention in the proposal but are crucial for effectiveness**. In the context of CRMs, "refuse" strategies could include banning single-use products encompassing CRMs[49], "rethink" strategies could include car-sharing

services reducing demand for batteries, and "reduce" strategies could include reduced frequency in replacing electronic equipment containing CRMs. The latter two approaches in particular would contribute to increased use rates of products and the CRMs contained within them, helping to mitigate any increase in demand for CRMs.

The Commission could promote and **create favourable conditions for business models** that contribute to circular economy strategies – in the context of CRMs and beyond. This is an area rapidly evolving in the literature and in practice, with many sources from which inspiration can be drawn[50]. The Commission could, for example, consider providing guidance on successful circular business models, and on potential incentives for their wider application.

Figure 1: Circularity strategies in order of priority based on their level of circularity. Adapted from Potting et al (2017) and RLI (2015)[51]



Conclusions and recommendations

As with much EU legislation, the devil will be in the detail of how the CRMA is implemented, including the development of its related implementing and delegated acts. Those with potential relevance to the promotion of circularity include implementing acts on the application of Strategic Projects, and on specifying which end-of-life products and waste streams contain relevant amounts of CRMs; and delegated acts on the definition of critical and strategic raw materials, and the recycled content of products incorporating permanent magnets.

In addition to these planned implementing measures, the following aspects should be considered by the European Parliament, the Council, and the Commission during the negotiation of the final text and subsequent implementation of the Act:

- Introducing more clarity (in the CRMA text, or via implementing acts or guidance) on **how the recovery potential for CRMs should be considered in Ecodesign requirements** developed under the ESPR, to better promote design for circularity.

- Ensuring the CRMA's ongoing implementation includes **mechanisms to take account of technological developments over time**, including a requirement that such developments do not act as a barrier to the circularity of CRMs.

- Ensuring **coherence between the CRMA and product and waste legislation** – both existing and future – with regards to promoting circularity of CRMs, including in relation to collection, recovery and recycling targets.

- Ensuring that **CRM-containing products and waste streams already covered by EU legislation do not lag behind** in terms of their circularity potential due to the suggested focus in MS national programmes on products not already covered.

- Emphasising the value of **clear product labelling and product passports** in enabling circularity, and potentially requiring all products with viable recoverable amounts of CRMs to bear a label or have a product passport.

- Considering the development of **targets specific to individual SRMs** for the proportion that should come from the EU's recycling capacity by 2030 (i.e., breaking down the aggregated 15% target) to highlight where particular efforts are needed.

- **Assessing whether existing EU-level funds will be adequate** to provide the necessary financial support to MS to achieve the CRMA's objectives, in particular regarding improving collection and recycling rates and recycling technologies. This should, for example, form part of the preparation of the Commission's Strategic Implementation Plan to guide future EU research and investment priorities.

- Developing **BREFS or other EU-level guidance on CRM recycling technologies**.

- Promoting the use of **market-based instruments**, such as extended producer responsibility with eco-modulated fees, or product or material taxes, to send price signals in support of recycling and the use of secondary CRMs.

- Supporting the **development of economies of scale for CRM recycling**, for example, through – but not limited to – the funding for additional Hubs for Circularity announced in the CRM Communication.

- Ensuring **absolute rather than relative assessment** of progress towards resource consumption within planetary boundaries as set out in the CEAP, by utilising **all circular economy strategies** in order of their priority and circularity potential to reduce demand. This includes **promoting and supporting circular business models** that lead to smarter product use and manufacturing through "refuse", "rethink", and "reduce" strategies.

- Keeping a dual focus on decarbonisation and dematerialisation by setting **science-based targets for reduced primary resource use**.

These recommendations, if implemented, would help to tackle some of the key circularity gaps in the proposed text of the CRMA, by fostering improved product design, providing better information on products, contributing to increasing collection and recycling rates, making recycling better and more economically viable, and tackling current unsustainable resource consumption and demand. By taking these aspects into account in its implementation, the potential of the CRMA to advance the EU's circularity objectives could be considerably increased.

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