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Circularity as a pillar of the EU's critical raw materials strategy

Promises and pitfalls

E-PAPER

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Executive summary

Circularity has moved from the margins of the EU's critical raw materials (CRMs) strategy to its core. The Clean Industrial Deal, the RESourceEU Action Plan and the forthcoming Circular Economy Act represent the most coordinated effort to date to build a functioning circular economy for CRMs in Europe. This paper examines both the promises and the pitfalls of this shift.

The paper unpacks key measures across four pillars: i) facilitating the cross-border flow of waste and secondary materials by tackling single market fragmentation; ii) boosting CRM recovery from priority waste streams while creating demand-side pull through tools like recycled-content mandates; iii) retaining CRM-rich materials within the EU through a layered set of export restrictions and monitoring of waste flows; and iv) engaging trading partners through trade agreements and new partnership models.

Yet the promises of circularity come with significant blind spots. The strategy remains heavily centred on recycling, which faces hard structural limits and cannot bridge the gap between surging demand and available secondary supply. The international dimension is comparatively underdeveloped, with partnerships still oriented toward securing primary supply. And the growing use of export restrictions, while in line with a broader global trend of 'circular resource nationalism', carries risks of trade friction, unintended environmental outcomes and a deepening 'circular divide' between high-income and lower-income economies.

Addressing these blind spots will require ambitious action at both domestic and international level – notably in the context of the upcoming Circular Economy Act – broadening the policy focus beyond recycling, embedding circularity in international partnerships and trade instruments, and confronting the harder question of the EU's own material consumption.

Abbreviations

CE	Circular Economy
CEA	Circular Economy Act
CID	Clean Industrial Deal
CMUR	Circular Material Use Rate
CRM	Critical Raw Material
CRMA	Critical Raw Materials Act
CTIP	Clean Trade and Investment Partnership
ECA	European Court of Auditors
EEA	European Environment Agency
EPR	Extended Producer Responsibility
ESPR	Ecodesign for Sustainable Products Regulation
EoW	End-of-Waste
FTA	Free Trade Agreement
JRC	Joint Research Centre
OECD	Organisation for Economic Co-operation and Development
SRM	Strategic Raw Material
WEEE	Waste Electrical and Electronic Equipment
WSR	Waste Shipment Regulation

Introduction

For over a decade, the EU has warned of its dependence on critical raw materials (CRMs). CRMs underpin the technologies at the heart of the Union's strategic priorities, from batteries and wind turbines to semiconductors and defence systems, and demand for many of these materials is set to surge in the coming decades. The EU remains heavily dependent on imports, supply is concentrated in a small number of countries and supplier governments are increasingly imposing export restrictions.[1] In this context, circularity – recovering and reusing materials already embedded in products in the EU market – has emerged as a central pillar of the EU's strategy to secure critical resources.

The Clean Industrial Deal (CID), the European Commission's strategy to strengthen industrial competitiveness while advancing decarbonisation, marks a turning point. For the first time, circularity is framed as a defining feature of EU industrial strategy. The CID states that circularity 'will be a priority' and is 'the key to maximising the EU's limited resources, reducing dependencies and enhancing resilience', setting the ambition to make the EU a world leader in the circular economy by 2030.[2] Since then, the European Commission has announced a series of initiatives – including the RESourceEU Action Plan, proposed amendments to the Critical Raw Materials Act and the forthcoming Circular Economy Act – that seek to translate this commitment into practice.

Part of circularity's appeal is in its potential to advance several strategic objectives at once: advancing decarbonisation and reducing the environmental footprint of resource extraction, boosting economic security by lowering import dependence, and strengthening industrial competitiveness. However, these objectives do not always align, and the benefits that materialise in practice depend on how circularity is operationalised, a tension this paper explores. At the same time, this renewed ambition comes against a backdrop of limited progress and raises new questions.

Despite over a decade of circular economy policymaking, tangible progress on CRM circularity in the EU has been slow and fragmented. And the very reframing of circularity as a security and competitiveness tool introduces trade-offs that deserve close attention. Measures to ensure the availability of secondary raw materials in the EU carry implications for partner countries, while the international dimension of the EU's growing circular economy agenda remains comparatively underdeveloped. And a strategy still heavily centred on recycling may fall short of deeper changes in resource consumption and material efficiency needed to transition from a linear to a circular economy.

This paper examines the growing role of circularity in the EU's CRM strategy, assessing both its promises and its pitfalls. It begins with an overview of the current state of play, documenting the gap between ambition and progress. It then unpacks the key measures through which the EU is operationalising circularity, organised around four thematic areas: facilitating cross-border flows of secondary materials, creating incentives for circular value chains, retaining CRMs within the EU and engaging with third countries. Finally, the paper assesses the limitations and trade-offs of the current approach before concluding with reflections on the conditions for a more balanced and effective circularity agenda.

2. State of play: where does the EU stand on circularity of CRMs?

Circularity has progressively moved from the margins of the EU's CRM strategy to a more prominent role. Successive policy initiatives, from the 2008 Raw Materials Initiative to the 2020 Action Plan on CRMs and, more recently, the Critical Raw Materials Act (CRMA) in 2024, have each expanded the role attributed to circularity in securing critical resources. The CRMA marks a significant step in this trajectory, introducing a benchmark whereby at least 25% of the EU's annual consumption of strategic raw materials should come from recycling by 2030.[3]

In parallel, the scope of the EU's circular economy policy framework has broadened. Where circularity in the CRM space was historically confined primarily to downstream waste management – governed by instruments such as the Waste Framework Directive, the Waste Electrical and Electronic Equipment (WEEE) Directive and the Waste Shipment Regulation – it has progressively extended upstream. Under the European Green Deal, instruments such as the Batteries Regulation and the Ecodesign for Sustainable Products Regulation (ESPR) began embedding circularity at the product-design stage, introducing requirements on durability, repairability, performance and traceability. This shift from a narrow end-of-life toward a lifecycle approach is a notable development, bringing the EU's policy framework closer to the comprehensive circular economy model described in Box 1.

Box 1. Suitability of CRMs for circular economy approaches

The **circular economy (CE)** is an economic system that reflects the shift away from the linear 'take-make-dispose' model towards systems that preserve and maximise material value and minimise waste. Central to CE is the idea of 'narrowing, slowing and closing' material loops – that is, reducing material intensity and resource use, extending product lifetimes and recovering end-of-life materials for reintegration into new value chains.[4]

Critical raw materials are materials of high economic importance and high supply risk, deemed essential to clean energy, digitalisation and defence technologies.[5] Given their durability, recyclability and adaptability properties, most CRMs are well suited to circular approaches. Metals such as aluminium and copper can be recovered and recycled repeatedly without significant loss of quality, while lithium, cobalt, nickel and rare earth elements can be chemically separated and reused in batteries, magnets and other high-tech applications, allowing them to keep their value in the economy across multiple cycles.[6]

Secondary raw materials are materials that have been obtained from recycling or recovery of end-of-life products, manufacturing scrap, industrial by-products, or other waste streams, as distinct from **primary raw materials** sourced through extraction.

Many CRMs are embedded in complex products at low concentrations, making recovery technically difficult or costly.[7] Effective circular strategies therefore require both upstream measures, such as eco-design requirements, and downstream measures, including recycling and recovery processes.

Yet despite this expanding policy framework, tangible progress has remained limited. Figure 1 illustrates the scale of the gap between the EU's circularity ambitions and the current reality. The EU's circular material use rate (CMUR) – the share of material inputs to the EU economy sourced from recycled and recovered materials – stood at just 12.2% in 2024, barely above the 10.7% recorded in 2010, meaning that nearly 90% of materials consumed in the EU economy still come from virgin sources. The Clean Industrial Deal aims to double the CMUR to 24% by 2030, but the European Environment Agency considers this unlikely to be met, noting that the required annual increase exceeds the total progress achieved over the past 14 years.[8]

For CRMs specifically, the picture is particularly stark. Recycling rates vary enormously across materials. Some widely used metals perform relatively well – copper at 55%, tungsten at 42%, aluminium at 32% – but most CRMs critical for clean energy and high-tech applications have lower, and some negligible, recycling rates.[9] A 2026 report by the European Court of Auditors found that of the 26 CRMs deemed essential for the energy transition, 10 are not recycled at all (e.g. lithium, gallium and silicon metal) and seven have recycling rates between 1% and 5%, including rare earths.[10] This points to significant losses of CRM-rich waste and end-of-life products that are either exported, stockpiled or landfilled rather than recovered. As a result, the Court concluded that the CRMA's 2030 recycling targets are unlikely to be met under current conditions, reflecting deep structural constraints.[11]

Successive reports and monitoring exercises have pointed to persistent regulatory, economic and market barriers. Current EU waste legislation is deemed largely insufficient to incentivise CRM recovery.[12] Most EU recycling and recovery targets (e.g. the WEEE Directive, the Waste Framework Directive and the CRMA) are input- or mass-based, focusing on how much waste is collected or treated without differentiating between specific high-value materials, and there is no incentive for recyclers to recover individual CRMs that are harder to extract or present in small amounts. The Batteries Regulation stands out as the notable exception, as the only EU legislation that introduces binding, material-specific recovery targets for CRMs, alongside recycled-content requirements and battery passports.[13] Moreover, regulatory fragmentation across Member States poses barriers to the cross-border circulation of waste and secondary raw materials within the Single Market. [14]

Market and economic barriers reinforce these challenges. Virgin materials often remain cheaper than recycled alternatives, circular business models face higher upfront costs and uncertain returns, and significant volumes of CRM-rich waste continue to leak out of the EU economy through exports or landfilling.[15]

Taken together, these barriers undermine the business case for investing in circular value chains in the EU, creating a vicious circle in which low collection and recovery volumes prevent economies of scale, which in turn keep costs high and discourages further investment.

Yet the strategic case for overcoming these barriers has never been stronger. Improving CRM circularity would simultaneously advance the EU's core strategic priorities – decarbonisation, industrial competitiveness and economic security (Figure 1).[16]

Figure 1. Why circularity of CRMs matters for the EU

Decarbonisation	Circularity reduces the environmental footprint of CRM supply chains. Mining accounts for ~8% of global greenhouse gas (GHG) emissions (expected to rise with demand), contributing to pollution, water stress, biodiversity loss and pressure on local communities.[17] Recycling CRMs is often far less energy intensive than primary production, helping cut upstream emissions and energy costs. This is especially relevant for the EU, where high energy prices have eroded competitiveness in energy-intensive sectors.
Economic security	Circularity reduces the EU's dependence on external suppliers and buffers against supply disruptions. The EU is over 80% import dependent for 22 CRMs, exceeding 90% for materials like magnesium and refined rare earths. Supplier countries are increasingly imposing export restrictions, directly affecting EU supply chains through price spikes, shipment delays and heightened uncertainty.[18]
Competitiveness	Circularity improves access to critical inputs and alleviates supply chain constraints. EU demand for most CRMs is projected to rise sharply, yet access to key commodities is cited as a major business obstacle for many EU companies.[19] Strengthening domestic circular value chains reduces exposure to volatile global commodity markets and price manipulation by dominant suppliers, while creating jobs in the struggling European recycling sector.

Recognising both the costs of inaction and the scale of the opportunity, the European Commission has placed circularity at the centre of its industrial strategy, with a series of recent and upcoming initiatives signalling a new level of ambition.

3. The turn to circularity: key EU measures targeting CRMs

Since the adoption of the Clean Industrial Deal in February 2025, the European Commission has moved quickly to translate its commitment to circularity into concrete policy. The CID frames circularity as an instrument of industrial competitiveness and strategic autonomy, projecting the European remanufacturing market to grow from €31 billion to €100 billion by 2030 and create 500,000 jobs, and committing the EU to doubling its circular material use rate from 12% to 24% by 2030.[20]

Several sectoral initiatives targeting CRM-rich waste streams have followed. While the Steel and Metals Action Plan establishes the importance of circularity in decarbonising and strengthening the competitiveness of energy-intensive industries, such as steel and aluminium, the RESourceEU Action Plan focuses on CRM supply security, targeting strategic waste streams such as permanent magnets, waste lithium-ion batteries, black mass and aluminium scrap, and was accompanied by a proposal to amend the CRMA.[21]

The most ambitious element, however, is still to come. The Circular Economy Act (CEA), expected in 2026, seeks to address the structural barriers that have held back progress by facilitating the movement of waste and secondary raw materials, increasing the supply of high-quality recycled materials while stimulating demand.[22] Unlike earlier circular economy action plans, which were framed primarily as environmental policy, the CEA is positioned more strategically as an instrument to increase the 'EU's economic security, resilience, competitiveness and decarbonisation' – a shift reflected in its governance, with oversight from executive vice-presidents responsible for both industrial strategy and the clean transition.[23]

Rather than providing an exhaustive inventory of these instruments, this section highlights key developments across four pillars of action, showcasing how circularity has become central to the EU's CRM strategy (Figure 2).

Figure 2. Key pillars of the EU's CRM circularity agenda

Facilitating cross-border flows Remove single market barriers so waste and secondary materials can circulate freely across Member States. *e.g. harmonised EoW criteria and EPR schemes, WSR digitalisation and 'green listing'*	**Boosting recovery and demand** Strengthen CRM recovery from priority waste streams and create pull for secondary materials. *e.g. WEEE directive review, e-waste levy, recycled-content targets and digital product passports*
Retaining materials Ensure availability of secondary raw materials in the EU by reducing leakages and restricting exports of strategic CRM-rich waste streams. *e.g. WSR restrictions to non-OECD countries, hazardous waste classification (black mass), restrictions on permanent magnets and aluminium scrap, and CN subcodes*	**International cooperation** Engage trading partners on circular value chains and diversify supply through strategic partnerships and cooperation frameworks. *e.g. circularity provisions in FTAs, CTIPs, CRM strategic partnerships and projects*

Source: author's analysis

3.1. Facilitating the cross-border flow of waste and secondary raw materials

The single market for waste and secondary raw materials remains deeply fragmented, a structural weakness that both the Draghi and Letta reports identified as a priority barrier.[24] Divergent interpretation and implementation of EU waste laws by Member States, and the different valorisation of industrial waste or by-products across countries and industries, hinder the cross-border movement of waste and secondary raw materials in the EU, increase compliance costs and limit the development of integrated recycling value chains.[25]

For CRM-rich waste streams, this fragmentation is especially consequential. CRMs are typically embedded in complex products at low concentrations, making their extraction technically challenging and cost intensive.[26] Recycling them profitably requires large, specialised facilities with predictable access to sufficient volumes, precisely the economies of

scale that cross-border barriers prevent. Without the ability to aggregate feedstock across Member States, strategic materials such as black mass and permanent magnet scrap are either exported outside the EU or left unrecovered.[27] The forthcoming Circular Economy Act is expected to tackle some of the most consequential barriers.

The first is the fragmentation of **end-of-waste criteria**, the rules determining when recovered materials cease to be classified as waste and can circulate as products. EU-wide criteria exist for only a few materials (iron, steel, aluminium and copper scrap), leaving all others subject to 27 divergent national regimes. A material classified as a secondary raw material in one Member State may be treated as waste in another, blocking cross-border trade and creating legal uncertainty for recyclers and investors. The CEA is expected to create harmonised criteria for additional materials, although it remains unclear whether CRM-rich waste streams will be prioritised.[28]

The second is the fragmented implementation of **Extended Producer Responsibility (EPR)** schemes. EPR is a practical application of the polluter-pays principle, under which producers bear financial and organisational responsibility for the management of their products at end of life. While EPR is mandated under EU waste legislation for a number of CRM-rich products (e.g. the WEEE directive and the Batteries Regulation), its design varies widely across Member States, with differing registration requirements and fee structures. The European Commission's WEEE Directive evaluation identifies this lack of EPR harmonisation as a key shortcoming, leading to gaps in enforcement and limiting the volume and quality of e-waste recycling.[29] The CEA is expected to introduce a degree of harmonisation by establishing minimum EU-wide rules on aspects such as fee modulation and registration requirements, but the scope and ambition of this harmonisation is yet to be seen.

The third concerns the movement of waste within the EU under the **Waste Shipment Regulation (WSR)**. Although the WSR was recently revised, administrative burdens and divergent interpretations persist, preventing materials from reaching the most specialised recycling facilities and leaving around 90% of waste being treated in the country where it is generated.[30] The European Commission is seeking to digitalise procedures and consider the 'green-listing' of certain types of CRM-rich waste to simplify intra-EU shipments for recovery.[31]

3.2. Boosting CRM recovery and stimulating demand for secondary materials

Beyond removing barriers to waste circulation, the EU is increasingly focused on strengthening the recovery of CRMs from priority waste streams and creating demand for secondary materials. These are two sides of the same coin: without improved collection and recovery, there is insufficient supply of secondary CRMs; without demand-side pull, there is no business case for investing in collection and recycling capacity.

On the **recovery side**, the most significant gap lies in e-waste (i.e. end-of-life electrical and electronic equipment), the fastest-growing waste stream in the EU and a major untapped source of CRMs.[32] E-waste already contains around one million tonnes of critical raw materials in the EU alone, a volume expected to roughly double by 2050. Yet only

one-third of e-waste is formally collected, collection rates remain well below the WEEE Directive's targets and less than 1% of rare earth elements are currently recovered.[33] Current e-waste rules set overall collection and recycling targets but do not incentivise or mandate the extraction of specific high-value CRMs, leaving recyclers little reason to invest in recovering materials that are harder to extract or present in small amounts. A revision of the WEEE Directive, expected as part of the CEA, is intended to address shortcomings in the current rules.[34] In parallel, the European Commission has proposed a fiscal incentive to improve collection rates. Under the proposed Multiannual Financial Framework (MFF) for 2028–2034 – the EU's next seven-year budget under negotiation – a new own resource would impose a levy of €2 per kilogram on uncollected WEEE in each Member State.[35]

On the **demand side**, the lifecycle regulatory instruments introduced under the European Green Deal serve a dual function. By making products more durable, repairable and easier to disassemble, instruments such as the ESPR and the Batteries Regulation reduce recovery costs and improve the quality of recovered materials. At the same time, by introducing binding recycled-content requirements, they create guaranteed markets for secondary CRMs, which otherwise struggle to compete with cheaper virgin inputs. The Batteries Regulation requires minimum recycled content for cobalt (16%, rising to 26%), lithium (6%, rising to 12%) and nickel (6%, rising to 15%) for new batteries placed on the EU market from August 2031, with higher thresholds applicable by 2036.[36] Delegated acts under the ESPR will introduce product-specific requirements for priority sectors, including iron and steel (1st priority) and aluminium (2nd priority), potentially including recycled-content targets.[37] Proposed amendments to the CRMA seek to count both pre- and post-consumer waste in recycled-content calculations for permanent magnets.

Moreover, traceability and disclosure requirements seek to provide recyclers with the information on material content and origin needed to target high-value CRM-rich components. These include digital product passports under the ESPR, battery passports under the Batteries Regulation and new labelling and disclosure obligations for products containing permanent magnets under the proposed CRMA amendment.

Broader **enabling measures** seek to scale up capacity and de-risk investment. The RESourceEU Action Plan announces support for strategic recycling projects and trans-regional recycling hubs, dedicated innovation funding, the creation of a European CRM Centre, and a commitment to create lead markets for circular products through public procurement.[38]

3.3. Retaining CRMs in the EU by restricting exports and preventing leakage

A defining feature of the EU's emerging circularity strategy is an increased focus on retaining waste and secondary materials within the Union, through a combination of export restrictions and strengthened monitoring of waste flows.

Significant volumes of high-value, CRM-rich waste currently leave the EU through legal exports, misclassification or illegal shipments, depriving domestic recycling industries of feedstock and undermining investment in processing capacity. EU waste exports have risen

roughly 75% since 2004, reaching approximately 33 million tonnes annually, with nearly half directed to non-OECD countries.[39] EU aluminium scrap exports reached a record 1.26 million tonnes in 2024, over 50% higher than in 2019, with much of it flowing to Asia, while ferrous scrap exports have averaged around 19 million tonnes per year.[40] In response, the EU has developed a layered set of measures, drawing on environmental and waste law, as well as trade policy tools, to keep CRM-rich materials within its borders.

The first layer is the Waste Shipment Regulation (WSR), which governs the cross-border movement of waste and provides the baseline framework for restricting outflows. The WSR was recently overhauled to address the environmental and health risks of waste being exported to countries lacking the capacity to manage it safely. From May 2027, exports of non-hazardous waste to non-OECD countries will be prohibited unless those countries can demonstrate environmentally sound waste management equivalent to EU standards. This represents a significant tightening that will cut off a major channel through which CRM-rich waste currently leaves Europe.[41]

Building on this framework, the European Commission has begun reclassifying specific CRM-rich waste streams to trigger more stringent export requirements. **Waste lithium-ion batteries and black mass** were classified as hazardous waste (effective September 2026), prohibiting their export to non-OECD countries.[42] The European Commission framed the rationale as dual: environmental protection through better shipment controls, and strategic autonomy by securing critical battery materials for domestic recycling. The European Commission's Joint Research Centre estimates that 50-65% of EU-generated black mass could already be processed domestically, yielding up to one million new electric vehicle battery packs per year.[43] It is estimated that China controls over 85% of global black mass refining capacity.[44]

Similar logic underpins the measures on **permanent magnets**. The European Commission is expected to propose measures to keep permanent magnet scrap within the EU by mid-2026, ensuring feedstock access for EU recyclers, which could produce approximately 3,800 tonnes of rare earth permanent magnets (roughly 20% of current EU demand) if provided with adequate supply.[45] To enforce these measures, the European Commission is developing dedicated subcodes under the Combined Nomenclature and the European Waste Catalogue, as permanent magnet scrap currently lacks a customs code that would allow trade flows to be monitored.[46]

For **aluminium scrap**, the European Commission is expected to announce targeted measures to address global imbalances and ensure that European smelters retain sufficient access to essential feedstock.[47] Unlike the previous measures, which rely on waste classification and the Basel Convention framework, the aluminium scrap initiative is being developed as a new standalone trade instrument. The European Commission launched a targeted public consultation in December 2025, with export duties and tariff rate quotas under consideration.[48] This distinction is significant: much aluminium scrap that meets end-of-waste criteria is legally classified as a product, placing it outside the scope of the Waste Shipment Regulation, requiring trade policy instruments to regulate outflows.[49] Similar measures for copper scrap could also be considered following further monitoring.

3.4. International cooperation on CRM circularity

The EU's circularity agenda also has an international cooperation dimension, with the European Commission engaging with trading partners on CRMs through a range of instruments, including trade agreements, strategic partnerships on raw materials and ad hoc bilateral initiatives.

Circular economy provisions have gradually entered the **EU FTAs**, though they remain largely framed in soft, non-binding language, and are included across different chapters, with no dedicated circular economy chapter or annex in any agreement to date.[50] While earlier agreements were almost entirely silent on circularity, more recent ones have introduced specific features illustrating how trade policy could support circular value chains: from provisions on remanufactured goods (EU-Vietnam) and market access for recycling services (EU-Singapore), to circular economy commitments in sustainability chapters (EU-New Zealand and EU-India) and the inclusion of secondary raw materials within the scope of a dedicated raw materials chapter (EU-Chile).[51]

Beyond trade agreements, the EU engages with trading partners on CRMs primarily through **strategic partnerships on raw materials**.[52] However, these partnerships remain primarily oriented towards diversifying and securing primary CRM supply. An analysis by the European Court of Auditors found that the roadmaps underpinning these partnerships prioritise geological exploration, research and innovation, and skills development, rather than recycling, secondary material recovery or circular economy cooperation.[53] The same pattern is visible in the **CRMA's strategic projects**, where all 13 projects located outside the EU target mining and processing – none focus on recycling.[54]

New instruments have nonetheless emerged that could, in principle, open the door to further international cooperation on circularity. The **Clean Trade and Investment Partnerships (CTIPs)**, presented under the Clean Industrial Deal as the external arm of the EU's industrial strategy, are designed to foster regulatory cooperation on, among other things, 'circularity [and] decarbonisation standards'.[55] However, the first – and so far only – CTIP, concluded with South Africa in March 2025, does not reference circularity in its text, and whether cooperation on circular value chains will materialise during implementation remains to be seen.[56] The EU has also begun to engage partners through broader **ad hoc cooperation frameworks**, such as the EU–India Resource Efficiency and Circular Economy Partnership, with a recently established joint working group on circular economy.[57]

The forthcoming export restrictions on permanent magnet scraps also carry an international dimension, as the European Commission has explicitly committed to designing these measures 'taking due account of its international obligations and partnerships with third countries', potentially opening the door to new forms of bilateral cooperation on secondary material flows.[58]

While these developments suggest a growing recognition that circularity must be part of the EU's international engagement, with new tools emerging that could facilitate cooperation on circularity, much of this agenda remains largely untested and comparatively underdeveloped vis-à-vis measures discussed in the previous sections. The EU's CRM diplomacy continues to prioritise securing primary supply, and significant untapped potential exists for the EU to engage trading partners on circular value chains.

4. Taking stock: a maturing agenda with blind spots

The measures examined in the previous sections signal a notable evolution of the EU's circularity agenda for CRMs, one that is more coordinated, more strategically oriented and broader in scope than anything that preceded it. Yet this maturing agenda is not without significant blind spots. This section takes stock of what the current approach gets right before examining two areas where limitations and trade-offs deserve close attention: the structural constraints on what recycling alone can achieve, and the external implications of the EU's growing use of circularity as a resource-security tool.

4.1. A more coherent and strategic approach

Several elements of the EU's emerging approach to circularity in CRMs represent genuine advances. The increasing coordination of funding, strategic projects and regulatory reform – notably through sectoral action plans and the forthcoming Circular Economy Act – offers a significantly more coherent and sector-specific policy architecture than earlier circular economy initiatives, which suffered from fragmentation and a lack of strategic prioritisation.[59]

Efforts to create a functioning single market for secondary raw materials, through harmonised end-of-waste criteria and EPR schemes, and streamlined waste shipments, seek to address structural barriers that have been identified for over a decade. These are, in many respects, the low-hanging fruit of the EU's circularity agenda; if delivered, they would represent a precondition for making CRM recycling commercially viable at scale. At the same time, the combination of supply-side measures seeking to improve collection and recovery of priority waste streams, with demand-side pull through recycled-content mandates and green public procurement, also reflects a more systemic understanding of the conditions needed to build viable circular value chains than earlier frameworks, which focused predominantly on waste management.

The move toward a lifecycle approach is also a step in the right direction. Regulatory measures like the ESPR and the Batteries Regulation have begun to embed circularity upstream, addressing durability, repairability and material traceability at the design stage. However, these instruments remain the exception rather than the norm, and their scope is limited to certain product groups. Moreover, the effectiveness of ESPR will depend on the ambition of forthcoming product-specific requirements.

4.2. The limits of a recycling-centred strategy

The circular economy, as conceptualised in the literature, rests on 'narrowing, slowing and closing' material loops by reducing material intensity, extending product lifetimes and recovering end-of-life materials. Yet the EU's current CRM strategy emphasises the third of these while giving comparatively limited policy attention to the first two.

The EU's material footprint remains stubbornly high at approximately 14 tonnes per capita – significantly above planetary boundaries – with waste generation at around five tonnes per capita annually.[60] Yet there are no binding targets for reducing absolute material consumption, and the policy framework does not yet systematically incentivise reuse, remanufacturing or material substitution for CRM-rich products. As the European Environment Agency has warned, substantial resource-use reductions cannot be achieved by recycling alone. [61]

Even within a recycling-centred approach, structural constraints limit what can realistically be achieved. Many CRM-rich products now being deployed, from EV batteries to wind turbines and permanent magnets, have long operational lifetimes of 10-25 years, meaning the CRMs embedded in products placed on the EU market today may not become available for recycling for one to two decades.[62] As EU demand for lithium is projected to grow 12-fold by 2030 and rare earths six- to seven-fold by 2050, recycling cannot be a near-term substitute for primary supply.[63] UN estimates suggest that, with existing infrastructure and technologies, recycling could meet only around 20% of total mineral demand between now and 2050, partly because the pace of the energy transition is accelerating faster than end-of-life materials become available.[64] Moreover, literature suggests that increased domestic recycling of metals and minerals generally does not reduce primary imports, indicating that recycling supplements rather than substitutes for the virgin supply.[65]

While initiatives such as the CRM Substitution Act expected by the end of 2026 and upstream lifecycle requirements under the ESPR and Battery Regulation are welcome steps, without stronger incentives to extend product lifetimes, optimise resource efficiency and reduce overall consumption, the EU risks treating circularity primarily as a downstream supply-security strategy rather than as a tool for the systemic transformation that a genuine circular economy demands.[66]

4.3. External implications: toward circular resource nationalism?

The EU's circularity agenda raises questions that extend well beyond its borders. As discussed, the international dimension of the EU's circular strategy for CRMs remains comparatively underdeveloped, with CRM diplomacy still primarily oriented toward securing primary supply. Yet the domestic measures the EU is pursuing – export restrictions, eco-design requirements, recycled-content mandates and waste reclassification – are not without external consequences.

The growing use of export restrictions deserves particular attention. Curbing exports of waste that importing countries cannot manage safely is a longstanding objective of EU environmental policy, and the tightening of the Waste Shipment Regulation responds to well-documented concerns about hazardous and non-hazardous waste being dumped in countries with inadequate treatment infrastructure. However, not all secondary material flows raise the same concerns. Materials such as ferrous scrap are valuable industrial inputs that contribute directly to decarbonisation in importing countries.

The EU remains the world's largest exporter of ferrous scrap, and several countries depend heavily on these flows for their industrial base and decarbonisation objectives. Countries including Turkey, Egypt, Malaysia and Thailand rely on scrap imports for more than 30% of their total steel production, while India's rapidly expanding electric-arc furnace sector depends significantly on imported scrap – particularly from the EU – to pursue its own decarbonisation goals.[67] Restricting these outflows may deprive lower- and middle-income countries of feedstock needed to develop local recycling industries and decarbonise energy-intensive sectors.[68] At the same time, emerging EU circularity standards, such as eco-design and traceability requirements, and recycled-content mandates, may function as de facto barriers for producers in developing countries lacking the infrastructure or technical capacity to comply.[69]

Without proactive international engagement, the EU's circularity agenda risks reinforcing a 'circular divide' in which industrialised economies accumulate secondary resource wealth while lower-income countries remain locked into primary extraction and commodity dependence.[70] Indeed, industrialised countries possess a significantly larger 'urban mine' – vast stocks of materials accumulated in infrastructure, products and buildings over decades of industrialisation – which gives them a structural advantage in the circular economy that lower- and middle-income countries cannot replicate. By retaining and recirculating these materials domestically, high-income economies are in effect keeping resources that often originated from extraction in developing countries, perpetuating an unequal global distribution of material wealth.[71] If the circular transition is shaped predominantly by resource-security interests, it risks reproducing the inequalities of the linear model it purports to replace.

At the same time, this approach also carries risks for the EU itself. The Union remains structurally dependent on imported primary CRMs and needs access to third-country markets for its clean-tech exports. An overtly inward-looking circular economy agenda could invite retaliatory measures from trading partners, complicate the EU's own CRM diplomacy and undermine the strategic partnerships it has worked to build.

The EU is not alone in this reorientation. Rather than treating circularity primarily as an environmental objective, a growing number of major economies are integrating circularity into their critical minerals strategies with comparable supply-security motivations: the UK targets 20% of CRM demand from domestic recycling by 2035; South Korea aims for 20% for 10 strategic minerals by 2030; Japan has set material-specific targets including 70% for lithium and 95% for nickel and cobalt; and India has launched a National Critical Minerals Mission with dedicated recycling incentives.[72] This convergence has been

characterised by Chatham House as a shift toward 'circular resource nationalism' – a policy paradigm in which countries prioritise sovereign control over secondary materials through domestic recycling targets, state support for recycling industries and trade restrictions on scrap and waste.[73] As more countries pursue circular resource nationalism simultaneously, the window for international cooperation on circular value chains narrows, making proactive engagement all the more urgent.

5. Conclusion

Circularity has moved from the margins of the EU's CRM strategy to its core. The policy developments examined in this paper represent the most coordinated effort to date to build a functioning circular economy for CRMs in Europe. By tackling long-standing single market barriers, strengthening CRM recovery from priority waste streams, creating demand-side pull and embedding circularity upstream through eco-design and traceability requirements, the EU is assembling a policy toolkit that is more coherent and more strategically ambitious than anything that preceded it.

Yet, as this paper has shown, the promises of circularity come with significant blind spots. The strategy remains heavily centred on recycling, an approach that faces hard structural limits and cannot, on its own, bridge the gap between surging demand and available secondary supply. The international dimension of the EU's circularity agenda is comparatively underdeveloped, while the growing use of circularity as a resource-security instrument and the increasing number of waste export restrictions carry trade-offs that deserve greater attention.

Navigating these tensions will require action on different fronts. Domestically, it means delivering on the ambitious regulatory reforms now in the pipeline – particularly the Circular Economy Act – while broadening the policy focus beyond recycling to include reuse, remanufacturing and absolute reductions in material consumption. Internationally, it requires embedding circularity in strategic partnerships and trade instruments, and supporting recycling capacity in partner countries. More fundamentally, it means confronting the harder question of the EU's own CRM consumption. A circular economy strategy built primarily around retaining and recycling materials within Europe's borders, without addressing the scale of resource demand or the implications for partner countries, will fall short of both its environmental ambitions and its strategic objectives.

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