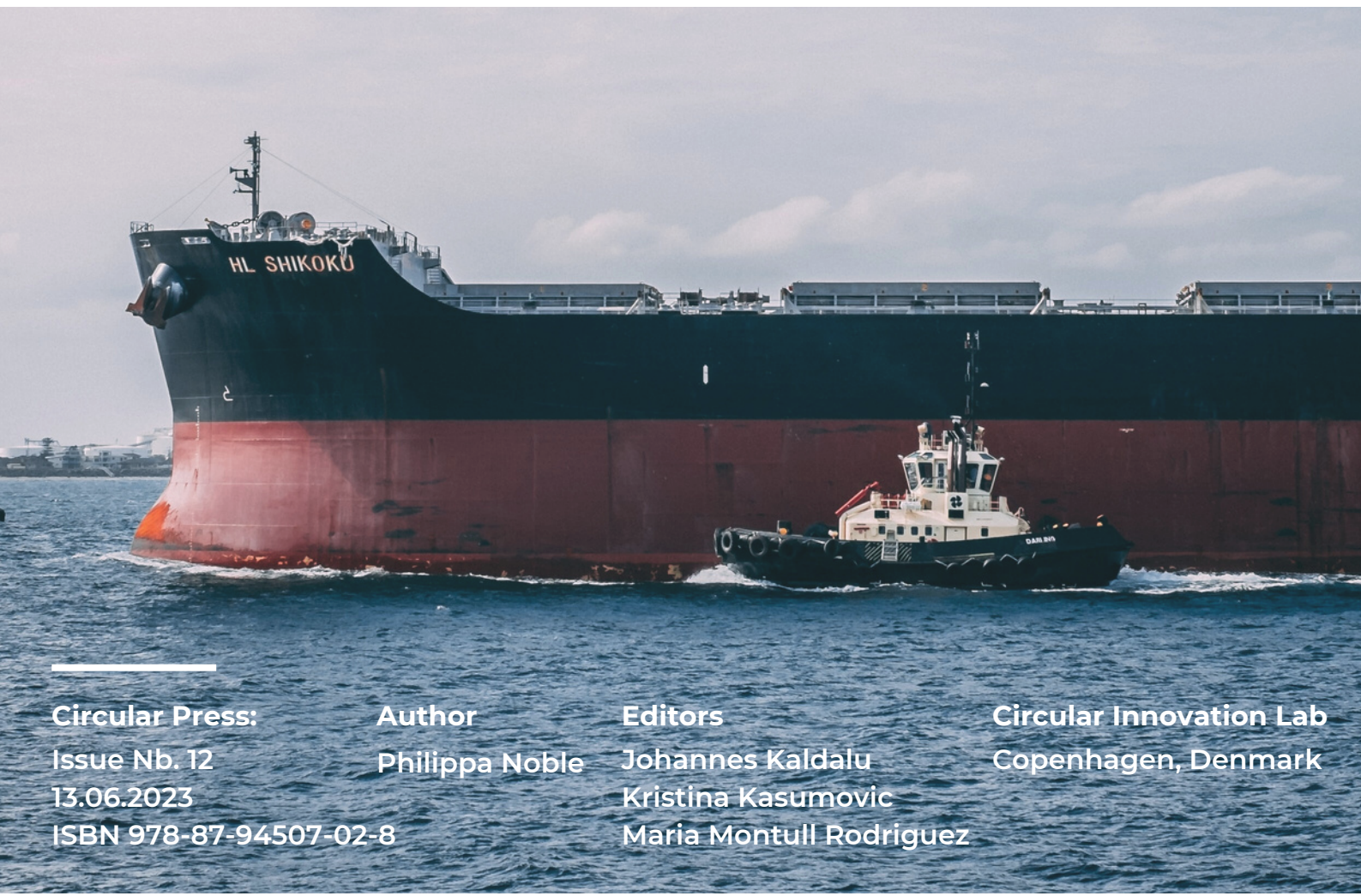


IMPACTS AND OPPORTUNITIES FOR DEVELOPING ECONOMIES UNDER THE EUROPEAN CRITICAL RAW MATERIALS REGULATION

A CIRCULAR ECONOMY VISION



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ABSTRACT

As the world transitions to green energy and greater technology use, critical raw materials (CRMs) are the new frontier of economic and political disputes. The European Union has identified this threat to supply chains, passing the European Critical Raw Materials Regulation to help stabilise European access to CRMs. Published in March 2023, the regulation seeks to improve EU extraction, processing, and recycling capacities with minimal reliance on other states. However, with the limited endowments of the EU in many CRMs, Strategic Projects in third countries will be utilised to ensure EU demand is satisfied.

This paper discusses the possible impacts of this regulation on developing economies: how they will be affected by Strategic Projects, shifting EU import demand, and circularity incentives.



1. Introduction

1.1 The European Critical Raw Materials Regulation

Following over a decade of price and trade stability, recent geopolitical events over the past three years have reminded the globe of the fragile nature of international supply chains. The Russian invasion of Ukraine left Europe without a vital source of cereals and oilseeds, of which Ukraine accounted for 52% of the global market in 2020 (Strubenhoff, 2022). The economic crisis triggered by the outbreak of COVID-19 further reveals the fragility of the international market. Not only did supply chains suffer due to physical issues of quarantine and shipping, but from 2020 to 2021, prices of commodities in the Producer Price Index increased by 9.8% (EUROSTAT, 2022).

With this instability and looming geopolitical threats in mind, the European Commission published the European Critical Raw Materials Regulation (ECRMR) on the 16th of March 2023 to protect its supply of critical raw materials (CRMs - listed in Annex 1). The regulation covers critical and strategic raw materials to ensure supply chains are secure against geopolitical shifts and supportive of the dual green-digital transitions expected in the near future. CRMs here are defined as materials critical for the European Union (EU) due to their supply risk and importance to the EU economy. Strategic raw materials (SRMs) are afforded greater focus within the ECRMR as they are used within strategic sectors such as digital, space, and defence technologies or are considered likely to become supply risks in the near future due to their projected demand growth and the current supply capacities of the EU.

For example, with the digital transition in mind, demand for lithium (used in electric vehicles, batteries, and energy storage) is expected to increase 12-fold by 2030, the ECRMR's planning horizon (Carrara et al., 2023). Lithium demand is further predicted to increase 89-fold by 2050. Physical constraints are not the only supply issues faced by the EU, however. Future political constraints could see CRMs restricted. Particular concerns include the supply of magnesium, 97% of which originates from China currently (European Commission, 2023d).



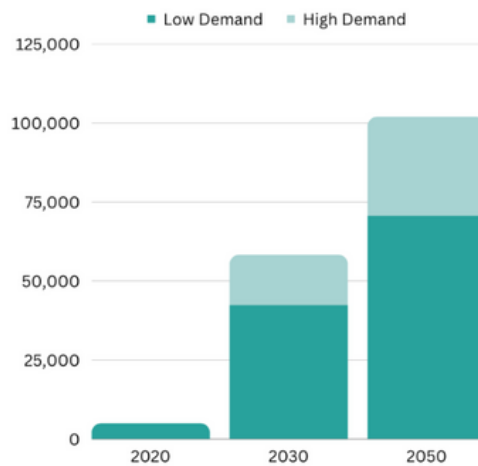


Figure 1: Forecasted demand for lithium in low and high demand scenarios in tonnes.

The ECRMR focuses not only on rare earth metals and uncommon materials, but also materials prevalent in our current economy such as aluminium (or bauxite) and copper. As supply of these more common materials is restricted to a few dominant exporters, the EU has included them on the CRM list to prevent a future bottleneck in supply chains that would significantly impact the EU economy. “Strategic” materials therefore refer to goods that are crucial to supporting the EU economy, whether through the digital transition, stock materials, or regular consumption.

The EU therefore joins the UK and the US in setting out regulations for CRM management to improve internal extraction, processing, and recycling capacities. The ECRMR sets goals for 2030, that:

- 10% of EU consumption must be covered by domestic extraction of CRMs (both through primary material mining and urban mining);
- 40% must be covered by domestic processing, including recycled content;
- 15% must be covered by recycling;
- A maximum of 65% of the EU’s annual consumption of a single SRM should originate from a single third (non-EU Member State) country (European Commission, 2023d).

1.2 The Circular Economy in the EU

The ECRMR continues a line of strong circular policies within the EU. In 2015, the EU published one of the first Circular Economy Action Plans. This was then updated with extended goals and action plans in March 2020. In 2019, the EU also announced the Green Deal - entailing over a trillion euro investment in green jobs and infrastructure. These policies cover union-wide circularity across industries, including: electrical and electronic equipment (EEE), batteries, packaging, plastics, textiles, construction, agriculture, and water. In comparison, the ECRMR focuses solely on circularity in specific supply chains.

The ECRMR utilises circular principles to develop a more strategically sound supply chain for CRMs. The circular economy (CE) employs a new model of sustainable production and consumption that extends the life cycle of products. What would be waste traditionally in our current take-make-waste system is redistributed, reused, repaired, remanufactured, and lastly recycled. Waste outflows therefore become new sources of value in the CE, while input flows narrow as secondary material is fed back into the value chain.

The ECRMR focuses on the final element: recycling. Through this end-of-life processing, value can be retained from used goods: rare metals can be extracted and recycled from electronic goods; aluminium can be recycled from used cans to make new ones instead of relying on the energy-intense process of extracting the metal from bauxite.

1.3 Impacts on developing economies

This paper follows UNCTAD's (2023) definition of developing countries, covering low- and lower-middle-income countries according to the World Bank classification - although, here, using the updated 2023 list. The focus is therefore on economies with a GNI per capita of \$4,255 or less in 2021 (listed in Annex 2).

As a policy focused on international and union-wide supply chains, the ECRMR will necessarily impact the economies currently and soon-to-be supplying the EU with CRMs. Undoubtedly, it will bring about new trade patterns that may harm or benefit third countries by shifting exports from one market to another. Economies reliant on extensive resource exports could suffer from reduced demand. As these economies are often classified as developing, they are unlikely to shift export dependence easily in reaction to the ECRMR. This paper aims to identify the likelihood of risks and opportunities for these economies.

Aside from loss of demand, developing economies could struggle to make use of the new diversified EU supply chain due to an increasing information burden on exporters. Achievement of the ECRMR goals relies on increased labelling, monitoring, and permitting requirements. Therefore, the data requirements of new customs regulations could become a barrier to developing economies in the ECRMR network.

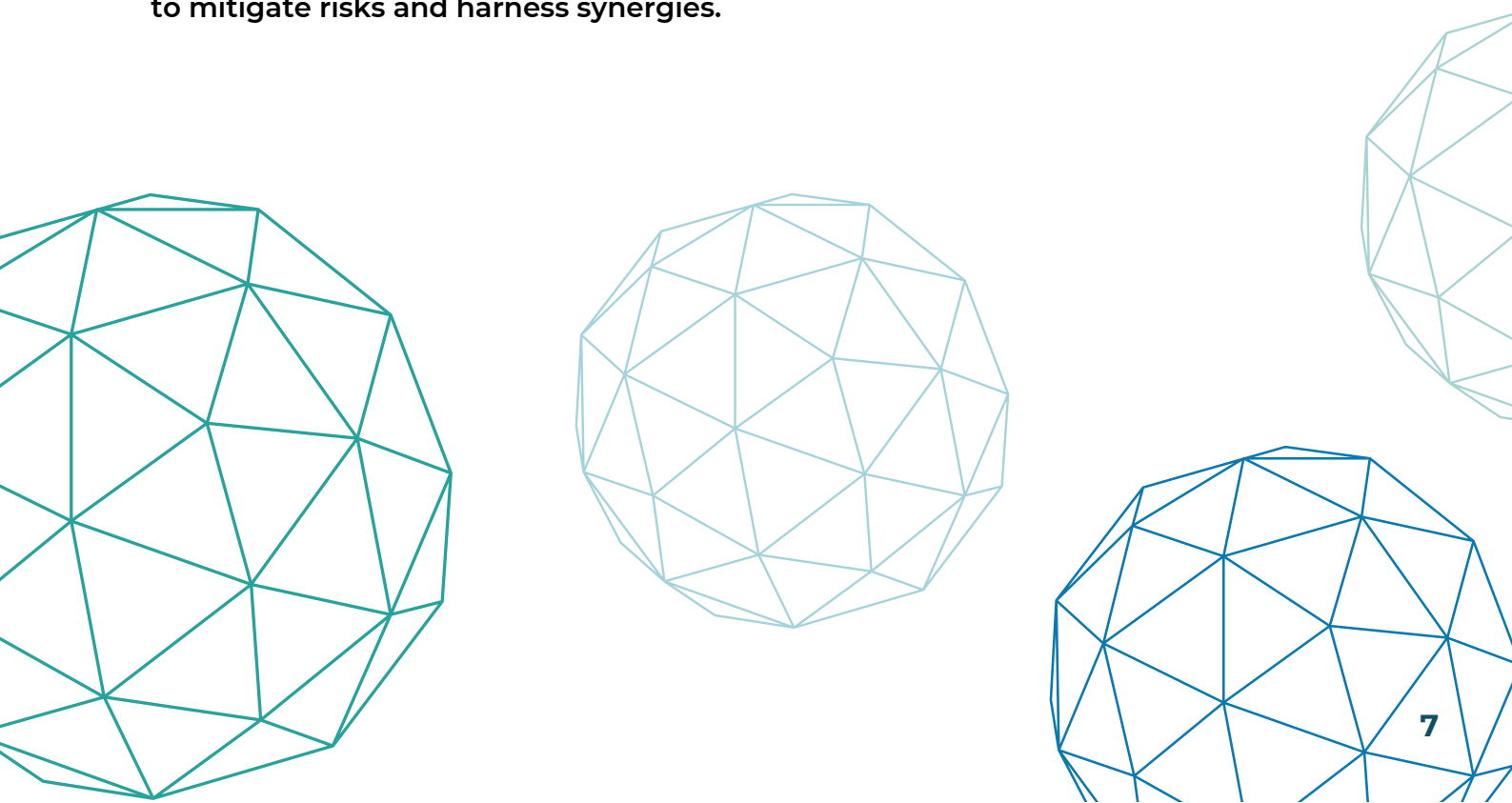
Although the EU aims to reduce reliance on third countries by definition, the ECRMR details how Strategic Projects and Partnerships will be used to supplement the union's capacity for extraction, processing, and recycling. In these "win-win" partnerships, the EU and third countries should enjoy mutual benefits. The EU should gain a more diverse and "like-minded" supply of CRMs; the third country should enjoy new investment from the EU into CRM management infrastructure and research through the EU Global Gateway.

1.4 Scope

Visualisations from resourcetrade.org have been utilised for three representative CRMs to provide a structure for analysis over diverse market types. The database is developed and maintained by Chatham House, using trade data from the Chatham House Resource Trade Database. It includes data on natural resource bilateral trade for over 200 economies. Data used in these visualisations are from 2020. Due to the impacts of the COVID-19 crisis, this could lead to skewed supply chains towards countries with more robust shipping access. However, due to the rapid developments in the use of CRMs and CE and protectionist policies, the base year 2020 was selected as it provides the most recent available statistic (within the resourcetrade.org database) for specific CRM markets.

Market analysis in Section 2 will utilise two sources: SCRREEN (2023) and Carrara et al (2023). The SCRREEN collection has been selected as it is the most complete and up-to-date set of research papers on the identified CRMs, quoting data averaged over 2016-2020 to give a representative statistic. Carrara et al (2023) equally represents the most in-depth study of CRM demand projections to date. Finally, trade impacts in Section 3 have been assessed based on SCRREEN (2023), US Geological Survey data, and resources from the Minerals Education Coalition.

This paper will explore the impacts on developing economies for international relationships and domestic industries and capabilities (in Sections 3 and 4 respectively). Given the circular focus of the ECRMR from the point of view of the European Commission, Section 5 will evaluate the potential impacts of this regulation on the circularity of developing economies and ways in which it could help or hinder the circular economy. Finally, this paper will endeavour to provide robust policy recommendations in Section 6 that will allow developing economies to mitigate risks and harness synergies.



2. Forecasts

2.1 Current State of Play

With the current EU supply chain, identified CRMs and SRMs show heavy import reliance up to 100 per cent. For some CRMs, the primary exporter to the EU covers more than 80 per cent of EU imports. The UK, for example, accounted for 95 per cent of the EU's beryllium imports averaged over 2016-2020 according to SCRREEN (2023). The same country supplied 94% of the EU's scandium imports, with only the US as a secondary importer. Türkiye also exports 93% of the EU's import demand for feldspar.

However, some markets are much less concentrated. EU antimony imports are supplied by 6 states: China, Tajikistan, Vietnam, South Korea, Türkiye, and Thailand - none of which supply more than 52%. EU coking coal imports are similarly accounted for by 6 nations, with a maximum market share of 28%. The copper market is even more crowded, with imports coming from 8 states, each supplying no more than 20% of EU import demand.

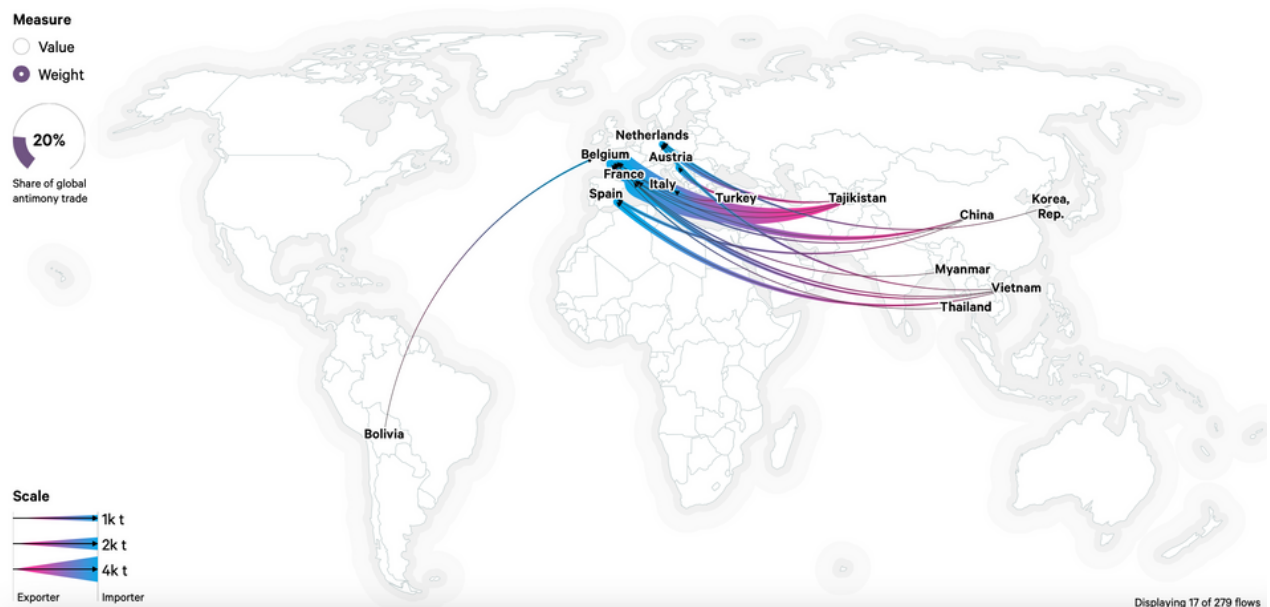


Figure 2: EU Imports of Antimony

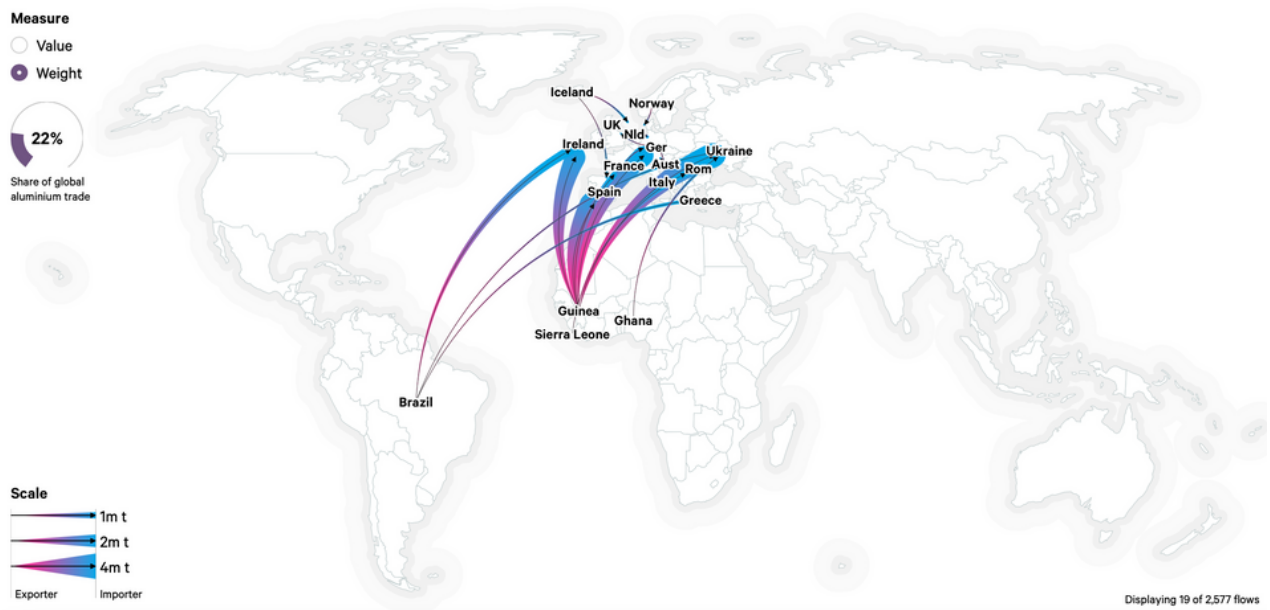


Figure 3: EU Imports of Aluminium (Bauxite)

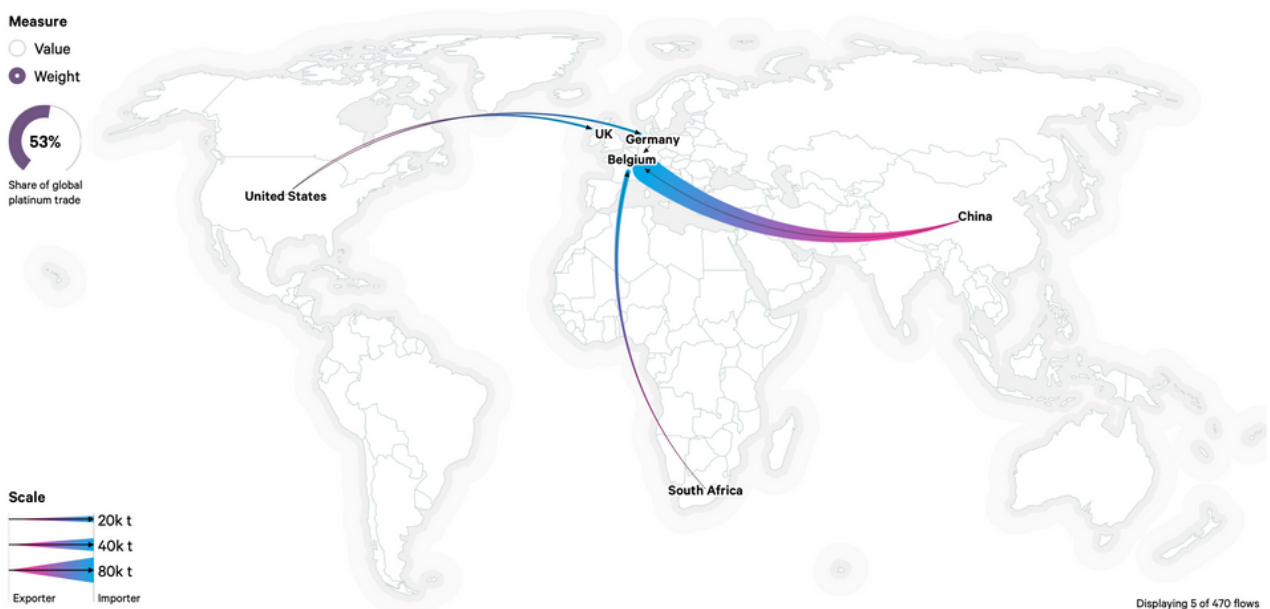


Figure 4: EU Imports of Platinum Group Metals

The figures above (sourced from resourcetrade.org, Chatham House, 2021) visualise the EU imports of various CRMs. This demonstrates the diversity of not only materials included in the CRM and SRM lists, but also of their trade relations. While antimony trade is mostly sourced from developing and emerging economies in South-East Asia (alongside Chinese exports), Aluminium exports emanate primarily from developing economies in Africa. Platinum Group Metals are sourced from diverse regions, but exporters are represented solely by developed economies. This exemplifies the difficulties the methodology faces in analysing impacts on developing economies, given the diversity of global markets accounted for in the ECRMR.

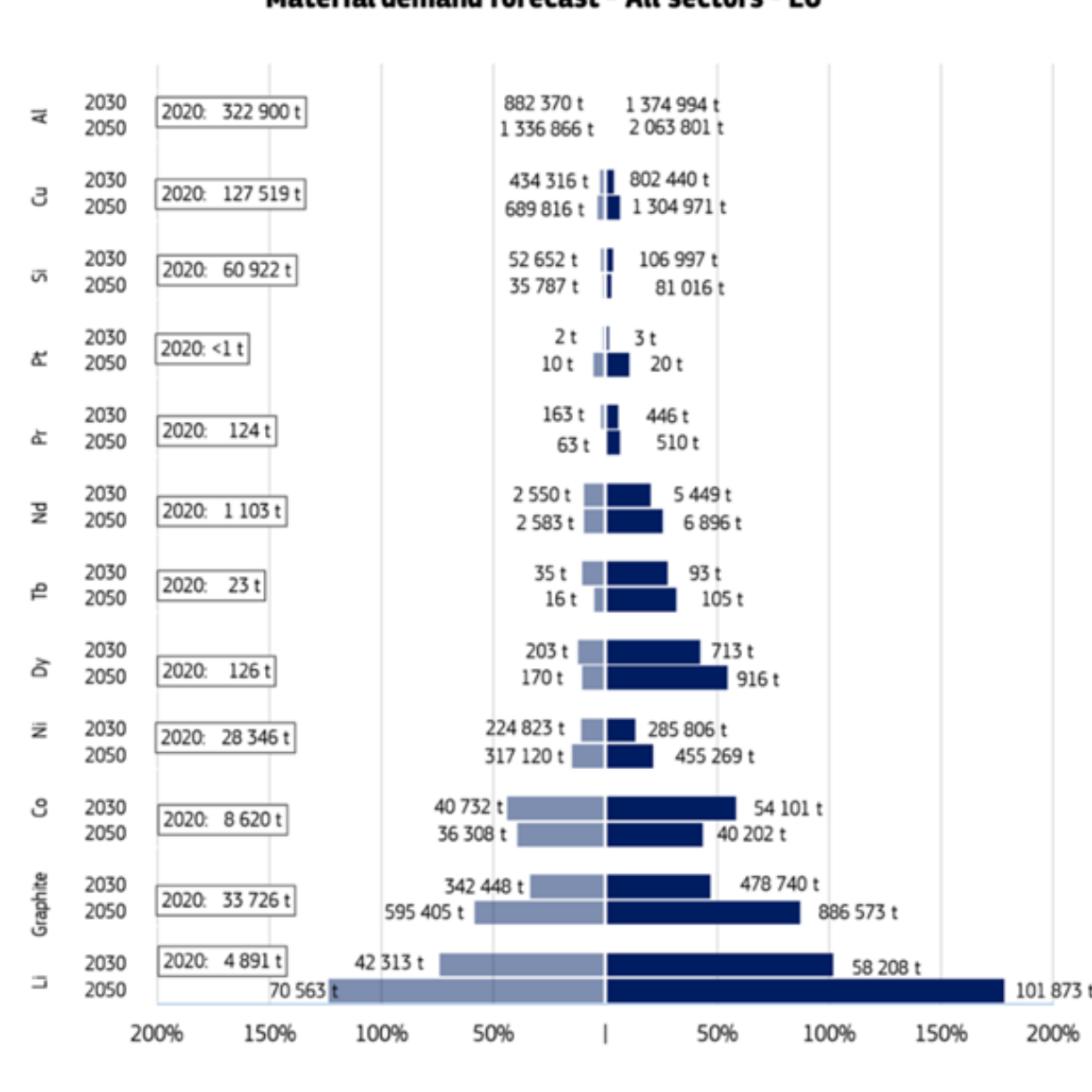
The visualisations, nevertheless, reveal the issues raised by the ECRMR. The dominance of Tajikistan in the antimony market and of China in platinum group metals brings the risk of supply due to dominant suppliers or political relations to the fore. The aluminium market exhibits some dominant supplier risk in the form of Guinea, but future supply is also threatened by EU high reliance on the metal.

2.2 Forecasting

Forecasting demand and international trade flows of CRMs proves even more complicated. For example, with the green energy transition projected to increase demand for wind energy to 165TWh per year in the steel production sector alone, it is clear that demand for wind-energy-enabling CRMs, such as those within wind turbine permanent magnets, will increase (Wind Europe, 2023). Carrara et al (2023) estimate this increase in EU demand for CRMs for permanent magnets to be up to seven-fold by 2050.

At the 2030 horizon of the ECRMR, EU lithium demand is predicted to increase eleven-fold, reaching a level 21 times as large as demand in 2020 by 2050 (Carrara et al., 2023). At the global level, this is expected to reach demand 18 times as large in 2030, or 90 times by 2050. For platinum, global demand shifts are expected to be in line with lithium demand. However, at the EU level, it is predicted that platinum demand will reach 200 times the demand level in 2020. Increasing global demand for lithium will reach 19 times the current global supply by 2050; while global demand for platinum is much more modest, at 0.6 times the current global supply.

The ECRMR primarily depends on European infrastructure or trade links that do not currently exist. Therefore, it can be expected that at least a lag of 3-5 years will precede any significant impacts on international trade and demand substitution into internal markets. Many CRMs, furthermore, are only found outside of the EU, meaning that aggregate demand for raw materials on the international market will likely follow the business-as-usual path.



Source: JRC analysis (Li = lithium, Co = cobalt, Ni = nickel, Dy = dysprosium, Tb = terbium, Pr = praseodymium, Pt = platinum, Si = silicon metal, Cu = copper, Al = aluminium).

Figure 5: Material Demand Forecasts for the EU (Carrara et al., 2023)

3. Trade Impacts

By definition, the ECRMR will have wide-reaching and long-lasting impacts on global trade. As developing economies are more likely to be reliant on resource exports, it is crucial these economies are considered as ECRMR policies are rolled out. Besides basic shifts in trading patterns, the ECRMR is expected to alter export structures of economies involved in CRM markets. In the long run, the reliance of the ECRMR on external Strategic Partnership suggests global markets could gravitate towards a handful of protectionist CRM blocs.

3.1 Trade patterns

At its most basic level, the ECRMR directly aims to shift global trade patterns for CRMs. This will diversify the EU's import portfolio, so no more than 65% of a single CRM is imported from one country. A further goal is to protect CRM supply chains from political disruption (European Commission, 2023b). Imports from countries that are viewed as not politically in-line with the EU will also be reduced as far as possible or reasonable. For example, the Russian oil crisis has revealed the power certain economies hold over the rest of the world. To avoid volatile prices, supply issues, and export bans, the EU aims to reduce imports from economies that could generate geo-political vulnerabilities. Given the high levels of CRM imports supplied by China, which in the past has used market power to restrict access to certain materials, this could constitute one example of a geo-political risk.

Economies affected the most by the ECRMR will likely include:

- a) Significant exporters of CRMs (making up more than 65% of EU demand);
- b) Exporters that risk politically-motivated market disruption for CRMs;
- c) Secondary exporters that could replace the EU imports of the above.

Trade will likely flow from a) and b) exporters to c) exporters.

Annex 3 details the EU import structure of identified CRMs and SRMs, highlighting areas where political and dominant supplier risks could lead to market shifts. Based on data from SCRREEN (2023), the Minerals Education Coalition, and the US Geological Survey, it is possible to isolate where developing countries will face opportunities and risks from these market shifts due to the availability of relevant resource deposits in their territories.

For the most part, CRMs are not currently extracted in significant quantities in developing economies. However, there are possible opportunities within the antimony, arsenic, bauxite, beryllium, bismuth, gallium, natural graphite, niobium, phosphorus, tantalum, and tungsten markets. Specific impacts on developing economies are visualised in Figure 6.

As China supplies the majority of EU imports of antimony (an estimated 52% average over 2016-2020), the ECRMR will aim to shift reliance away from this economy. Current suppliers from developing economies include Tajikistan (supplying 15% of EU imports) and Vietnam (supplying 12%), which stand to gain market share and export demand from shifting EU demand away from Chinese exports. Further, deposits of antimony have also been found in Bolivia, which could enter the EU CRM supply chain here. There are currently no identified risks for developing economies in the antimony market.

The arsenic market as it stands is dominated by Chinese supply, accounting for 93% of EU imports across 2016-2020. Japan and the UK each supply 3.6% and 2.9% of EU import demand for arsenic respectively. Although there is no representation so far of developing economies in EU suppliers, there are arsenic mining sites in both the Philippines and Morocco that could enter the market.

The bauxite (or aluminium) market is dominated by developing economies - which brings both opportunities and risks. Guinea stands as the dominant supplier of bauxite to the EU, supplying 70% of EU imports on average between 2016-2020. This is 5 percentage points above the new target of maximum supply from one country under the ECRMR. Therefore, Guinea will likely lose market share in EU imports. This could be displaced to other developed economy import markets, although will likely lead to a net decrease in Guinean exports of bauxite. In contrast, Sierra Leone provides an estimated 9.7% of EU imports of bauxite. Given the identified dominant supplier risk here, Sierra Leone should gain EU export demand due to its standing trading relationship with the union.

The UK supplies an estimated 95% of EU imports of beryllium, highlighting a significant dominant supplier risk. EU demand could be displaced to other exporters to the EU in this market: namely, the US, and South Africa. However, beryllium deposits in Mozambique could elevate the state to a major player in EU beryllium imports. Further, as the ECRMR has no provisions for a reduction in consumption in CRMs, overall demand is likely to increase which could necessitate new trade partners for beryllium.

Regarding bismuth imports, China supplies an estimated 63% of EU import demand. Both dangerously close to a dominant supplier risk and a previously identified political risk, current exporters in this market are likely to gain displaced EU demand such as: Laos and Vietnam. Deposits of bismuth in Bolivia suggest it could also enter the EU market.

With a 97% import reliance, the EU market for gallium is a severe supply risk. China represents a dominant supplier and political risk, supplying an estimated 80% of EU import demand for gallium. Displaced demand from Chinese exports should bolster the exports of current actors in the EU market: the US and Ukraine.

Currently, Ukraine only supplies 3% of the EU import demand for gallium. With a required reduction in Chinese exports of at least 15 percentage points, Ukrainian exports of gallium could increase dramatically. This is further supported by Ukraine's position as a Strategic Partner for CRMs.

Natural graphite is a surprisingly well diversified import market relative to other CRMs. However, the market share of China (42% of EU import demand) represents a significant political risk. Therefore, demand should be redistributed at least somewhat towards other actors in the market. Mozambique (15% of EU import demand) and Madagascar (6% of EU import demand) could see improvements in their exports to the EU.

Brazil caters to the majority of EU import demand for niobium - supplying an estimated 86% of EU imports in this market. A targeted reduction of Brazilian exports of 21 percentage points under the ECRMR should reallocate EU demand significantly. This will likely primarily be streamlined towards current exporters to the EU such as Canada (an identified Strategic Partner) and Kuwait. However, deposits in Rwanda and Mozambique could introduce these states to the market. The presence of Mozambique in multiple CRM markets could compound their strategic importance to the EU, supporting their interests and potentially improving their likelihood of gaining Strategic Partner status.

The 100% import reliance rate of the EU on phosphorus highlights the market as a key supply risk. Kazakhstan's market dominance, supplying an estimated 70% of EU import demand, suggests secondary exporters to the EU will benefit from the ECRMR. Vietnam, which supplies 25% of EU import demand at present, could see significant increases in its exports of phosphorus.

Tantalum presents a complicated example for developing economies. The current market for EU imports of tantalum is completely supplied by developing economies. As forecasted demand for CRMs in general is increasing exponentially, the business-as-usual scenario reveals significant benefits for tantalum exporters. However, the Democratic Republic of Congo (DRC) has been identified as a political risk due to its weak governance rating which could prevent a stable supply of tantalum (Buschke, 2021). Therefore, it is likely that, without supporting policies, EU demand from the DRC will be redistributed towards Rwanda, Mozambique, Indonesia, Nigeria, and Ethiopia. However, research is currently ongoing for policies to mitigate governance risks, which will be further explored in Case Study 1.

Finally, Chinese exports make up a large portion of the tungsten market - accounting for 31% of EU import demand. As an identified political risk, the ECRMR will likely shift EU demand towards other exporters, either within the current EU trade partners or external deposits.

For developing economies, this refers to Vietnam, Bolivia, and Rwanda. However, as the import reliance for tungsten is 88% (relatively low for CRMs) and Chinese exports only account for a minor portion of EU consumption, impacts in this market are expected to be low for developing countries.

Notably, China oversees 100 per cent of natural graphite processing for batteries as well as 80 per cent of overall rare earth production and processing (Foroohar, 2023). This leaves large gaps in the market for developing economies with sufficient infrastructure to replace these processing plants.

Where there are identified political or dominant supplier risks but no opportunities for developing economies, there are no significant deposits or market presence of these states for that CRM. This could change as exploration efforts increase.

3.2 Export Structure

In the short run, it is unlikely that developing economies will see any shifts in their export structures. The ECRMR allows 3 years for any actions to be taken or goals to be measured (European Commission, 2023d), therefore there is a very low probability of large-scale demand shifts occurring within the next few years.

In the medium run, it is likely that demand shifts will begin, although limited. The ECRMR's goals are ambitious in creating infrastructure that does not currently exist within the EU. However, goals of covering 10% of EU consumption of CRMs with domestic extraction leave much of the market left to play for, if this is even achieved by 2030.

With no future goals outlined, it is difficult to forecast long term impacts on developing economies. This is especially true as the USA and the UK have both published their own versions prior to 2023. Their limited impacts on international trade so far suggest the ECRMR will also likely have minimal impacts. Their existence further implies the international market for CRMs is in a state of flux, so long-term impacts will rely on the development of the market in the next 5-10 years.

Those not in line with EU political beliefs, however, could see large shifts in their export structure. For example, the DRC, which scores very low on the EU governance metric and accounts for a high proportion of EU cobalt imports at the mining stage, will likely suffer export structure shifts under the ECRMR.

Case Study 1: Cobalt Mining in the Democratic Republic of Congo

The EU's green transition relies on the increasing utilisation of lithium-ion batteries and fuels cells.

While lithium-ion batteries, as is expected, demand greater consumption of lithium, fuel cells depend on CRMs such as cobalt, titanium, and platinum. In a medium scenario forecast of EU demand for cobalt, predicted demand reaches 83,418 tonnes by 2030 and 149,372 tonnes by 2050 - more than 8 times and almost 15 times the 2018 recorded demand respectively (Buschke, 2021).

Currently, the DRC supplies 63% of global cobalt consumption (European Commission, 2023e). Buschke (2021) shows the closest alternative exporters, Zambia and Madagascar, supply 10 times less than the DRC. Issues arise within this supply chain as weak governance, and Chinese ownership of many DRC cobalt mines, could prevent a reliable supply of cobalt to importing countries. Furthermore, human rights violations, child labour, unsafe working conditions, and the prevalence of corruption raises questions for the EU's ethical sourcing policies. Nevertheless, recent research shows positive impacts of the Better Mining and Mutoshi Cobalt Pilot Project on these ethical indicators (Mancini et al., 2021).

Therefore, overall, given the resource endowment of the DRC, forecasted shifts in EU demand for cobalt, and lack of other alternatives, political and ethical risks should have limited impacts on EU import demand for DRC cobalt. However, if sufficient deposits are found in other states, the DRC could face significant economic impacts of redirected EU demand. The built-up areas surrounding cobalt mines since 1975 mapped out by the Africa Knowledge Platform suggests that cobalt mining provides an income for a large portion of the DRC's population (Buschke, 2021). Losing this to any extent would have an extreme impact on the DRC's economy.

As the ECRMR focuses not only on current resource endowments but also pushes a new phase of exploration within and outside of EU Member States (for example, in Ukraine), the DRC should prepare for this eventuality and harness the policies recommended by Mancini et al (2021).

3.3 Long Term Trends in Protectionist Policies

In the very long term, developing economies could be affected by multiple Climate Clubs. Both the previous USA and UK CRM policies and the new ECRMR reveal the realities of an increasingly protectionist international market. The publicity the ECRMR has gained over the past few months and its wide-reaching impacts as a policy from an influential trader will only further this trend.

This will either be through its own effects, or through raising political awareness of CRM supply chain fragility.

Strategic Partnerships will exist within EU Member States and with specific corporations in third countries. Therefore, the ECRMR will theoretically avoid dramatic divisions of the global supply chain along borders and political alignments.

However, if all large political entities (from states to political unions) decide to follow in the EU's footsteps, there is a significant possibility that the international market will become divided into areas of economic integration - for example, a series of customs unions. The ECRMR policy document states that preference will be given to potential Strategic Partners who are already currently engaged in a Free Trade Agreement with the EU (European Commission, 2023c).

This concern is only strengthened by the goal to protect EU CRM supply chains from political disruption. Given the dominant political structures have changed only superficially in the last 50 years, one should be concerned for the regrowth of economic imperialism. The title "Scramble for Rare Earths" (Glenny, 2022) does state the situation too strongly.

Political alignments are already being seen under the ECRMR and European Strategic Partnerships. For example, Avellana Gold, one of the presenters at the EU-Ukraine 1st Review meeting in 2022, revealed goals to shift sales focus from China to the EU (Ukrainian Geological Survey, 2022). Africa has been specifically identified as the new boundary for rare earth material extraction (Raimondi, 2021). Chinese restrictions of gallium exports to the US during 2019 disputes over Huawei began the global hunt for unutilised deposits of these materials.

Since then, the US Department of Defence began discussions with Burundi and Malawi for collaborations on rare earth materials projects. Australian firms now have a presence in Tanzania and Malawi with two different rare earth material projects (Ngualla Mining Project) and (Makuutu Project). Further, Japan is involved in similar projects in Namibia and South Africa with the Japan Oil, Gas, and Metals National Corporation (Raimondi, 2021).

In the long term, then, it seems that Africa is the new frontier for CRMs. The continent in general, including many developing economies within it, will benefit from capital investment and increased FDI. However, these states could also suffer yet another era of the resource curse as foreign powers exert political influence across the continent once again.

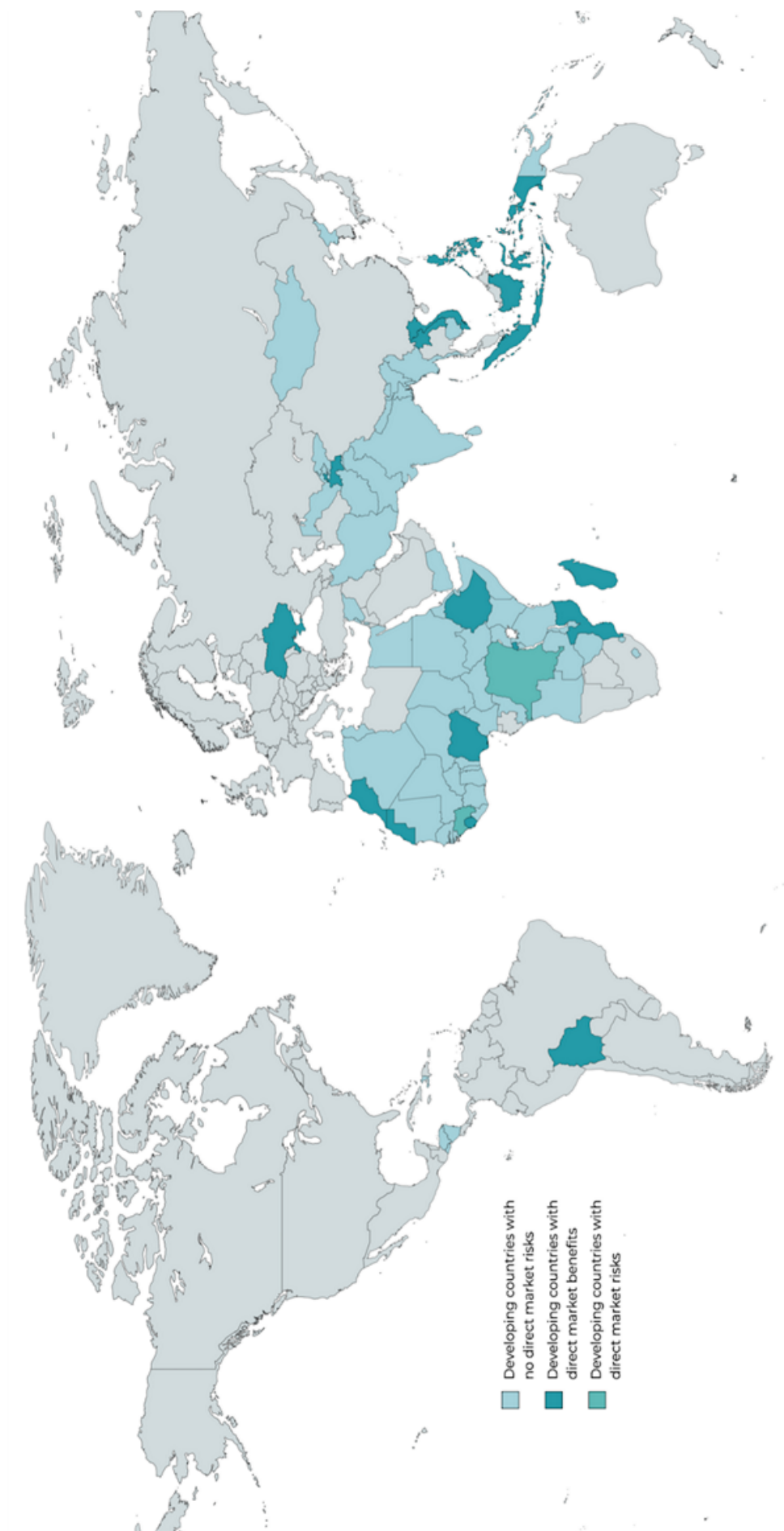


Figure 6: Predicted Trade Impacts of the ECRMR on Developing Countries

4. Domestic Impacts

Shifting global trade will have strong impacts on the domestic capacities of developing economies. Where countries gain from redirected EU demand, especially those benefiting from Strategic Partnerships, developing economies could enjoy significant foreign direct investment into their extraction, processing, and recycling industries. Current EU commitments to investments in Africa suggest benefits could extend past directly related capital and knowledge transfers.

4.1 Building industry capacity

4.1.1 CRM Industry

Strategic Projects and Partnerships laid out in the ECRMR Impact Policy document could lead to significant benefits for developing economies. CRM capital and technological capabilities could develop further with technological, knowledge, and financial transfers from the EU. Current Strategic Partnerships include Canada (2021), Ukraine (2021), Kazakhstan (2022) and Namibia (2022). Negotiations with Norway and Greenland are currently underway. Further, trade agreements with Mexico, the UK, New Zealand, and Chile all include provisions for Energy and Raw Materials trade (European Commission, 2023c). It is important to note, however, that the only developing country here is Ukraine.

Strategic Partnerships at the national level aim to achieve multiple mutually beneficial goals. For developed economies, this includes integrating CRM value chains, cooperation in research and innovation, and further in ESG standards to improve CRM sustainability. For developing economies, the above are supplemented by focuses on capacity building in the third country, and transfers of technology and knowledge to develop the required infrastructure for such projects (European Commission, 2023c).

In the ECRMR Proposal, Strategic Projects in states with ratified Free Trade Agreements or Strategic Partnerships are preferred. The criteria for selection are even more exclusionary for developing economies. Projects would be held to high environmental and social performance standards that could be unattainable within a developing economy context. Projects would also require one or more European companies to commit to purchase a designated amount of production across a specific time period before it could be considered. More specific criteria include the requirement to reinforce “more than one stage of the raw materials value chain” in that state or region; and to be supported by domestic private investment (European Commission, 2023a).

Nevertheless, demand for raw material deposits specifically in developing economies is significant. The ECRMR Proposal details a “Team Europe” approach that would connect the EU, Member States, the European Investment Bank, the European Bank for Reconstruction and Development, and other relevant bodies to bring some CRM projects labelled a “priority” through the Global Gateway programme (European Commission, 2023c). In theory, this would align both parties’ interests to support CRM supply chains and defined goals in third countries - such as sustainable job creation and supporting decent work. The third country’s government has the opportunity to object to EU partnerships within their state, helping to ensure that civil and private interests are aligned.

Strategic Projects claim, therefore, to generate economic value and jobs in each scenario. One mechanism for value creation, for example, is the re-mining of former mining regions, which could boost economic growth through an increase in new jobs. However, initial estimates on job creation are low (with a low estimate of 3,840 direct jobs across all Strategic Projects; or a high estimate of 100,000 direct and indirect jobs with at least 100 Strategic Projects created) (European Commission, 2023c). Covering both Member States and third countries, current impact assessments for third countries appear remarkably low.

The greatest benefit for developing economies is the potential for capacity building and technology transfers. Through the Global Gateway programme, the EU has committed to encouraging and directly investing in knowledge and technology transfers in third countries. The EU-Africa Global Gateway Investment Package has already invested 150bn EUR into multiple projects across industry, science and technology, and environmental pursuits (European Commission, 2022). The ECRMR Proposal and Impact Report both refer to this programme as a way to directly support third country partnerships across the globe. If this is utilised to its fullest, the Global Gateway will enable many more economies to take advantage of the ECRMR’s Strategic Partnerships.

To date, Global Gateway investments have greatly impacted specific developing sectors. Within the digital transition focus, the EU has supported the construction of submarine and terrestrial fibre-optic cables. For example, the Medusa project is working to connect EU Member States and Northern African states with submarine cabling, with aims to extend this to West Africa. Alongside efforts to support economic integration between African states to establish AfCFTA, actions to launch the AfCFTA tariff book and a Rules of Origin system dispels some concerns of negative impacts of trade with EU Member States on economic sovereignty (European Commission, 2022). Further, the EU is already investing in sustainable raw materials supply chains in Africa. Along these lines, the EU is working to develop bilateral agreements with third countries with significant resource deposits to instigate investment into the raw materials value chain as a whole, economic diversification, and local industry.

Through greater investments into the three identified elements of the EU's CRM supply chain (extraction, processing, and recycling), economies eligible for Global Gateway support could see a net improvement in their current account balance. Improved CRM management infrastructure could generate new CRMs exporters with greater processing capacity and newly identified or accessible reserves for extraction. Therefore, it becomes increasingly difficult to evaluate the impact on developing countries in particular. Nevertheless, the inclusion of the Global Gateway programme into the ECRMR's activities supports the notion that the ECRMR could bring more opportunities than risks for developing economies.

Case Study 2: Ukraine as a Strategic Partner of the EU

In July 2021, the EU-Ukrainian Strategic Partnership on Raw Materials and Batteries was launched to enable greater technological transfers and trade between the two political bodies. From this, the EU allocated an additional 750,000 EUR to Ukraine for technical assistance in the development of the CRM and battery industries (Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, 2021). A primary roadmap for 2021-22 resolved to:

- Organise a low carbon plan for the CRM market, with a long-term strategy to decarbonise the CRM industry in Ukraine;
- Support sustainable extraction and processing of CRMs and batteries through public and private sector training in Ukraine;
- Develop greater data management capabilities in Ukraine, including creating a "Data Room" with geological reports and re-assessed reserve data utilising international standards;
- Support new deposit exploration and environmental monitoring with Earth-observation programmes and remote sensing;
- Organise joint-venture projects between EU and Ukrainian actors through Business Investment Platforms.

In 2022, during EU Raw Materials Week, the European Bank of Reconstruction and Development (EBRD) and the Ukrainian Geological Survey signed a Memorandum of Understanding to enable improvements in Ukrainian geodata management. In the same year, the EU and Ukraine agreed to develop a new 2023-24 roadmap to plan progress for the raw materials industry within the state. This Memorandum of Understanding also included funding from the European Investment Bank (EIB) for Ukrainian CRM projects. Following this, the EU funded a study by the Better Regulation Delivery Office (BRDO) titled "Main Barriers and Perceived Risks for Investment in the Ukrainian Raw Materials Resources Sector", generating a detailed evaluation of CRMs in Ukraine and a plan for future investments (Bashniak et al., 2022).

By November 2022, at the EU–UA Strategic Partnership on Raw Materials 1st Review meeting, Ukraine had already developed one advanced investment case with the EBRD alongside three other cases totalling an investment of 500m EUR. In a second presentation, the EBRD revealed their policies for organisation actions, which overall followed free-market guidelines:

- Encouraging privatisation and commercialisation to improve competitiveness and governance;
- Encouraging private sector rule of law and fair competition;
- Utilising efficient regulation, market liberalisation, and diversified industries to support energy security;
- Developing the financial system, including capital markets and non-bank financing;
- Supporting trade and investment, developing infrastructure, and encouraging integration of EU standards (Ukrainian Geological Survey, 2022).

This is likely to put the EU and developing economies on an even more unequal footing, demanding free-market policies from potential and actual trade partners while incubating domestic industries.

However, many of these benefits come with Ukraine's membership in the European Raw Materials Alliance (ERMA). Therefore, although Ukraine is classified as a developing economy, its unique connections to the EU could afford it greater privileges through cultural and geographical similarities. Further, its positioning at the front line of Russian aggression could increase EU desires to connect with the state economically and politically to maintain the buffer between the EU and Russia. Neither of these characteristics are shared with other identified developing economies.

Ukraine also benefits from significant deposits of many CRMs: titanium, coal, lithium, cobalt, germanium, vanadium, fluorspar, natural graphite, phosphate rock, and phosphorus (Bashniak et al., 2022). Developing economies with similar known deposit levels could, therefore, enjoy similar interest and investment into their CRM industries.

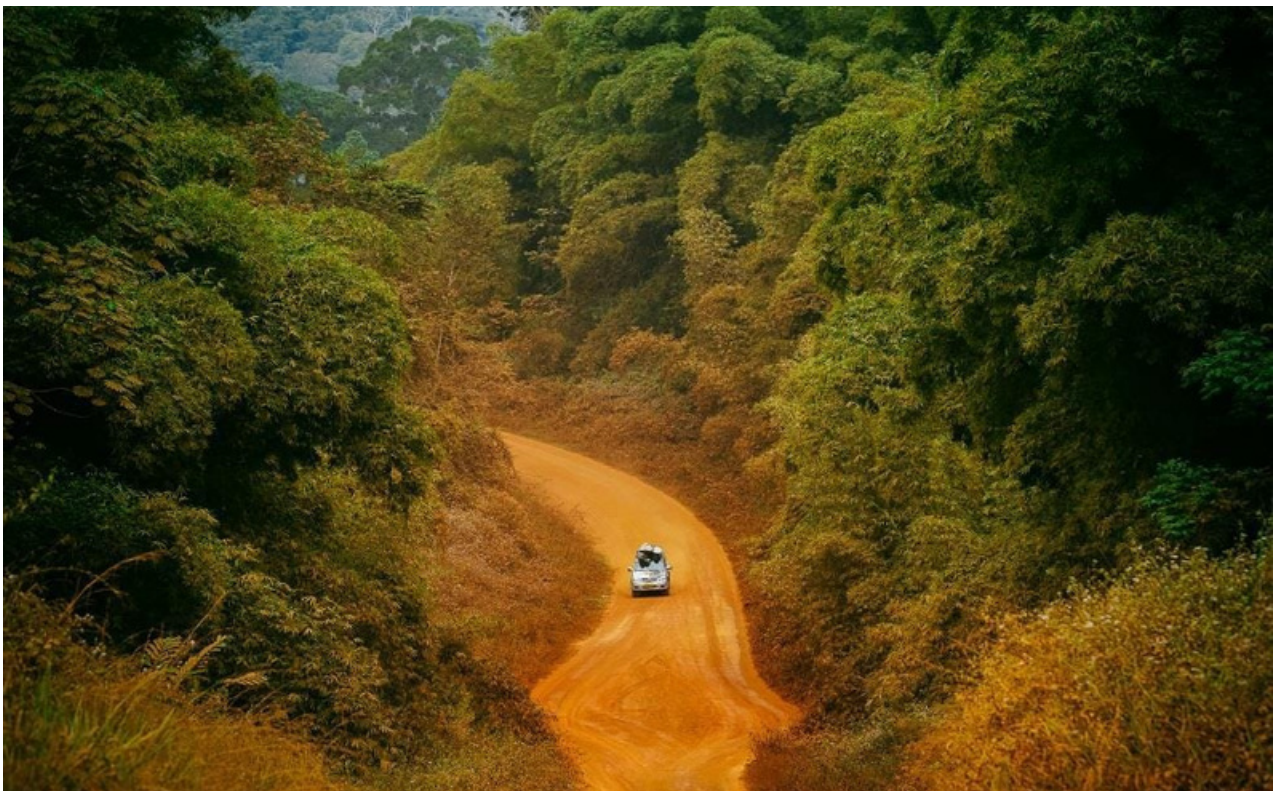
4.1.2 Secondary Industries

Select CRM extraction, processing, and recycling industries in developing economies are set to benefit from Strategic Partnerships both in terms of employment and capacity building - if, that is, industries in developing economies are selected. However, the effects of a relatively more stable CRM supply in the EU could damage secondary industries in developing economies.

One of the benefits for the EU detailed by the ECRMR Impact document is an improved competitiveness in secondary industries - i.e. those that rely on CRMs for production (European Commission, 2023b). With a CRM supply chain that will insulate the EU economy from price and supply shocks that the rest of the world will endure, the EU will enjoy less volatility in secondary industries. It is likely, however, that Strategic Partners will continue to struggle against this supply chain fragility as partnerships are with only the EU, not the entire network.

The ECRMR could set a precedent for global circular supply chains, enabling greater security in CRM price and supply levels. This would essentially nullify the gains in competitiveness for EU secondary institutions in theory. However, gains in global market power are unlikely to dissipate. The EU, therefore, is set to gain in competitiveness even after global systems are constructed.

Currently, the secondary industries for CRMs are not significantly established within developing economies. The EU has identified some of these industries as green technology, telecommunications, aerial imaging, aviation, medical devices, transportation, and defence. However, as developing economies turn to their own digital and green transitions like the EU, they could face significant challenges. With regards to developing these industries, traditional temporary protectionist policies would become impossible due to the insistence of the EU that partnerships follow free market thinking. Infant industries will likely struggle to gain critical mass to compete on the global market without being undermined by EU or other competitors. This becomes an even more extreme long-term impact as economic autonomy in CRM industries is adopted by the global community.



Further, supplying the EU with domestic resource deposits has a long-term cost for developing countries. Critical resources within the economy could become depleted forcing developing economies to rely on imports from EU recycling and processing industries, or the global market. As global demand for CRMs such as lithium is set to increase 89-fold by 2050, a scenario where developing economies are reliant on CRM imports could be much more damaging than what is experienced today in the initial stages of CRM utilisation (Carrara et al., 2023). Stock use of CRMs in future decades will further compound the issue. CRM-intensity is predicted to increase severely. For example, following the green energy transition, utilisation of lithium in electric vehicles, which are predicted to replace current vehicle types, will ensure the stock use of lithium increases immensely. This will surely cause greater issues in the global market for CRMs due to its limited supply. McKinsey (2023) shows the predicted 2030 demand for lithium carbonate is more than double the predicted 2030 supply scenario.

4.2 Challenges and Opportunities with Labelling Requirements

Despite the potential of Strategic Projects, formal requirements for extraction, processing, and recycling information provision restrict the ability of developing economies to participate in the ECRMR network. The ECRMR sets out intentions to develop stronger international standards including minimum sustainability certifications for CRM projects and declarations of CRM environmental footprints entering the EU market.

Due to the prominence of informal markets throughout developing economies and specifically within waste management sectors, monitoring requirements and environmental impact criteria are unlikely to be met. Around 83% of jobs within Africa are considered informal (ILO, 2023). In Nigeria, for example, there are over 100,000 informal workers within the electronic waste processing industry alone (Thapa et al., 2022). The informal sector brings with it significant harm to its workers and the environment due to the lack of government regulation of actions and emissions. Despite legislation, the freedom of the informal sector allows illegal landfills to be utilised to process waste outside of formal recycling facilities.

The significantly lower cost of informal sectors displaces value streams from formal systems for recycling and processing. Although, this is unlikely to be a significant factor in extraction industries. This displacement ensures formal systems operate below efficient recycling capacities, undermining more formal versions of the industry. It is therefore unlikely, in a policy space that does not acknowledge informal markets, that both systems can coexist in a sufficiently environmentally-friendly way that could enable Strategic Projects to operate in developing economies.

In 2022 and 2023, policy has begun to address the isolation of informal markets from the formal economy. Thapa et al (2022) included government support and cooperation with the formal sector as policy recommendations to ensure informal markets are safer and more regulated. The International Labour Organisation also held a two-day conference on informal labour markets in Africa during May 2023 with the aim of changing the policy narrative to support informal markets, rather than undermine them (ILO, 2023). Therefore, while in the short run the recycling and processing industries, especially in Africa, are undermined by the prominence of informal labour and a lack of monitoring, within the next decade these industries will become more attractive investment destinations. This could be too late, however, to take advantage of the ECRMR.

In contrast, the emphasis on increased labelling and information requirements could tackle a different issue faced by developing economies: waste exports. Despite the Basel Convention, developing economies such as African states are subjected to mislabelled or illegal waste exports of electrical goods and vehicles. Extended Producer Responsibility fees are levied across the EU to tackle this issue internally. However, there is so far no way of transmitting these fees to importing economies. A recent study estimated that lost EPR fees from exports of electrical goods from the EU to Africa totaled between 340m-380m EUR. For end-of-life vehicles, lost EPR fees stood at between 294.6m-409.4m EUR (Arya 2023). These lost fees ensure that African states import faulty goods without benefiting from funds to develop waste management infrastructure. However, with increased information responsibilities, the accidental export of waste or polluting goods should decrease, reducing strain on African waste management systems.

4.3 Permitting shifts

Decreases in permitting acceptance timelines, as laid out in the ECRMR, could lead to immense opportunities for developing economies in infrastructure investment. The policy so far only details that permit processes will not exceed 24 months for extraction Strategic Projects or 12 months for processing and recycling Strategic Projects (European Commission, 2023d). However, this applies only to EU Member States. The reduction in permitting timelines, nevertheless, is a key policy of the ECRMR, aiming to shift the EU's CRMs supply chain speedily to a more circular model. It can be assumed a similar, although perhaps not so extreme, policy will be established for third countries in the near future.

With reduced wait times, available funding in developing economies could be utilised more effectively to develop stronger infrastructure. Investment and grants could support greater levels of innovation and business creation in these economies by limiting the financial strain on companies to survive the ratification process and reducing the risk of lost sunk costs. Therefore, Strategic Projects in developing economies should see an increase in CRM infrastructure investment.

5. Circular Economy Impacts

Although portrayed as a policy for circular CRM supply chains by some, the ECRMR focuses on stable (not necessarily sustainable) supply chains. The three key goals of the ECRMR include: increased awareness of CRM supply risks, improved EU CRM supply chain capacity, and the reduction of the EU's CRM-related environmental footprint (European Commission, 2023b). Some of these are circular-adjacent goals, but by no means are they circular-targeting. Even the policy's defined indicators aim solely for extraction, processing, and recycling capabilities. In its main goals, the ECRMR targets only the last resort of circular systems: recycling.

Smaller goals detailed in the full proposal include improved waste collection and recycling technologies along with more circular aims. For example, Member States are required to encourage the reuse of products using CRMs by 2026, although no acceptable level of reuse is defined. Further, Member States must work to ensure labour in CRM-related industries are trained to engender circularity within the CRM value chain (European Commission, 2023d).

The demand for circularity is stronger, however, when looking at permanent magnets. Here, the ECRMR requires overt labelling of magnet type (Neodymium-Iron-Boron, Samarium-Cobalt, Aluminium-Nickel-Cobalt, or Ferrite).

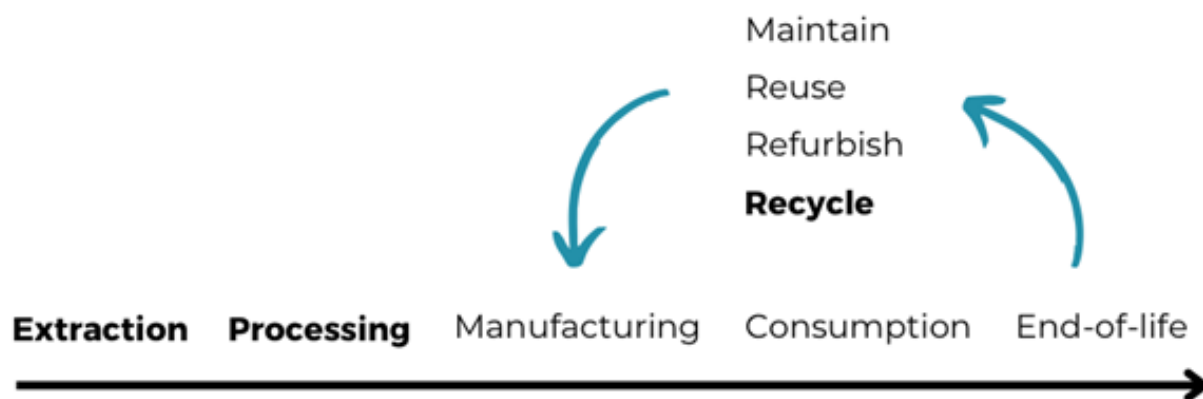


Figure 7: ECRMR focus along a circular CRM value chain

5.1 International Scene

With the international nature of third country Strategic Projects and the ECRMR's emphasis of stronger labelling requirements, the policy could drive forward global circular infrastructure. Key issues identified for the development of circular international trade include limited product information and a lack of harmonised export codes for products like secondary materials and circular-enabling goods.

Stronger labelling protocols and Digital Product Passports are becoming a reality with ECRMR. Current links to Ukraine and Canada as Strategic Partners are beginning to develop this information network that will enable the circular economy on a global scale, but the future inclusion of more developing economies will attempt to harmonise coding regulation, allowing frictionless circular customs going forwards.

The collection of CRMs from products at their end-of-life, as the key goal of the ECRMR, could reinforce the utilisation of preferred circular methods (reuse, repair, remanufacture) alongside recycling. For example, increased modularity in mobile phones could allow the deconstruction of products for recycling and easier repair of broken components.

Growing EU demands for circularity in CRM value chains increases global awareness of the circular economy. As the EU requires greater levels of recycling infrastructure to enable CRM trade, the ECRMR could lengthen the list of economies with Circular Economy National Roadmaps.

Therefore, through network effects and strong political influence, the ECRMR could further the cause of the circular economy across the international scene. Developing economies will feel greater pressures to accommodate circular demands from importing countries, but could also benefit from technological transfers to bolster their circular capabilities. Following the World Trade Organisation's (WTO) Technical Barriers to Trade Agreement, economies demanding greater circularity or more stringent product labelling should take the lead in redistributing circular-enabling technologies.

However, the development of protectionist policies such as the ECRMR could lead to a problematic scenario of dual or multiple systems. Similar policies have been pursued by the UK and the US in recent years, specifically to target supply risks caused by reliance on China. At a minimum, the ECRMR could further polarise the circular cause at the international level, with economies catering to the requirements of either the EU or China. If the US or the UK supply chains also pose a threat to the EU, this could further dilute the harmonised regulations called for above. Regardless, growing circular demands from CRM trading partners will generate greater circular capacities within developing economies involved.

5.2 Capabilities

As above, growing demands for circular-enabling processes (labelling, recycling infrastructure, emissions tracking) will instil developing economies with greater circular capabilities - either through their own investments, or through the support of programmes such as Strategic Partnerships.

It is important, however, to consider the difference in political and economic power in global markets between the EU and developing economies. The greater capacity of EU Member States to use subsidies to support growing CRM and circular industries puts the union at a strong advantage. Subsidies could allow the EU to protect infant CRM-related industries from competition on the global market, artificially redirecting demand to domestic markets. Developing economies often do not have this luxury due to their weaker position in government budgets, borrowing constraints, and scrutiny by free trade-promoting powers. Even the EBRD declares that Strategic Partners receiving investments should meet high criteria for free trade behaviours and competition.

In this political climate, the ECRMR is likely to worsen tensions between key European and Northern American powers and their East Asian counterparts. As the EU becomes more protectionist in its CRM policies, those losing out in this deal could retaliate. A subsidy race could isolate developing countries, preventing them from competing in circular-related industries on a global scale.

However, those developing countries identified above as good fits for ECRMR Strategic Partnerships should enjoy similar economic protections - mostly through investment and technological and knowledge transfers. Therefore, developing economies with high endowments of CRMs (either known currently or found later during exploration efforts) should be sheltered from unbalanced global competition and should benefit from direct transfers into circular industries. Other developing economies, however, will likely be restricted in their capacity to transition to a circular economy structure.



6. Policy Recommendations

Overall, developing economies could harness the opportunities that the ECRMR provides much more than be harmed by it in the short to medium run. In order to support economic growth and protect current domestic industries in developing economies, governments can take multiple actions. For those with identified direct market benefits in Figure 6, policymakers can engage with Strategic Projects in extraction. In order to develop market presence and compound the benefits of ties with the EU, these economies can look to invest in secondary functions (processing, recycling) to create as close to a “One Stop Shop” as possible.

For those not identified in Figure 6, governments can also invest in these non-extraction functions. The ECRMR has clearly stated Strategic Projects will be chosen in order to fill gaps in the value chain, thus, there is still plenty of room for opportunities in developing economies given the current lack of EU CRM infrastructure.

For those identified in Figure 6 with direct market risks, such as Guinea and the DRC, policymakers should aim to diversify export buyers and key industries where possible. Although, the dominance of the DRC and Guinea, in cobalt, tantalum, and bauxite exports respectively, suggests global and EU demand will shift only minimally.

In general, developing economies should make use of the WTO’s Technical Barriers to Trade Agreement to find as much support as possible through knowledge and technological transfers.

To further promote circular economy principles in developing economies, governments can pre-emptively develop stronger customs systems. Digitalised processes will reap significant benefits going into the future, both in terms of ease of trade and for the adoption of key circular infrastructure, such as Digital Product Passports (DPPs). DPPs have already been referenced by the ECRMR for trade in permanent magnets, and are likely to be carried across industries where possible. Adopting similar information requirements for customs processes will enable future trade with the EU as circularity requirements increase (such as declarations of recycled material content, or environmental footprint).

This will also further the adoption of circular processes in developing economies as impacts are more overt to producers and consumers. Maintaining economic autonomy, for example through the strengthening of AfCFTA for Africa, will be crucial in ensuring future circularity in developing countries.



Highlighting the extractive and processing capacities of developing countries could cause this image to dominate, attracting further unwanted waste trade as detailed above. Further, resilience against politically-driven CRM management divisions, especially as Africa has been identified as the new “frontier” of raw materials, will be crucial in ensuring the goal of harmonised systems is feasible for a circular future. Alongside this, the currently unmonitored informal labour markets present in many developing economies should be tied to formal structures, if not, for many good reasons, formalised themselves.

To enable long run investments into extraction infrastructure in developing economies, states should be conscious to develop socially and environmentally sustainable mining systems. These are key criteria for ECRMR Strategic Projects. Through proper regulation and enforcement of legal protections for both labour and the environment, policymakers can therefore protect their land, people, and international standing.

Finally, developing economies must also protect their own domestic access to CRMs. Governments should seek to create robust trading policies to export reserves of CRMs in a conscious, sustainable way. Policymakers should further look to reduce domestic consumption of CRMs where possible to reduce their own reliance on global supply chains.

7. Conclusion

The ECRMR represents the first significant step in international circular policy, attempting to stabilise supply chains for CRMs and make their consumption more sustainable. With an extreme increase in CRM demand forecasted for 2030, it is likely we will see even more of these policies published in the next five years, thus it is critical we evaluate their impacts on global trade and equality.

This paper investigated the effects the ECRMR could have on developing economies over the short, medium, and long term. Section 3 highlighted the impacts of the ECRMR on international trade. Assuming the policy's goals for extraction, processing, recycling, and single-exporter quotas are achieved, economies most likely to be affected include: dominant suppliers (of more than 65% of EU demand), countries labelled as political risks, and secondary importers within these markets. Many of the developing economies identified here will benefit from shifting EU demand as they represent neither dominant supplier or political risks. However, Guinea and the DRC should seek to diversify their exports. Although the EU has begun projects to assist the DRC, the economy ranks low on the governance metric, which could easily disrupt global supply of cobalt and tantalum. Guinea is a dominant supplier of bauxite - supplying 70% of EU import demand. It is also likely that new exporters, including some developing economies such as Bolivia, will enter the CRM market as the EU and other countries attempt to diversify supply. In the long term, developing economies, especially those on the African continent, could face increased protectionist policies, strong geopolitical divides, and even a growth in economic imperialism.

Section 4 discussed the impacts of the ECRMR on the domestic policies and capabilities of developing economies. Using Ukraine as a key example of success under Strategic Partnerships, it is shown that developing economies could benefit greatly from partnering with the EU. The emphasis on investment and knowledge or technological transfers promises a means for developing economies to take the lead in CRM management infrastructure. However, this could cost them their secondary industries - those reliant on CRMs but potentially still facing the same supply chain fragility as before. Informal labour markets could prove difficult to manage with increasing labelling and information requirements. However, improved permitting acceptance could develop more formal markets, with a stronger funding landscape.

The impact on developing economies' circular capacities is limited in the short run. Yet, as policies similar to the ECRMR are created, a more robust global culture of circular trade will promote improved circular systems in domestic industries.

Developing countries will likely face difficulties in potential geopolitical divides (which could create duplicate circular systems) and in their exclusion from similar borrowing and investment powers enjoyed by developed economies.

Section 6 detailed policy recommendations for developing economies to safeguard their domestic industries and ensure they are able to harness the opportunities created by the ECRMR. Developing countries should look to make use of Strategic Projects as far as possible, ensuring investment and capital streams are directed towards their economy. For those with identified risks (Guinea and the DRC), diversifying domestic industries and exports is a priority. Where Strategic Projects are not created, utilisation of the WTO's Technical Barriers to Trade Agreement should allow developing countries to garner reasonable levels of capital inflows to maintain market power.

With the new levels of information and labelling requirements brought in by the ECRMR, and alluded to in trade agreements and National Circular Economy Roadmaps across the globe, developing economies should look to invest in their customs systems. Similar information requirements across customs systems will allow for greater trade in the future as circularity demands increase, and can ensure swift development of trade agreements if an opportunity for a Strategic Partnership presents itself. The formalisation of informal labour markets, or their connection to formal systems, should further develop this.

Finally, developing countries should look first and foremost to protect their own interests. The ECRMR could drain developing economies of their resources - which will become crucial to their own digital and green transitions in the near future. Thus, robust trading policies, reductions in CRM consumption, and strengthening economic autonomy are priorities.

Future research should aim to conduct a full analysis of EU capabilities to identify specific opportunities for developing countries across extraction, processing, and recycling. Improved data on recycling and processing capacity is required to evaluate this fully. Feasibility studies for new entrants to the CRM market would also enable faster adoption of the ECRMR and Strategic Partnerships.

8. The Next Paper

Having addressed the ECRMR's international impacts, we must seek ways to support a just, circular ECRMR from within the EU. The next paper in this series will discuss policies that can ensure the success of the ECRMR. It will aim to tackle the entire circular value chain (from reuse, repair, and remanufacture, to recycling as a last resort), refocusing the ECRMR upstream. The paper will also address optimum financing options to support circular infrastructure development.

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— ANTIMONY, ARSENIC, ALUMINIUM AND BAUXITE, BARYTE, BERYLLIUM, BISMUTH, BORON/BORATES, COBALT, COKING COAL, COPPER, FELDSPAR, FLUORSPAR, GALLIUM, GERMANIUM, HAFNIUM, HELIUM, LITHIUM, MAGNESIUM, MANGANESE, NATURAL GRAPHITE, NICKEL, NIOBIUM, PHOSPHATE ROCK AND ELEMENTAL PHOSPHORUS, PGMS, RARE EARTH ELEMENTS, SCANDIUM, SILICON METAL, STRONTIUM, TANTALUM, TITANIUM METAL, TUNGSTEN, VANADIUM

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Annexes

Annex 1: List of critical and strategic raw materials

Critical Raw Materials	Strategic Raw Materials
Antimony Arsenic Bauxite Baryte Beryllium Bismuth Boron Cobalt Coking Coal Copper Feldspar Fluorspar Gallium Germanium Hafnium Helium Heavy Rare Earth Elements Light Rare Earth Elements Lithium Magnesium Manganese Natural Graphite Nickel – battery grade Niobium Phosphate rock Phosphorus Platinum Group Metals Scandium Silicon metal Strontium Tantalum Titanium metal Tungsten Vanadium	Bismuth Boron - metallurgy grade Cobalt Copper Gallium Germanium Lithium - battery grade Magnesium metal Manganese - battery grade Natural Graphite - battery grade Nickel - battery grade Platinum Group Metals Rare Earth Elements for magnets (Nd, Pr, Tb, Dy, Gd, Sm, and Ce) Silicon metal Titanium metal Tungsten

Annex 2: List of developing economies as defined by the World Bank as “low-income” or “lower-middle income” economies in 2023

LOW-INCOME ECONOMIES (\$1,085 OR LESS)

Afghanistan	Guinea-Bissau	Somalia
Burkina Faso	Korea, Dem. People's Rep	South Sudan
Burundi	Liberia	Sudan
Central African Republic	Madagascar	Syrian Arab Republic
Chad	Malawi	Togo
Congo, Dem. Rep	Mali	Uganda
Eritrea	Mozambique	Yemen, Rep.
Ethiopia	Niger	Zambia
Gambia, The	Rwanda	
Guinea	Sierra Leone	

LOWER-MIDDLE INCOME ECONOMIES (\$1,086 TO \$4,255)

Angola	India	Philippines
Algeria	Indonesia	Samoa
Bangladesh	Iran, Islamic Rep	São Tomé and Príncipe
Benin	Kenya	Senegal
Bhutan	Kiribati	Solomon Islands
Bolivia	Kyrgyz Republic	Sri Lanka
Cabo Verde	Lao PDR	Tanzania
Cambodia	Lebanon	Tajikistan
Cameroon	Lesotho	Timor-Leste
Comoros	Mauritania	Tunisia
Congo, Rep.	Micronesia, Fed. Sts.	Ukraine

Côte d'Ivoire	Mongolia	Uzbekistan
Djibouti	Morocco	Vanuatu
Egypt, Arab Rep.	Myanmar	Vietnam
El Salvador	Nepal	West Bank and Gaza
Eswatini	Nicaragua	Zimbabwe
Ghana	Nigeria	
Haiti	Pakistan	
Honduras	Papua New Guinea	

Annex 3: EU Suppliers and Import Reliance for CRMs, Opportunities and Risks for Developing Countries

SRM	CRM	EU Consumption	End-of-Life Recycled Input Rate (%)	EU Import Reliance (%)	Suppliers	Percentage	Political Risk	Supply more than 65%	Opportunities for developing countries	Risks for developing countries
	Antimony	16,667	28	47	China, Tajikistan, Vietnam, South Korea, Türkiye, Thailand	52%, 15%, 12%, 6%, 4%, 3%	Y		Tajikistan, Vietnam, Bolivia	
	Arsenic	1,260	0	27	China, Japan, UK	93%, 3.6%, 2.9%	Y		Philippines, Morocco	
	Bauxite	16,146,077	32	89	Guinea, Brazil, Sierra Leone	70%, 13.8%, 9.7%		Y	Sierra Leone	Guinea
	Baryte	394,125	0	73	Bulgaria, Germany, Slovakia	57%, 34%, 9%				
	Beryllium	5.5	0	100	UK, USA, South Africa	95%, 3%, 2%		Y	Mozambique	
S	Bismuth	2,420	0	70	China, Thailand, Laos, South Korea, Vietnam	63%, 13%, 10%, 6%, 4%	Y		Laos, Vietnam, Bolivia	
S	Boron	51,450	1	100	Türkiye, USA, UK	70%, 20%, 5%		Y		
S	Cobalt	15,000	22	100	Japan, USA, Brazil	47%, 25%, 20%				
	Coking Coal	36,510,980	0	65.60	Australia, Poland, US, Russia, Canada, Czech Republic	28%, 26%, 20%, 8%, 6%, 5%				
S	Copper	2,054,007.30	55	48	Poland, Chile, Brazil, Peru, Spain, Bulgaria, Sweden, Canada	20%, 15%, 10%, 10%, 9%, 5%, 5%, 4%				
	Feldspar	9,800,000	1	55	Türkiye, Norway	93%, 6%		Y		
	Fluorspar	600,000	1	67	Mexico, South Africa	60%, 15%				
S	Gallium	30	0	97	China, USA, Ukraine	80%, 15%, 3%	Y		Ukraine	
S	Germanium	48	2	42	China, Russia, USA, Hong Kong, UK	69%, 10%, 9%, 5%, 4%	Y			
	Hafnium	35	0	-29	France	100%				
	Helium	5,830	2	100	Qatar, Algeria, USA, China, UK	35%, 27%, 24%, 4%, 3%				
S	Heavy Rare Earth Elements	7,136.87	4	100	China, Japan, Russia, UK, USA, South Korea		Y			

S	Light Rare Earth Elements	COMBINED	3	COMBINED	DATA COMBINED SO NO INDIVIDUAL STATS AVAILABLE					
S	Lithium	2,916	0	100	Chile, Russia, Switzerland, Argentina, USA	68%, 8%, 7%, 6%, 5%		Y		
S	Magnesium	76,766	12	100	China, Netherlands, Germany, Austria, Czechia	58%, 14%, 8%, 8%, 2%	Y			
S	Manganese	270,393	9	97	South Africa, Gabon, Brazil, Ukraine, Australia	42%, 40%, 8%, 4%, 1%				
S	Natural Graphite	77,340	3	97	China, Mozambique, Brazil, Madagascar	42%, 15%, 13%, 6%	Y		Mozambique, Madagascar	
S	Nickel – battery grade	77,781	16	30	Canada, South Africa, USA	63%, 16%, 9%				
	Niobium	13,484	0	98	Brazil, Canada, Kuwait	86%, 12%, 1%		Y	Rwanda, Mozambique	
	Phosphate rock	7	17	62	Morocco, Algeria, Russia, Israel, Senegal	38%, 20%, 14%, 13%, 8%				
	Phosphorus	69,172	0	100	Kazakhstan, Vietnam, China, USA	70%, 25%, 4%, 1%		Y	Vietnam	
S	Platinum Group Metals		10							
	Iridium/ Ruthenium/ Osmium	17.25		Cannot be consolidated	South Africa, UK, USA, Japan, Switzerland	31.4%, 31.4%, 13%, 10%, 6%				
	Palladium	20		Cannot be consolidated	USA, Russia, UK, South Africa, Switzerland	29.7%, 28.9%, 21.8%, 10.6%, 5.9%	Y			
	Platinum	72		Cannot be consolidated	UK, South Africa, Switzerland, Russia	51.5%, 17.8%, 8.4%, 7%				
	Rhodium	Net Export								
	Scandium	5.7	0	100	UK, USA	94%, 4%		Y		
S	Silicon metal	440968	0	74	Norway, Brazil, Russia, Bosnia and Herzegovina, Australia	45%, 12%, 5%, 5%, 4%				

	Strontium	50,000	0	1.65	Germany, Mexico, Japan, Italy	94%, 2%, 1%, 1%				
	Tantalum	395	0	100	Democratic Republic of Congo, Rwanda, Ethiopia, Nigeria	36%, 30%, 6%, 5%	Y		Rwanda, Mozambique, Indonesia, Nigeria, Ethiopia	Democratic Republic of Congo
S	Titanium metal (extraction stage)	457,050	19	100	Norway, South Africa, Canada, Mozambique, Ukraine, UK, Australia, Sierra Leone	23%, 16%, 14%, 10%, 9%, 9%, 6%, 6%				
S	Tungsten	17,273	42	88	China, Vietnam, USA, Russia	31%, 14%, 9%, 9%	Y		Vietnam, Bolivia, Rwanda	
	Vanadium	12,931	1	94	Netherlands, Austria, Russia, Germany	22%, 16%, 15%, 7%	Y			

The majority of the data in the above table was sourced from SCRREEN (2023) as the CRM profiles represent the most in-depth study conducted in the last year. Figures for the End-of-Life Recycled Input Rate were sourced from the European Commission's Study on the Critical Raw Materials for the EU 2023 Final Report. "Political Risk" and "Supply more than 65%" are evaluated based on the above sources, while "Opportunities" and "Risks for developing economies" are evaluated based on SCRREEN listed suppliers, and developing economies listed by USGS (2022) and Mineral Education Coalition for relevant CRMs.