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BALANCING STRATEGIC AUTONOMY AND SUSTAINABILITY: IMPLEMENTING THE EU CRITICAL RAW MATERIALS ACT ACROSS DIVERSE CRITICAL MINERAL VALUE CHAINS

EXECUTIVE SUMMARY

The European Union's green and digital transitions depend on secure access to and supply of critical raw materials (CRMs). However, **this policy brief – authored by students and scholars from several European universities across academic fields ranging from geography to chemistry, law, and economics – argues that a one-size-fits-all policy implementation risks generating unintended consequences, including environmental degradation, human rights violations, and uneven distributional effects within and beyond the EU.**

At the global level, CRMs supply diversification efforts may reshape geopolitical alliances but risk perpetuating environmentally destructive extraction patterns in lower-income countries, especially if demand continues to grow unchecked. At the European level, strengthening processing capacity could benefit industrial resilience, yet it may also shift environmental pressures to specific regions. Locally, new mining projects within the EU may create economic opportunities, including jobs and regional development, but they also intensify land-use conflicts and spark political opposition. Without careful governance, transparency, and inclusive decision-making, the transition risks displacing socio-ecological burdens onto rural, poor, and marginalized communities, and to even intensify the climate crisis.

This underscores the need to **prioritize the reduction of CRM consumption, substantially scale up circular economy strategies, and foster fair international partnerships**, alongside supply-side measures. Using **nickel, lithium, aluminium, and rare earth elements (REEs)** – all classified as critical raw materials by the EU – as illustrative cases, this policy brief explores the dilemmas tied to each material, utilizing these insights to shape high-level recommendations for future CRM policy.

KEY MESSAGES AND RECOMMENDATIONS

Key problem: Relying on a uniform, extraction-focused approach to secure Critical Raw Materials - without sharply curbing primary demand - risks displacing severe socio-ecological burdens onto vulnerable communities both within and beyond the EU.

Recommendations:

→ **Implement material-specific strategies.**
→ **Reduce primary consumption.**
→ **Scale up high-quality recycling.**
→ **Enforce strict socio-ecological standards across the value chains and promote inclusive decision-making processes.**
→ **Foster equitable trade partnerships.**

CONTEXT

Critical raw materials (CRMs) are considered "critical" because they are both economically important for key industries – such as renewable energy, electronics, and defence – and subject to a high risk of supply disruption due to their limited global production and geopolitical concentration. In response to growing geopolitical tensions and supply chain vulnerabilities, the EU Critical Raw Materials Act, adopted in 2023, establishes clear benchmarks across the strategic raw materials value chain: **by 2030, the EU aims to source at least 10% of its annual EU consumption from domestic extraction, 40% from EU-based processing, 25% from recycling, while ensuring that no more than 65% of supply comes from a single third country** (European Commission, 2023).

While these targets aim to strengthen resilience and strategic autonomy, they apply uniformly across a diverse set of materials whose environmental, social, political, and economic realities differ substantially.

Nickel, lithium, aluminium, and rare earth elements (REEs) are selected due to their essential role in key green and digital technologies: lithium and nickel are central to battery production for electric vehicles and energy storage, rare earth elements are crucial for permanent magnets used in wind turbines and electronics, and aluminium is widely used in lightweight structures for transport and renewable energy systems.

CRITICAL RAW MATERIALS ARE NOT UNIFORM IN THEIR CHALLENGES

GEOLOGICAL DISTRIBUTION

Some materials are relatively abundant but concentrated in specific processing locations, while others are geologically scarce and geographically limited. For example, rare earth elements (REEs) are not particularly rare in the Earth's crust but are predominantly processed in China (73%), whereas lithium reserves are concentrated in a few regions such as the "Lithium Triangle" in Chile, Argentina, and Bolivia. These countries together with Australia and China account for 80% of global reserves, meanwhile EU deposits represent just 1.2% of the world reserves. Similarly, around 55% of global nickel reserves are located in Indonesia, Australia, and Brazil, with Europe accounting for just 2% (including the French overseas territory of New Caledonia). In contrast, aluminium is not geologically scarce, but its production depends on other constraints.

SUPPLY CHAIN STRUCTURE

Value chains vary in their complexity, degree of vertical integration, and concentration across extraction, processing, and refining stages. For instance, the rare earths supply chain is highly integrated and dominated by China, particularly in mining and refining. Aluminium, by contrast, has a more globally diversified and mature value chain, with multiple producers across regions, but is heavily dependent on energy-intensive refining processes. The EU is notably dependent on imports of processed aluminium, with around 58% sourced from outside the region. EU members countries have to import over 90% of their nickel demand (including New Caledonia as France), around 99% of their lithium demand, and 100% of REEs (Reichl and Schatz, 2025).

GOVERNANCE CONDITIONS IN PRODUCER COUNTRIES

Regulatory capacity, rule of law, environmental standards, and the integration of mining activities into broader development strategies differ significantly between extraction countries. Nickel production in Indonesia, for example, has been shaped by strong state intervention and export bans to promote domestic processing, whereas cobalt mining in Democratic Republic of the Congo raises ongoing concerns about labour conditions and environmental oversight.

GEOPOLITICAL CONCENTRATION AND TRADE DYNAMICS

Some materials are subject to high levels of market concentration, export controls, and strategic trade dependencies. Rare earth elements are a prominent example, with China having a monopoly on global supply and having previously imposed export restrictions, while lithium markets are becoming increasingly strategic due to surging demand for electric vehicles and energy storage, whereas just two decades ago its applications were comparatively limited.

RECYCLING OR REUSE POTENTIAL

Some materials are easier to recycle or reuse than others. The recycling of a material usually requires high levels of cooperation between industries and stakeholders and, moreover, depends on the implementation of the respective industry of recycling. Aluminium stands out as highly recyclable, with recycling requiring far less energy than primary production, making it a key priority for reducing demand for virgin material (Korhonen et al, 2018). In contrast, lithium recycling from batteries remains technologically complex and is not yet widely deployed at scale, despite growing demand.

SOCIOECOLOGICAL IMPACTS

Across the value chain, each critical raw material entails a broad range of potential socioecological impacts. Aluminium production is associated with high energy consumption and the generation of hazardous by-products such as red mud. Lithium extraction, particularly in arid regions, can place significant pressure on water resources, while rare earth mining and processing can generate toxic waste if not properly managed. These impacts further highlight the importance of developing more sustainable sourcing, recycling, and material efficiency strategies.

RECOMMENDATIONS

RECOMMENDATION 1: *ADOPT DIFFERENTIATED, MATERIAL-SPECIFIC STRATEGIES.*

Given the heterogeneity of critical raw materials (CRMs), policymakers should systematically assess the specific risks, supply chain structures, and socioecological impacts associated with each material. This implies designing tailored policy mixes – for instance, prioritizing recycling for materials like aluminium, while focusing on supply diversification and demand management for more geographically concentrated materials such as lithium or rare earth elements.

RECOMMENDATION 2: *REDUCE PRIMARY CONSUMPTION.*

To decrease import dependency and supply chain pressures, policymakers must prioritize the reduction of primary CRM consumption by extending product lifetimes. This requires implementing strong "right to repair" regulations, offering financial incentives for repair services, and establishing mandatory take-back schemes. By enforcing Extended Producer Responsibility (EPR) and mandating that manufacturers design durable and easily disassemble products, governments can shift the industry's focus from end-of-pipe recycling to prioritized reuse and refurbishment, fundamentally lowering overall material demand.

RECOMMENDATION 3: *SCALE UP HIGH-QUALITY RECYCLING SYSTEMS.*

Where reuse is no longer possible, recycling should be optimized to recover materials efficiently and retain their quality. This requires investment in recycling infrastructure, improved collection systems, and stronger coordination across value chains. Regulatory frameworks can set minimum recycled content requirements and support the development of secondary raw material markets.

RECOMMENDATION 4: *ENSURE HIGH SOCIOECOLOGICAL STANDARDS ACROSS ALL STAGES OF THE VALUE CHAIN AND PROMOTE INCLUSIVE DECISION-MAKING PROCESSES*.

Any development or expansion of extraction, processing, or recycling of (critical) raw materials – whether within the EU or abroad – must comply with robust environmental and social standards. This includes minimizing pollution, protecting biodiversity, ensuring responsible water use, and upholding labour rights. Certification schemes, due diligence requirements, and stricter enforcement mechanisms are key tools in this regard. The promotion of inclusive decision-making processes aims to fully involve local communities in the different development steps. And local communities should have the right to say 'no' to any extraction, processing, or recycling projects. When projects occur on Indigenous territories, free, prior and informed consent (FPIC) must be applied.

RECOMMENDATION 5: *REBALANCE TRADE RELATIONSHIPS WITH PRODUCER COUNTRIES.*

The EU should move beyond purely extractive trade models and foster more equitable and sustainable partnerships with countries in the Global South. This includes supporting local value addition (e.g., processing and refining), technology transfer, and capacity building, as well as ensuring that revenues from resource extraction contribute to broader development goals in places of extraction. Trade agreements should integrate binding sustainability and governance provisions to promote fairer and more resilient supply chains.

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References:

European Commission. (2023). Proposal for a regulation of the European Parliament and of the Council establishing a framework for ensuring a secure and sustainable supply of critical raw materials. https://single-market-economy.ec.europa.eu/publications/european-critical-raw-materials-act_en

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: The concept and its limitations. Ecological Economics, 143, 37–46. https://doi.org/10.1016/j.ecolecon.2017.06.041

Reichl C., Schatz, M. (2025). World mining data 2025. Austrian Federal Ministry of Finance. Volume 40, Vienna, 2025. https://www.world-mining-data.info/wmd/downloads/PDF/WMD%202025.pdf

Scientific background:

Joint Research Centre. (2024). Lithium — Raw materials' profile. European Commission, Raw Materials Information System. https://rmis.jrc.ec.europa.eu/rmp/Lithium

Joint Research Centre. (2024). Nickel — Raw materials' profile. European Commission, Raw Materials Information System. https://rmis.jrc.ec.europa.eu/rmp/Nickel

Joint Research Centre. (2024). Rare Earth Elements — Raw materials' profile. European Commission, Raw Materials Information System. https://rmis.jrc.ec.europa.eu/rmp/Rare%20Earth%20Elements

Joint Research Centre. (2024). Aluminium — Raw materials' profile. European Commission, Raw Materials Information System. https://rmis.jrc.ec.europa.eu/rmp/Aluminium

Nickel Institute (2026). About nickel. https://nickelinstitute.org/en/nickel-applications/