POLICY BRIEF

BRIDGING THE GAP:
SECURING EUROPE'S CRITICAL RAW MATERIALS FOR THE CHIPS AND CIRCULAR ECONOMY ACTS

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SUMMARY

Resilient supply chains for Critical Raw Materials (CRMs) are non-negotiable — from electric vehicle batteries and grid storage essential for decarbonisation to advanced electronics underpinning digital sovereignty and defence. Without CRMs, neither Europe's chips nor its circular economy can be truly sovereign or competitive. Despite this strategic urgency, Europe faces a critical, systemic policy gap, which manifests in four barriers to a Circular and Sovereign Supply of CRMs in Europe: Regulatory Fragmentation, Unsustainable Ecosystems (industrial planning neglects the circular integration of material flows), an Incomplete Circular Model (overemphasis on end-of-life recycling), and a Deficit in Social Acceptance.

The RELiEF project developed and validated innovative processes for recovering lithium from unconventional secondary sources to incorporate it into battery component manufacturing and remanufacturing. In this document we present our findings to overcome the identified barriers and provide a roadmap for integrating Secondary CRMs into the EU's legislative agenda. Analysis carried out by the RELiEF project demonstrates that securing a circular supply of CRMs requires coordinated action. By integrating the "Secondary Critical Raw Material" principle into the Circular Economy Act and the European Chips Act, the EU can address specific bottlenecks that currently hinder the recovery of materials from industrial waste.

RECOMMENDED TARGETED ACTIONS:

Standardize the Definition of Secondary CRMs:
- A unified EU definition within the Circular Economy Act
- Create legal certainty to unlock private investment

Level the Playing Field through Verifiable Sustainability:
- Transition from company self-assessments to mandatory, independent third-party verification of environmental and social footprints.
- Digital Product Passport

Incentivize Circulation and Cost-Competitiveness:
- Introduce fiscal incentives or regulatory "green premiums" for materials sourced within circular industrial ecosystems.

Institutionalize Adaptive Governance and Social License:
- Mandate active community engagement and benefit-sharing
- Governance frameworks should be designed to be "adaptive," allowing for updates as recovery technologies and social expectations evolve

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INTRODUCTION

Europe's leadership in the digital and green transitions hinges on a secure and sustainable supply of critical raw materials (CRMs). Landmark initiatives like the Circular Economy Act and the updated European Chips Act aim to achieve strategic autonomy and a circular economy, but their success is threatened by a critical, cross-cutting **policy gap: the lack of a coherent EU framework for Secondary Critical Raw Materials.** Secondary CRMs, such as battery-grade lithium — recovered not just from end-of-life products, but from the vast, untapped potential of industrial wastewater, mine tailings, and manufacturing scrap. **Currently, narrow regulatory definitions of "recycled content" exclude these non-conventional sources.** Coupled with a fragmented policy landscape, unsustainable cost drivers like energy, an overemphasis on end-of-life recycling, and a deficit in social acceptance, this systemic failure stifles the innovation and investment urgently needed to scale recovery technologies. The result is continued vulnerability in strategic supply chains and unfulfilled circular economy ambitions.

The Horizon Europe RELiEF project provides the evidence-based framework to close this gap. RELiEF has developed and validated innovative processes to extract high-purity, battery-grade lithium precisely from these non-conventional secondary sources. Moving beyond laboratory proof-of-concept, the project delivers an integrated analysis demonstrating that success requires a unified strategy built on four pillars: **(1) Harmonising policies to unlock investment, (2) Enabling sustainable technology to ensure competitiveness , (3) Ensuring resource efficiency and access through coordinated circular strategies, and (4) Ensure Social license and adaptive governance** (See Figure 1).

Evidence from the RELiEF project shows that Europe's digital and green transitions depend on operational alignment. Integrating 'Secondary CRM' principles into the Circular Economy and European Chips Acts addresses a specific policy gap, enabling the transformation of industrial residues into strategic assets. This targeted intervention provides a practical pathway to strengthen the resilience and sovereignty of both value chains.

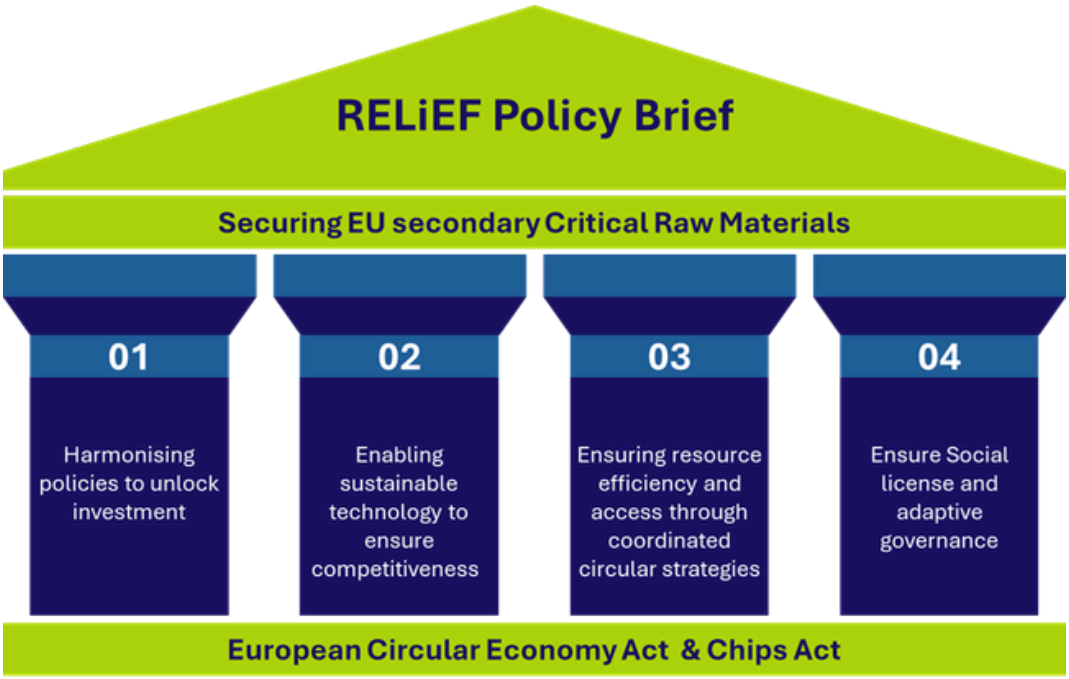

Figure 1. Four pillars strategy recommendations for the European Circular Economy Act and Chips Act

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THE CRITICAL LINK & THE POLICY GAP

Europe's industrial future is being forged by two parallel ambitions: to lead in advanced semiconductor manufacturing under the Chips Act and to pioneer a resource-efficient model under the Circular Economy Act. These ambitions are not separate; they converge on a single, indispensable foundation: a secure, sustainable, and circular domestic supply of CRMs such as lithium, cobalt, and graphite. These CRMs are the lifeblood of the technologies that will **power Europe's dual transition.** From electric vehicle batteries and grid storage essential for decarbonisation to advanced electronics underpinning digital sovereignty and defence, resilient CRM supply chains are non-negotiable. Without them, neither Europe's chips nor its circular economy can be truly sovereign or competitive.

FOUR BARRIERS TO A CIRCULAR AND SOVEREIGN SUPPLY

Despite this strategic urgency, Europe faces a critical, systemic policy gap. **The current framework fails to establish a coherent, enabling environment for Secondary Critical Raw Materials** — high-value resources recovered from industrial waste, mining residues, and end-of-life products. This gap manifests across four dimensions, creating a perfect storm that stifles Europe's ambitions:

- **Regulatory Fragmentation:** A lack of policy coherence and legal certainty creates investment risk, deterring the capital needed to scale innovative recovery technologies.
- **Unsustainable Ecosystems:** Recovery processes are often energy-intensive, and industrial planning neglects the circular integration of material flows, undermining both environmental and economic viability.
- **An Incomplete Circular Model:** An overemphasis on end-of-life recycling ignores the crucial strategies of repurposing and remanufacturing, leading to significant quality reduction and material losses across the value chain.
- **A Deficit in Social Acceptance:** Projects face delays and opposition due to inadequate community engagement and static governance that cannot adapt to rapid technological change, eroding public trust.

This multi-faceted gap perpetuates reliance on primary imports, leaves strategic domestic resources untapped, and ultimately undermines both the Circular Economy and Chips Acts before they are fully implemented.

INTRODUCING THE RELIEF EVIDENCE

The RELiEF project consortium has directly addressed this challenge by developing and validating innovative processes for **recovering lithium from unconventional secondary sources** to incorporate it into battery component manufacturing and remanufacturing. From the perspective of the abovementioned four pillars (Figure 1), we present our consolidated findings to overcome the four barriers to a Circular and Sovereign Supply of CRMs in Europe. Together, they provide **a roadmap for integrating Secondary CRMs into the EU's legislative agenda**, ensuring the Chips and Circular Economy Acts contribute to building a resilient and circular foundation for Europe's industrial future.

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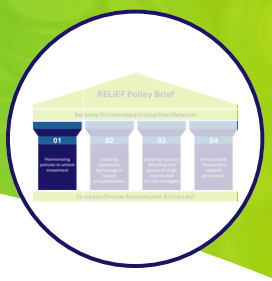

PILLAR 1:
HARMONISING POLICY & REDUCING REGULATORY UNCERTAINTY

Evidence: Stakeholder analysis of the EU's Green Deal Industrial Plan (GDIP), Net-Zero Industry Act (NZIA), Critical Raw Materials Act (CRMA), and Battery Regulation (Patil and Vonk, 2025), combined with direct industry engagement as part of the RELiEF project roadshow and clustering activities.

Key Finding: Some stakeholders perceive the EU's suite of green industrial policies as lacking coherence, creating an unclear and inconsistent regulatory environment. This fragmentation — especially regarding rules for Secondary CRMs — alongside skepticism about the achievability of targets, is a primary barrier to investment. Social acceptance and streamlined permitting are highlighted as essential enablers; without them, even well-designed policies will struggle.

Implication for the Acts: The Circular Economy Act and Chips Act risk becoming additional layers of complexity unless they are designed as streamlined, coherent instruments that actively resolve existing overlaps and establish clear rules for secondary materials. Their success depends on integrating the critical enablers of social acceptance and predictable permitting from the outset.

1. For the Circular Economy Act:

- **Actively resolve policy overlaps.** The Act must explicitly clarify its interaction with the CRMA and Battery Regulation, creating a single, clear set of rules for secondary materials to eliminate stakeholder concerns about "unintended contradictions and redundancies."
- **Embed social acceptance from the start.** Mandate transparent community engagement and benefit-sharing as prerequisites for projects concerning secondary material recovery, turning a critical challenge into a foundation for legitimacy.

2. For the Chips Act:

- **Institutionalise regulatory stability for strategic materials.** Integrate fast-track permitting for projects supplying Secondary CRMs into the European Semiconductor sector.
- **Formalise a "regulatory sandbox" for traceability.** Use the Act's strategic framework to pilot and scale digital tools like the European battery passport for high-tech supply chains, demonstrating how coherent, forward-looking regulation can drive innovation and security.

Patil, A, and WA Vonk. 2025. 'Stakeholder Perspectives on EU Regulatory Frameworks: Navigating Critical Raw Materials, Battery Innovation, and Recycling Challenges [Version 2; Peer Review: 2 Approved]'. Open Research Europe 5 (104). https://doi.org/10.12688/openreseurope.19634.2.

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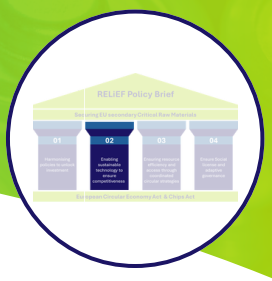

PILLAR 2:
ENABLING SUSTAINABLE TECHNOLOGY TO ENSURE COMPETITIVENESS

Evidence: Life Cycle Assessment (LCA) and sustainability analysis from the RELiEF project (INEGI, 2024) and related research on lithium recovery and next-generation batteries (Gouveia & Ribeiro, 2024; Gouveia et al., 2025).

Key Finding: The environmental and economic case for recovering Secondary CRMs is not automatic. Its viability hinges on two preconditions: 1) access to affordable, plant-level renewable energy, and 2) the systematic integration of circular material flows at the earliest design stage. LCA confirms energy is the primary cost and impact driver, while high-purity output depends on strategic foresight in industrial planning.

Implication for the Acts: Legislation must move beyond setting recycling targets. To secure a sustainable supply, it must actively create competitive conditions for green recovery technologies by tackling their main cost driver (energy) and mandating the circular-by-design ecosystems needed for resilience.

1. For the Circular Economy Act:

- **Legally define "Secondary CRMs"** Establish a clear EU definition that recognises high-quality materials from cross-sectoral waste streams (e.g., mining residues) as strategic resources, creating the legal basis for new circular markets.
- **Prioritize secondary materials manufactured within Europe**, giving priority to low impact materials and improved social conditions.
- **Mandate circular-by-design industrial planning.** Require a standardised assessment of CRM flows in local waste streams as a prerequisite for new industrial plant permits.
- **Mandate independent verification of sustainability claims,** including verified product environmental footprint (PEF approach) and traceable material sourcing.

2. For the Chips Act:

- **Provide recommendations on strategic end-use products that integrate chips,** fostering incentives and policy support in targeted value chains, to foster competitiveness and innovation in key value chains that are highly dependent on chips.
- **Encourage R&D for alternative materials in chip manufacturing,** including closed-loop systems for production scrap.
- **Incentivize the mapping and monitoring of social issues** throughout the value chain, with specific strategies to reduce social risks.
- Verifiable sustainability and due diligence integrated within risk management and competitiveness frameworks, **incentivising long-term cost stability, resilience, and ethical standards.**

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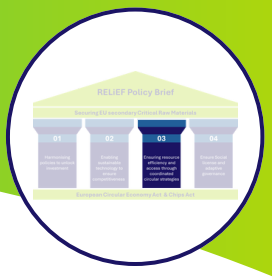

PILLAR 3:
ENSURING RESOURCE EFFICIENCY AND ACCESS THROUGH COORDINATED CIRCULAR STRATEGIES

Evidence: Doctoral research into the circular lithium economy (Quinteros-Condoretty, 2025) and related studies, demonstrating that a multi-strategy portfolio is essential to mitigate material losses and secure supply (Quinteros-Condoretty et al., 2025; Lähdesmäki et al., 2023; Quinteros-Condoretty et al., 2021).

Key Finding: A narrow policy focus on recycling end-of-life batteries leads to significant system-level material losses. Europe's resource security requires a coordinated portfolio of circular economy strategies, in which recycling from secondary sources is considered alongside end-of-life batteries to expand the pool of available secondary materials. Aligning these strategies, rather than allowing them to implicitly compete, is essential to preserve material quality, availability, and long-term supply security, and to build a resilient and efficient system.

Implication for the Acts: Legislation that incentivices only recycling of end-of-life batteries creates a systemic lock-in, undermining resource efficiency and supply security. The Circular Economy Act must address multiple potential raw material sources to expand the resources available for recycling, while allowing for other circular strategies, while the Chips Act should adopt a systems approach to build resilient supply chains made of interconnected systems.

1. For the Circular Economy Act:

- **Explicitly recognise and regulate circular strategies** to ensure efficient resource use by setting upstream practices that preserve the timing, quality, and accessibility of lithium and other CRMs entering recovery and recycling systems, through appropriate design, safety, data and traceability requirements.
- **Align incentives across circular strategies** to minimise system-wide material losses and safeguard long-term resource efficiency and supply security, without prescribing a hierarchy among strategies.
- **Support industrial symbiosis platforms** that connect CRM-rich waste streams (including tailings, wastewater, and manufacturing scrap) with suitable recovery and concentration technologies.
- **Require national circular economy plans to include a battery and CRM skills strategy** developed jointly by industry, universities and vocational institutes, covering design for circularity, diagnostics, safety and systems thinking.

2. For the Chips Act:

- Ensure that cross-industry circular economy projects linking the battery, semiconductor and chemical sectors are fully eligible for **Chips Act funding**. This includes projects deploying repurposed EV batteries as on-site energy storage in semiconductor fabrication plans, as well as projects integrating recovered CRMs from battery or industrial waste streams into chemicals or specialised production equipment.
- Require all supply chains supported under the Chips Act to adopt **interoperable digital product passports and traceability systems** compatible with battery passport frameworks, allowing material-level circularity tracking across interconnected value chains.

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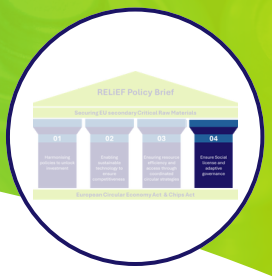

PILLAR 4:
ENSURING SOCIAL LICENSE AND ADAPTIVE GOVERNANCE

Evidence: A social life cycle assessment of the RELiEF value chain, identifying social risks related to aspects such as working conditions, human rights, equality and fair competition (Orola et al. 2024a). Strengthened with qualitative analysis (Orola et al. 2024b; Orola et al. 2025) on EU policy (document analysis of 26 policies) and stakeholder interviews addressing value chain actors, NGOs and policy makers (Kainiemi et al. 2024), against the backdrop of just energy transitions (Kainiemi et al. 2025).

Key Finding: Working conditions, fair salary, corruption and equality are the main social challenges to be addressed related to the lithium-ion battery value chain in Europe. Current EU policy is Although social acceptance for secondary sources is higher compared to primary extraction, collaboration and genuine engagement with local communities should be integrated in all steps of the value chain from early stages of the project. Harmonizing new policies with the existing policy framework is important to avoid policy gaps and conflicts (which can create uncertainty for companies and make investments challenging). Improving circularity is essential to alleviate the negative social impacts related to primary raw materials.

Implication for the Acts: Legislation that fails to mandate high social standards, proactive community engagement, and policy coherence will undermine its own goals. Furthermore, static laws will quickly become obsolete and acts must be crafted as adaptive, socially grounded instruments that provide long-term certainty.

1. For the Circular Economy Act:

- **Mandate social and environmental criteria as prerequisites.** Make verifiable standards for fair work, anti-corruption, and equality mandatory for accessing public funding or permits for battery projects.
- **Enforce mandatory, Verifiable Sustainability Criteria.** High sustainability standards on all battery materials to ensure all producers bear the true costs, removing the unfair price advantage of unsustainable imports
- **Ensure genuine engagement.** Stakeholder engagement should be integrated in decision making processes and have influence on outcomes, not just utilized as a tool to increase legitimacy.
- **Harmonize policy and practices across member states.** There are significant differences in national policies and permission processes. Alignment with EU level policy should be ensured to improve policy consistency, coherence, comprehensiveness and credibility across the EU area.

2. For the Chips Act:

- **Harmonise high social standards across the value chain.** Use the Act to extend stringent EU social governance (fair wages, anti-corruption) to upstream suppliers of CRMs for semiconductors, ensuring a consistent benchmark.
- **Create strong incentives for circularity and manufacturing in the EU area.** Promote self-sufficiency and reduce dependency from imported materials. Particularly materials that might be produced with lower social sustainability.

Orola, A., Kainiemi, L., Levänen J., Uusitalo V. (2025) Impact in a context: Complementing social life cycle assessment with controversy mapping. Journal of Industrial Ecology (in review).

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The implementation of Circularity in EU battery and raw material policy, Laura Kainiemi, Minttu Laukkanen, Katariina Buure, Anni Orola, 2024. YHYS colloquium 27-29.11.2024 in Lappeenranta, Finland

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PATH FORWARD

Analysis carried out by the RELiEF project demonstrates that securing a circular supply of CRMs requires coordinated action. By integrating the "Secondary Critical Raw Material" principle into the Circular Economy Act and the European Chips Act, the EU can address specific bottlenecks that currently hinder the recovery of materials from industrial waste.

We recommend the following targeted actions to support the practical implementation of these Acts:

Standardize the Definition of Secondary CRMs: Embed a unified EU definition within the Circular Economy Act that recognizes high-purity materials recovered from industrial wastewater, mine tailings, and scrap as strategic resources. This creates the legal certainty required to unlock private investment in non-conventional recovery.

Level the Playing Field through Verifiable Sustainability: To address the unfair price advantage of unsustainable primary imports, the Commission should transition from company self-assessments to mandatory, independent third-party verification of environmental and social footprints. Tools like the Digital Product Passport must link EU market access to these verified standards to ensure fair competition for domestic secondary materials.

Incentivize Circulation and Cost-Competitiveness: Recognizing that sustainable recovery often carries higher initial costs, the EU should introduce fiscal incentives or regulatory "green premiums" for materials sourced within circular industrial ecosystems. This reduces the final price for EU companies and encourages the domestic circulation of strategic assets.

Institutionalize Adaptive Governance and Social License: Move beyond static permitting by mandating active community engagement and benefit-sharing throughout the project lifecycle. Governance frameworks should be designed to be "adaptive," allowing for rapid regulatory updates as recovery technologies and social expectations evolve, thereby securing long-term public trust.

Implementing these targeted updates will help transform secondary resources into strategic assets, providing a clearer pathway for the Circular Economy and Chips Acts to contribute to a resilient and sovereign industrial base.

For more information about the project visit the RELiEF website:

https://www.lithium-relief.eu/

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