



POLICY BRIEF:

Unlocking Critical Raw Materials from Mine Waste While **Protecting** **Freshwater Ecosystems**



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Funded by
the European Union

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Executive summary:

The RAWMINA project demonstrates that innovative bioleaching and nano-based technologies can **safely recover critical raw materials (CRMs)** from mine waste while **reducing environmental risks** paving the way for a circular economy in the mining sector.

Introduction:

Mine waste is one of the largest waste streams in the EU and a significant source of pollution to aquatic ecosystems. These wastes often contain valuable **CRMs** (e.g. antimony, cobalt, germanium, tungsten), but they are also a source of **toxic metal pollution**. Current approaches typically treat these waste sites as liabilities rather than resource opportunities.

RAWMINA's Innovation

1

The RAWMINA pilot system integrates:

Bioleaching using microbial oxidation to release metals from sulphide ores.

Selective nano-based separation for CRM recovery.

A process designed for **low energy consumption, minimal waste, and closed water loops**.

2

Environmental Safety Assessment:

RAWMINA's environmental performance was assessed using **ecotoxicological testing** on:



Aquatic biofilms
(microbial communities)



Macroinvertebrates
(e.g. freshwater snails and amphipods)



Ecosystem functions
(e.g. organic matter decomposition).

3

Key Findings:

- **Bioleached residues** showed no significant toxic impact on aquatic ecosystems, and no acid mine drainage potential.
- **Final effluents from the pilot plant** had:
 - **Low or undetectable toxic metal concentrations** post-dilution.
 - **No adverse effects** on freshwater snails (*Physa acuta*) or biofilm biomass.
 - **Slight changes** in microbial community composition — attributed to **increased conductivity** from calcium and magnesium, not toxicity.

Policy Recommendations:

- 1 **Support the deployment of RAWMINA-like technologies** across Europe to enable CRM recovery from mine waste in a safe, sustainable manner.
- 2 **Update EU mining and water policy frameworks** to:
 - Promote CRM recovery from legacy waste sites.
 - Require **environmental safety assessments** using community-level ecotoxicological indicators (e.g. biofilms, macroinvertebrates).
- 3 **Establish conductivity thresholds and site-specific dilution guidelines** for effluent discharge to protect small or low-flow freshwater bodies.
- 4 **Incentivize circular economy innovations** in the extractive sector via targeted funding, permitting support, and regulatory clarity.

Conclusion:

The RAWMINA project provides **proof of concept** that CRM recovery from mine waste can be achieved **without compromising freshwater ecosystem health**. With appropriate safeguards and scaling support, such technologies can contribute to both **green industrial policy** and **ecological protection** in Europe.



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