

"ADVANCING ECO-FRIENDLY HYDROMETALLURGY FOR SUSTAINABLE RARE EARTH ELEMENT RECYCLING AND CIRCULAR ECONOMY INNOVATION"



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The Problem

CAUSES

Unsustainable rare earth extraction practices
Current REE recovery methods are energy-intensive and rely on hazardous chemicals.

Growing global demand for REEs
The clean energy and tech sectors increase dependency on imported critical raw materials.

Lack of efficient recycling systems
Industrial REE waste is underutilized due to the absence of scalable green processes.

ISSUES

BEFORE

OPPORTUNITIES

AFTER

Development of eco-friendly REE separation technologies
Introduction of ionic liquids, SILMs, and natural adsorbents to replace polluting methods.

Integration of circular economy principles
Water recycling and waste valorisation reduce environmental impact and resource loss.

Strengthened EU autonomy in critical materials
Promotes sustainable domestic recovery routes and reduces external dependency.

OUTCOMES

The Approach

✓ **WP6 – PROJECT MANAGEMENT**
Monitoring progress and deliverables
Financial and administrative reporting
Quality assurance and risk mitigation
Ethical and gender balance oversight

✓ **WP5 – COMMUNICATION, DISSEMINATION AND TRAINING**
Visual identity and project website
Science cafés and public outreach
Social media strategy and technical press articles
Open access publications

✓ **WP4 – INTEGRATED DEMONSTRATION & FEASIBILITY AND REUSE**
REE recovery module simulation
Water treatment demonstrator
Economic analysis and Life Cycle Assessment
Stakeholder involvement and technical standardization



✓ **WP1 – DEVELOPMENT OF ECO-FRIENDLY ILS & MEMBRANE SYSTEMS**
Synthesis of green ionic liquids
Development of Supported Ionic Liquid Membranes
Physicochemical and rheological characterization
Integration with natural polymer supports

✓ **WP2 – SELECTIVE REE EXTRACTION**
Speciation studies of REEs in ILS
Liquid-liquid extraction performance analysis
SILM performance validation
Analytical techniques: ICP-OES, luminescence, XAS

✓ **WP3 – WATER TREATMENT AND REUSE**
Adsorption studies with PYP/ZEO materials
Regeneration of used adsorbents
Reuse as catalysts for advanced oxidation
Evaluation with real industrial wastewater

The Aims



Sustainable REE Recycling
Recover rare earths using eco-friendly hydrometallurgical recycling processes.



Green Solvent Replacement
Use biodegradable liquids and adsorbents to remove toxic chemicals.



Efficient REE Extraction
Optimize REE recovery with advanced separation and membrane technologies.



Advanced Water Treatment
Filter contaminants using natural adsorbents and sustainable filtration systems.



European Resource Independence
Reduce REE imports through local, sustainable recycling solutions.



Research-Industry Connection
Transfer lab innovations to industry for scalable real-world applications.



Circular Economy Integration
Recycle water, reuse waste, and reduce resource consumption.



Global Scientific Collaboration
Unite academia, industry, and policymakers to advance sustainability.

Target groups

MEDIA

Scientific journalists, editors and tech-focused media outlets interested in the environmental and innovation aspects of FREECOVER's outcomes.



MULTIPLIER AGENTS

European Commission dissemination platforms (e.g. EEN, Innovation Radar) and technology clusters that help amplify the project results through networking, brokerage, and exploitation support.



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INDUSTRIAL PLAYERS

Companies and SMEs in the recycling, mining, environmental technology and clean energy sectors. Interested in process scalability, REE recovery solutions, and reducing dependency on imported resources.



PUBLIC ADMINISTRATIONS

Policy makers and government agencies engaged in critical raw material strategies, green industrial policy, circular economy regulations, and resource security at national or EU level.



OTHER PROJECTS

EU-funded or regional projects in the fields of sustainable materials, environmental technology, industrial symbiosis or water reuse, willing to collaborate and share insights.

Capacity building

SKILLS

Enhancing technical and transversal skills through training, transfer and project-based learning.

SYNERGIES

Building strategic links with EU initiatives, research projects and innovation networks.

ACCEPTANCE

Promoting uptake of green technologies via outreach, scalability and stakeholder engagement.

INTERDISCIPLINARY

FREECOVER fosters collaboration between chemists, environmental engineers, materials scientists and sustainability experts

SDGS



Expected Outputs



Sustainable Rare Earth Recycling

Developing eco-friendly hydrometallurgical processes to recover critical raw materials and reduce environmental impact.



Innovative Separation Technologies

Utilizing advanced ionic liquids and membrane systems to enhance efficiency and sustainability in rare earth element extraction.



Strategic Collaboration & Impact

Bringing together academia, industry, and policymakers to drive innovation and support the EU's circular economy goals.