

Deliverable 6.6

Advisory Board and networking activities

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Advisory Board and networking activities

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¹ PU = Public PP = Restricted to other programme participants (including the Commission Services) RE = Restricted to a group specified by the consortium (including the Commission Services) CO = Confidential, only for members of the consortium (including the Commission Services)

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Summary

This report is devoted to inform about the governance and networking building processes in METALLICO project along the first period (M5-M12).

The deliverable describes the progress that the project has done regarding two main areas: the *Advisory Board* progress, as the central instrument that has been designed for project governance, on the one hand, and the activities that have been carried out related to *clustering and networking with other European projects* and other similar initiatives, on the other.

Amongst these, the accession of the METALLICO project to the Cluster Hub “Production of raw materials for batteries from European resources” is of particular relevance.

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1. Introduction

This is the first annual report of a series that will be released every end of year of the project (M12, M24, M36 and M48) to report about the governance and networking building processes in METALLICO project (tasks 6.5 and 6.6).

With this purpose, the deliverable has been divided in these two main topics:

- the Advisory Board progress as the central tool for project governance (task 6.5, starting M6)
- and the activities that have been carried out related to clustering and networking with other European projects and other similar initiatives (task 6.6, starting M5).

2. METALLICO's Advisory Board

2.1. Conceptual framework

An advisory board for a project is a group of external experts or individuals with specific skills and knowledge relevant to the project's goals. In the specific case of METALLICO, it was included as a valuable tool to improve the governance of the project, facilitate the results dissemination and networking, but also with the aim to foster the contribution of the project to shape public policies related to circular economy and recovery of raw materials in the Andalusian mining sector.

From a general perspective, the functions, objectives, and methodology to organize an advisory board are as following:

Functions of an Advisory Board

- **Strategic Guidance:**
Provide strategic advice and guidance based on their expertise.
- **Networking:**
Utilize their networks to connect the project with valuable resources, partners, or opportunities.
- **Problem-Solving:**
Offer insights and solutions to challenges the project may face.
- **Industry Knowledge:**
Bring industry-specific knowledge to enhance decision-making.
- **Mentorship:**
Act as mentors to key project members, offering experience-based advice.

Objectives of an Advisory Board

- **Enhance Decision-Making:**
Improve the quality of project decisions through diverse perspectives.
- **Risk Mitigation:**
Identify potential risks and provide strategies for risk mitigation.
- **Innovation:**
Foster a culture of innovation by introducing new ideas and approaches.

- **Stakeholder Confidence:**

Increase stakeholder confidence by having reputable experts associated with the project.

- **Long-Term Success:**

Contribute to the project's long-term success and sustainability.

Organizing an effective advisory board involves thoughtful selection of members, transparent communication, and a commitment to leveraging the expertise and role of its members for the benefit of the project and its sustainability.

Organization of an Advisory Board:

- **Selection of members:**

Identify institutions and individuals with diverse skills and experiences relevant to the project's needs.

- **Define roles and expectations:**

Clearly define the roles and expectations of advisory board members.

- **Setting the rules:**

Consider setting the rules for the advisory board functioning to ensure there is framework to work that is clear and agreed by all the members.

- **Meetings calendar:**

Schedule regular meetings to discuss progress, challenges and seek advice.

- **Communication:**

Establish effective communication channels between the project team and the advisory board.

- **Recognition:**

Acknowledge and appreciate the contributions of advisory board members.

2.2. Background

One of the most important premises for the proposal and implementation of this Advisory Board in the case of the METALLICO project was the significance of actively involving the regional mining Administration of Andalusia (Secretaría General de Industria y Minas, SGIM). It was crucial for them to not only play a participatory role but also take on a leading role regarding the project's findings and their future implementation.

In connection to this, it's important to consider that this choice was supported by two fundamental factors:

- **Andalusia as a leading European mining region**

Andalusia is one of the mining regions within the OECD that has been selected by this organization as a case study due to its strategic importance and exemplarity among other European regions, as documented in the "Mining Regions and Cities Case of Andalusia, Spain, OECD Rural Studies" report¹.

¹ Mining Regions and Cities Case of Andalusia, Spain, OECD Rural Studies - © OECD 2021, <https://doi.org/10.1787/47062327-en>

“Andalusia is the largest mining producer in Spain, the second-largest copper producer in the EU and a leader in marble and gypsum production. The region benefits from two distinct mining subsectors, each with a rich network of suppliers that are relevant for local development: the metallic mining sector (e.g. copper and zinc), which accounts for most of the regional mining production, and the non-metallic sector (ornamental rocks, aggregates and industrial minerals), which is highly dispersed across the territory. The regional mining value chain has the potential to leverage the increasing global and EU demand for sustainable raw materials and thus become a frontrunner in leading technologies and circular processes for environmentally sustainable mining. This study identifies how Andalusia can build on its strengths and address current and future challenges to improve regional productivity and well-being while accelerating the transition to a low-carbon economy and assisting EU climate goals”.

- A strategic mining planning has recently been approved by Andalusian mining administration ([EMSA 2030](#))

Alongside this, the Andalusian region was immersed in a strategic planning process that engaged various regional stakeholders and where the implementation of the circular economy held significant weight.

2.3. Activities

- [Presentation event to mining regional Administration \(June 2023\)](#)

On 21st June 2023, three representatives from METALLICO project (María González-Moya and Ana Lara from IDENER, and Virginia del Río from At Clave) attended a face-to-face meeting in Seville to present the METALLICO project to the technical-political team of the mining Administration of the Andalusian government (SGIM), in charge of regulatory, planning and management of the mining activity in this region.

In addition to describing the main contents (goals, tasks, processes to be tested, case studies and expected results) of the project, this Administration was invited to integrate in the governance spaces that will be created in the METALLICO framework in the coming months and specifically the Advisory Board. The response was very positive and two interlocutors have been designated to channel communication with this institution in relation to the following tasks.

- [Further progress](#)

Subsequently, contacts have been maintained in order to make further progress in shaping the Advisory Board. Up to date, preliminary contacts with University of Huelva (research group in metals recovery from secondary resources) and industry association of mining related companies of Andalusia (AMINER) have also got successful responses.



2.4. Next steps

The next steps to conform and launch the Advisory Board are the following:

- Keep the preliminary contacts, meetings and informal conversations to prepare the basis for the composition, organisation and functioning of the Advisory Board
- Organise and celebrate the launching event of the Advisory Board (preferably along M13-M15, but depending on SGIM availability)
- Establish the Advisory Board rules and meeting schedule
- Agree on the communication channels
- Celebrate a second session to be held according to the established periodicity

3. Networking and clustering

3.1. Introduction

This chapter is devoted to describe the activities that have been developed along the year (in this first report from M5-M12) related to clustering and networking processes in which different METALLICO partners have been involved.

In June 2023, METALLICO became a member of the [*Cluster Hub for production of raw materials for batteries from European resources*](#) in which other 11 UE research projects are also members



3.2. Activities

This section shows the main activities carried out in the referred period in relation to the clustering and networking process, being the most relevant the incorporation of METALLICO into the *Cluster Hub for production of raw materials for batteries from European resources*.

3.2.1. Cluster Hub “Production of raw materials for batteries from European resources”

The Cluster Hub “Production of raw materials for batteries from European resources” is a knowledge exchange ecosystem where partners involved in different European projects can “prototype” ideas in reality. The platform facilitates collaboration among research institutes, industry and innovation stakeholders driving the recycling of batteries and the production of raw materials for battery applications from primary and secondary resources available in Europe.

It was born late in 2022, when the Clustering Workshop *Production of raw material for batteries from European sources* led to synergies and collaborations between research and industry. Today, the Cluster Hub “Production of raw materials for batteries from European sources” is a collaboration-driven community sharing the same mission – to foster the knowledge necessary to drive a more sustainable and circular production of raw materials for the European battery industry in which 12 projects, including METALLICO, are participating.



Cluster Hub: Manifesto

Mission → to foster the knowledge necessary to drive a more sustainable and circular production of raw materials for the European battery industry



Expand the network
Provide exploitation opportunities



Organise forums to discuss common issues



Provide joint input to the European Commission
Identify future challenges



Foster new innovations
Discover new approaches & processes

Funded by the European Union

These projects have received funding from the European Union's Horizon 2020, respectively Horizon Europe Research and Innovation programmes.

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The Cluster Hub is conformed by the following EU research projects, additional information about all of them is included in Annex 1.

THE CLUSTER

Besides the regular meetings the Cluster Hub member hold, on 16th November, during the 2023 edition of the Raw Materials Week, the twelve EU funded projects that constitute the Cluster Hub ‘Materials for batteries’ gathered for their annual event in Brussels.

The main objective of the meeting was to meet and discuss the latest developments in the participating projects as well as the new challenges and opportunities discovered through the projects’ lifetime. Co-organised by RELiEF, EXCEED, ENICON and RAWMINA, the event was also the opportunity to welcome the four new members of the Cluster (EXCEED, RAWMINA, METALLICO and CRM-geothermal).

The workshop gathered nearly 100 organisations driving the production and the recycling of raw materials for battery applications from primary and secondary resources.

Building on the initial objective of creating an environment that could foster knowledge exchange on different approaches for the recycling and recovery for battery applications, the event focused on three major topics that depict the transversality characterising the projects:

- Session 1: the raw materials through research and science,
- Session 2: the roles and challenges of industry and market for raw materials,
- Session 3: the raw materials under the scope of sustainability, durability and social acceptance.

During this annual meeting, an interactive session led by RELiEF project had the objective of Mapping the European battery material recycling landscape.



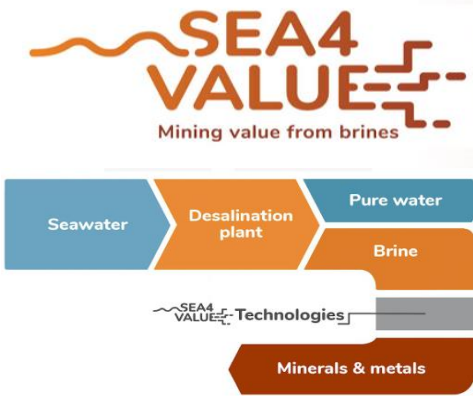
3.2.2. Sea4value

Another EU project with which several exchange and networking sessions have been held is Sea4Value project.

Sea4Value is a project that will design and implement technologies for recovering minerals and metals from seawater desalination brines.

The aim is to make desalination plants the third source of valuable raw materials in the European Union. It is developing 10 innovative technologies to integrate them in a multi-mineral and modular process, which will be the first industrially viable brine mining method.

This European project brings together 16 partners from Spain, Germany, Italy, Belgium, Ukraine, Netherlands, Finland and Switzerland. They represent think-tanks, technology development entities, research centres, universities, industrial companies and public authorities.



After previous contacts in order to get to know each other and look for synergies, METALLICO was invited to the Sea4Value Workshop on “Critical Raw Materials from unconventional sources. Ensuring supply through Circular Economy” that was held in Barcelona on 17th November 2023. WP1 leader (UPC) participated in the event as a representative of METALLICO Consortium.

Workshop
Critical Raw Materials from unconventional sources
Ensuring supply through Circular Economy.

SEA4 VALUE
 Mining value from brines

📅 17 november
 🕒 10 am to 2 pm
 📍 Barcelona - Pending

Organised by:



Co-organisers:



Supported by:



This project is funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 869703



Funded by the European Union

3.2.3. Cluster CRM Poland-Ecoloop Fundacja

Finally, a preliminary contact has been established with representatives from the Ecoloop Fundacja (Horizon Europe Cluster 5 National Contact Point in Poland).



The ECOLOOP Foundation is a joint initiative of female leaders and professionals in the field of sustainable development, ESG and Circular Economy with experience in national and international projects in large companies in cooperation with science, NGOs, SMEs and local governments and international institutions. Successfully creating and coordinating clusters, including national key clusters, such as the Polish Cluster on Raw Materials.

This contact will allow analyse future collaboration opportunities between METALLICO Consortium and this organisation and also it is in progress their introduction to the Cluster Hub *“Production of raw materials for batteries from European resources”* in order to investigate other members’ interest in collaborating with them or even both Clusters’ involvement in future events.

3.3. Next steps

The next steps regarding the clustering and networking processes are the following:

- Actively participate in Cluster Hub (face-to face and virtual meetings, workshops, etc.) and contribute to the discussions and research progress.
- Search for new EU projects but also European initiatives that may have a potential interest in contacting and collaborating.
- Not only within Europe but also investigate initiatives, projects or events in the international scope that may be of potential interest to METALLICO objectives.

Annex 1. List of projects members of Cluster Hub



CROCODILE EU-funded project

First of a kind commercial Compact system for the efficient Recovery Of Cobalt Designed with novel Integrated Leading technologies

Coordinator: FUNDACION TECNALIA RESEARCH & INNOVATION (Spain)

Start date: 1 June 2018 - End date: 30 November 2022

Objective

The CROCODILE project will showcase innovative metallurgical systems based on advanced pyro-, hydro-, bio-, iono- and electrometallurgy technologies for the recovery of cobalt and the production of cobalt metal and upstream products from a wide variety of secondary and primary European resources. CROCODILE will demonstrate the synergetic approaches and the integration of the innovative metallurgical systems within existing recovery processes of cobalt from primary and secondary sources at different locations in Europe, to enhance their efficiency, improve their economic and environmental values, and will provide a zero-waste strategy for important waste streams rich in cobalt such as batteries. Additionally, CROCODILE will produce a first of a kind economically and environmentally viable mobile commercial metallurgical system based on advanced hydrometallurgical and electrochemical technologies able to produce cobalt metal from black mass containing cobalt from different sources of waste streams such as spent batteries and catalysts. The new established value chain in this project will bring together for the first time major players who have the potential of supplying 10,000 ton of cobalt annually in the mid-term range from European resources, corresponding to about 65% of the current overall EU industrial demand. Therefore, the project will reduce drastically the very high supply risk of cobalt for Europe, provide SMEs with novel business opportunities, and consolidate the business of large refineries with economically and environmentally friendly technologies and decouple their business from currently unstable supply of feedstocks.



RHINOCEROS EU-funded project

Batteries reuse and direct production of high performances cathodic and anodic materials and other raw materials from batteries recycling using low cost and environmentally friendly technologies

Coordinator: FUNDACION TECNALIA RESEARCH & INNOVATION_(Spain)

Start date: 1 September 2022 - End date: 31 August 2026

Description

When the battery of an electric car comes to the end of its life, it is not inactive but has a capacity of at least 75 %. Therefore, it can be repurposed for up to a decade in applications such as stationary energy storage. The EU-funded RHINOCEROS project will seek economical and environmentally friendly routes



for reusing, repurposing, reconditioning and recycling end-of-life batteries. Researchers plan to develop a smart system enabling the automated classification of battery materials and the reassembly of working modules in new repurposed batteries. Furthermore, they will investigate ways to cheaply produce high-performance materials for the anode and cathode from the recycled materials. Project achievements will help prevent Europe's technological dependence on other parts of the world.

Objective

Rhinoceros will develop, improve and demonstrate, in an industrially relevant environment, an economically and environmentally viable route for re-using, re-purposing, re-conditioning and recycling of EoL EV and stationary batteries. Rhinoceros will first develop a smart sorting and dismantling system enabling the automated classification and dismantling of LIBs and the reassembly of still working modules in new repurposed batteries for second life applications such as batteries for energy storage systems. When direct reuse and repurpose of batteries is not possible, a circular recycling route of all the materials present in LIBs (e.g. metals, graphite, fluorinated compounds and polymers, active materials) will be followed to close the materials loop. This route is based on a set of cost efficient, flexible and environmentally friendly routes targeting the pre-treatment, refining and the recovery of materials. Through product qualification by industrial end-users, Rhinoceros will demonstrate the direct production of high performances cathodic and anodic materials and other raw materials at competitive costs from battery recycling. The achievements will bring Europe to an increased independence level from foreigner manufacturers and raw materials suppliers.



BATRAW EU-funded project

Recycling of end of life battery packs for domestic raw material supply chains and enhanced circular economy

Coordinator: ACONDICIONAMIENTO TARRASENSE ASSOCIACION (Spain)

Start date: 1 May 2022 - End date: 30 April 2026

Objective

BATRAW main objective is to develop and demonstrate two innovative pilot systems for sustainable recycling and end of life management of EV batteries, domestic batteries, and battery scraps contributing to the generation of secondary streams of strategically important CRMs and battery RMs. The first pilot will deliver innovative technologies and processes for dismantling of battery packs achieving recovery of 95% of battery pack components and separating waste streams including cells and modules by semi-automated processes for recycling. BATRAW's second pilot will scale and demonstrate efficient pre-treatment and continuous hydrometallurgical recycling of battery cells and modules including innovative steps for C-graphite, Al and Cu separation from black mass and Mn extraction, achieving a recovery of the full range of battery RMs (Co, Ni, Mn, Li, C-graphite, Al and Cu) at selectivity of 90-98%. Innovations will be scaled and demonstrated in a pilot system with recycling capacity of 1 ton lithium-ion battery (LIB) packs dismantled per shift (8 hours) and treat 300 kg BM per day. BATRAW outcomes are of strategic importance within the prospects of the exponentially growing EU battery market and reducing EU import dependency of CRMs. The project will further promote the overall sustainability and circularity of battery products and raw materials by developing new procedures for battery repair and reuse, enabling faster diagnostics and conversion of EV packs into second life batteries, delivering eco-design guidelines for battery manufacturing, demonstrating blockchain platform for raw material tracking and supply chain transparency (Battery Passport) and delivering guidelines for safe transports and handling of battery waste. The project aims to maximize



market uptake and impact through ambitious C&D&E plan including circular business models, innovations workshops, dissemination in EU platforms, policy briefs and other strategies to reach markets and stakeholders.

FREE4LIB FREE4LIB EU-funded project

Feasible recovery of critical raw materials through a new circular ecosystem for a Li-ion battery cross-value chain in Europe

Coordinator: FUNDACION CARTIF (Spain)

Start date: 1 September 2022 - End date: 31 August 2026

Description

The transport sector is responsible for around one quarter of Europe's greenhouse gas emissions. Electric vehicles can contribute significantly to the decarbonisation of future road transport. But lithium-ion batteries (LIBs) remain an obstacle: they are not green enough to sufficiently reduce mobility footprints. Recycling is the answer. However, the recovery of lithium is a complicated process that the EU-funded FREE4LIB project aims to simplify. It will develop technologies to achieve six new sustainable and efficient processes to recycle end-of-life LIBs. The project will also deliver three processes aimed at reuse of metals and polymers and electrode synthesis for remanufacturing new LIB battery packs based on the design for recycling. The use of Battery Passports will overcome the current lack of access to open data in the LIB value chain.

Objective

The negative environmental impact results from the linear 'take, make, dispose' and dominant economic models of our time, traditionally adopted by decision-making of main stakeholders around mobility are changing thank to EV's irruption, but Lithium-Ion Batteries (LIBs) are not yet green enough to reduce mobility footprint to lowest levels. Thus, recycling has to be developed to achieve higher efficiencies and recovery rates to reintroduce Critical Raw Materials from End-of-Life (EOL) LIBs. Recycling technology is still at the lab-scale due to the complex structure of EOL LIBs. Currently, pyrometallurgy is the most applied method in the industry. Although this process does not need pre-treatment, its energy-wasting, the equipment investment is large and it will cause serious pollution. In response to these problems, many companies have developed hydrometallurgical processes, that can recover Li and Al with low energy consumption. However, it requires pre-treatment, leaching, purification and other steps, and it could be a long way. FREE4LIB aims to develop at TRL 5-6 technologies to achieve 6 new sustainable and efficient processes to recycle EOL LIBs (dismantling, pre-treatment and 4 materials recovery processes) delivering innovative recycling solutions to reach highly efficient materials recovery (metal oxides, metals and polymers) improving the supply of secondary resources at EU level. FREE4LIB also will deliver 3 processes aiming at metals and polymers re-using and electrode synthesis for re-manufacturing new LIBs, and it will study options to harness non-reusable elements. It will also deliver a Battery Passport (BP) methodology to improve processes traceability. Besides, 2 Open Platforms will be deployed: BP and Data-driven models for the process's optimisation. At end, to validate and spread FREE4LIB: new LIBs will be assembled on battery packs and engagement activities with citizens, policymakers and battery stakeholder will be carried out, respectively.



RESPECT EU-funded project

Flexible, Safe and efficient REcycling of Li-ion batterieS for a comPetitive, circular, and sustainable European battery manufaCTuring industry

Coordinator: ORANO MINING (France)

Start date: July 2022 - End date: June 2026

Description: *Enhancing Europe's lithium-ion batteries value chain*

With the right conditions, batteries will play a crucial role in climate change mitigation. Lithium-ion (Li ion) batteries – capable of storing wind, solar and electric energy forms – are vital to accelerating the decarbonisation of transport and integrating renewable energies into electricity grids. In this context, the EU-funded RESPECT project will develop a global process encompassing a process-chain flexible enough to treat all kinds of batteries in closed loop. Specifically, it will address two recycling routes: full hydrometallurgy and direct recycling and an improved life cycle assessment of each recycling segment. RESPECT will also ensure knowledge sharing on Li-ion battery green recycling processes through engagement with international stakeholders and experts.

Objective

In the context of increasing global battery use, developing sustainable, safe and efficient processes is a tangible issue to further enhance circular economy and strategic autonomy of the European Li-ion batteries value chain, in line with the battery partnership's objectives launched under Horizon Europe. RESPECT main objective is to develop a global process encompassing a process-chain flexible enough to treat all kind of batteries in closed loop, considering the variability of Li-ion batteries chemistries (NMC, LFP, NCA, LMO) , applications (EV and ESS) and states (aged, damaged, EoL, production scraps) up to date not covered by any process on the State of the Art. RESPECT addresses two recycling routes: full hydrometallurgy and direct recycling and an improved Life Cycle Assessment of each recycling segment to lower emissions and reduce secondary pollution, safety and health risks. RESPECT will aim to design and validate the recycling processes up to pilot scale to recovering the highest amount of resources, including CRMs and active materials present in the batteries to closing the loop by their reuse in cathode and anode materials for new batteries. Socio-economic, as well as sustainability aspects will be covered throughout the project. To ensure a successful project implementation, knowledge sharing on Li-ion battery green recycling processes will be fostered, based on the engagement with relevant international stakeholders and experts through the advisory board. Based on a solid and interdisciplinary consortium of partners covering the whole value chain, RESPECT seeks high recovery rates (for Li, Mn, Co, Ni or graphite) with low environmental impact and strong energy savings, in accordance with the European Green Deal and the proposed Battery Regulation.



LiCORNE EU-funded project

Lithium recovery and battery-grade materials production from European resources



Coordinator: FUNDACION TECNALIA RESEARCH & INNOVATION (Spain)

Start date: 1 October 2022 - End date: 30 September 2026

Description: *New technologies in Li processing and recovery*

Europe imports more than half of the necessary battery materials, such as lithium (Li), nickel (Ni), cobalt (Co) and magnesium (Mg). Domestic production is important. In this context, the EU-funded LiCORNE project will establish the first-ever Li supply chain in Europe. It aims to increase European Li processing and refining capacity for producing battery-grade chemicals from ores, brines, tailings and off specification battery cathode materials. This supply chain encompasses five large primary resource owners having resources of lithium carbonate equivalent, in which 2.7 million tonnes of LCE are located in Europe. The value chain includes a cathode manufacturer able to reuse valuable Li, Co and Ni that will be recycled from waste cathode material. LiCORNE will investigate different groundbreaking technologies in Li processing and recovery.

Objective

LiCORNE aims to establish the first-ever Li supply chain in Europe. The goal is to increase the European Li processing and refining capacity for producing battery-grade chemicals from ores, brines, tailings and off-specification battery cathode materials. This supply chain encompasses five large primary resource owners (including one of the world leader in Li production) having resources of ~7.8 Mt lithium carbonate equivalent (LCE), in which 2.7 Mt LCE are located in Europe. The European primary resources that are considered in LiCORNE would be enough to supply ~3000 GWh of batteries (i.e. ~10 years to the expected 300 GWh/year production capacity in Europe by 2030). Additionally, the value chain includes a cathode manufacturer who will be able to reuse valuable Li, Co and Ni that will be recycled from waste cathode material, and one producer and distributor of battery-grade Li-chemicals. LiCORNE will investigate 14 different groundbreaking technologies that have been selected for their potential to operate at low CAPEX and OPEX, low carbon footprint, flexibility and industrial scalability. Those technologies are led by 8 top R&D centers in Europe to tackle the main bottlenecks in Li processing and recovery. During 2.5 years, R&D partners will investigate those technologies and bring their TRL from 2 to 4. After this phase, and guided by LCA and LCCA, the most promising technologies will be selected for upscaling to TRL5. During this phase a prototype system will be constructed and demonstrated at TRL5 to produce ~1 kg of battery-grade Li-chemicals (i.e. LiOH·H₂O, Li₂CO₃ or Li-metal) from ores, brines, tailings and waste cathode material, with the recycling of Co and Ni from the latter. Results will be communicated and disseminated to a wide range of stakeholders and a first business model for a full and optimized Li supply chain in Europe will be established based on the results of the project and cost of Li produced.



RELIEF EU-funded project

Recycling of Lithium from Secondary Raw Materials and Further

Coordinator: AVESTA BATTERY & ENERGY ENGINEERING (Belgium)

Start date: 1 July 2022 - End date: 30 June 2025

Description: *A big boost for lithium recycling*



Funded by
the European Union

Battery scrap is not the only source of lithium (Li) that can be recovered. There are other Li sources. In this context, the EU-funded RELiEF project will target the recovery of Li from other secondary sources. This will reduce unrecovered Li from its waste generation, estimated at 27 % of the current global production. Specifically, the project proposes an integrated recycling facility for the production of Li from secondary raw material materials with continuous processing to produce materials for batteries. Li wastes will be reduced by more than 70 %, which will instead be recycled into high-value battery-grade material. RELiEF will greatly strengthen the EU's competitiveness in the battery storage value chain.

Objective

Current recycling technology is focused on recovering Li from battery scrap, while hardly much focus and technological development is going towards other Li sources. Hence the aim is to recover Li from potential secondary sources, in order to reduce unrecovered Li from its waste generation, which is estimated to be approx. 27.33% of the current global Li production. RELiEF proposes an integrated recycling facility for Li from secondary raw material sources with continuous processing to produce battery materials. Li wastes will be reduced by more than 70%, which will instead be recycled into high value battery-grade material. The results of the integrated and continuous process up to battery precursor recovery will be demonstrated at TRL 5 and battery active material closed-loop process will be demonstrated at TRL4 with a 1.5 – 2.5 kg/week output of battery active materials and a new business model will be developed for the materials acquisition and processing, taking into account environmental and social sustainability. The expected results will contribute to decreasing the dependency of the EU on imported battery chemicals and raw materials. RELiEF will greatly strengthen the EU's competitiveness in the battery storage value chain.

The RELiEF consortium consists of 12 partners, six of which are SMEs (ABEE, EXT, EURICE, IST, PEG, TC), four are non-profit RTOs (IMNR, INEGI, ZSW, NOVA) and further two are universities (LUT, ULB) and one associated industrial partner (LANX), Thus, it a very high amount of industry involvement, entirely in the form of innovative SMEs covering the technological and also the impact maximization related aspects of the project; a perfect combination of basic research methodologies, chemical process and analysis capabilities, technology development in an industrial environment and strong ties to the recycling and battery industry and policymaking entities inside the EU.



ENICON EU-funded project

Recycling of Lithium from Secondary Raw Materials and Further"
Sustainable processing of Europe's low-grade sulphidic and lateritic nickel/cobalt ores and tailings into battery-grade metals

Coordinator: KATHOLIEKE UNIVERSITEIT LEUVEN (Belgium)

Description: *Sustainable refining methods for the profitable recovery of nickel and cobalt*

Electric vehicles are expected to dramatically increase the demand for nickel (Ni) and cobalt (Co) over the next two decades. Europe is expected to face difficulties in securing a reliable, affordable and sustainable supply chain as the concentration of such minerals in the continent is scarce. The EU-funded ENICON project aims to improve the refining capacity of domestic and imported low-grade Ni/Co. ENICON's metal recovery route using hydrochloric acid dispenses with the old-school hydro-based approach that involves continuously precipitating and redissolving metals. Thus, it reduces the amount of chemicals needed for metal dissolution, which result in the production of potentially harmful waste streams.

Objective

The cobalt (Co) and nickel (Ni) demand is expected to be about 20 times higher in 2040 than in 2020. Given that Europe plays only a minor role in the global Ni/Co supply chains, which are concentrated in the DRC, Indonesia and China, we face a serious problem in securing a reliable, affordable and sustainable supply of battery-grade Ni/Co, vital for Europe's aims to be climate-neutral by 2050. In view of a "domestic and foreign sourcing" procurement model, ENICON exploits the potential of (low-grade) Ni/Co resources within Europe – i.e. sulphidic Ni/Co ores and derived Ni/Co-bearing pyrite and silicate tailings, and limonitic/saprolitic laterite Ni(/Co) ores – while improving and developing the Ni/Co-refining capacity that can process imported ores, concentrates and intermediates. ENICON comprises both major improvements to existing Ni/Co metallurgical unit operations in Europe as well as the development of a new HCl-based route for both Ni/Co sulphide concentrates and laterites. ENICON's HCl-route dispenses with the old-school hydro-approach of continuously precipitating and redissolving metals that requires lots of chemicals and creates problematic waste streams. The HCl-based route can be extended to the downstream processing of FeNi (Class-II Ni) obtained from laterites; (2) Mixed (Ni/Co) Sulphide/Hydroxide Precipitate (MSP/MHP) from the bioleaching of Co-rich pyrite tailings; and Ni/Co-containing silicate tailings. ENICON targets a "forensic geometallurgy" protocol, making it possible to identify and mitigate the mineralogical and textural reasons for processing losses along existing and new flowsheets. To make the transition to (near) zero-waste processing and to further reduce CO₂-footprints, ENICON develops enhanced mineral-matrix valorisation processes. The outputs from ENICON's group of European Ni/Co mining, processing and refining companies will all be benchmarked in terms of positive environmental and techno-economic impacts against current methods.



RAWMINA EU-funded project

Integrated innovative pilot system for Critical Raw Materials recovery from mines wastes in a circular economy context

Coordinator: ACONDICIONAMIENTO TARRASENSE ASSOCIACION (Spain)

Start date: 1 May 2021 - End date: 31 October 2024

Description: Integrated innovative pilot system for Critical Raw Materials recovery from mining wastes in a circular economy context. Used to produce a wide range of goods and applications, an unreliable supply of critical raw materials is a growing concern. Currently, the EU relies on the import of raw materials like Antimony, Cobalt and Germanium. In this context, the EU-funded RAWMINA project will develop an innovative pilot system for the clean and sustainable production of non-energy, non-agricultural raw materials in the EU from mine waste resources. Specifically, it will standardise an innovative energy, water- and cost-effective continuous pilot process for producing raw materials. It will also contribute to reducing production costs and environmental impacts.

Objective

RAWMINA will develop and demonstrate an innovative pilot system for the clean and sustainable production of non-energy, non-agricultural raw materials (RMs) in the EU from Mine Waste (MW) resources. RAWMINA will implement and standardize an innovative energy, water- and cost-effective continuous pilot process for producing RMs. It will integrate novel bio-leaching and nano-based materials for Sb, Co, Ge and W selective recovery from MW from "unexploited/underexploited metal

containing materials”. RAWMINA will improve EU competitiveness and create added value in RMs processing, refining and equipment manufacturing by developing a new circular business model as an alternative to traditional linear mining economy. RAWMINA will integrate different technologies that will be demonstrated (TRL7) with MW of diverse geological compositions from EU and non-EU mines demonstrating flexibility in processing of the innovative pilot system. The project will perform a techno-economic and sustainability assessment throughout the entire life cycle considering health, safety, socio-economic and environmental impacts; maximizing water/energy efficiency and waste/wastewater reduction. IP, exploitation and business plans will be developed ensuring market penetration, technology export and first exploitation plan. RAWMINA will transform MW into a resource, enabling marketable products recovery to be used in batteries, flame retardants, optical fibers and industrial tools. The project will create a CRM Recovery Helix to maximise clustering and will interact with local communities to gain EU citizens trust. It will increase resource efficiency and sustainability of EU industry, contributing to decrease EU CRM import dependency. Apart from sheltering the EU from possible shortages in CRM supply, the project will contribute to reduce production costs and environmental impacts, contributing to the objectives of the European Innovation Partnership on RMs.



CRM-geothermal EU-funded project

Sustainable mining of raw materials from geothermal fluids

“Sustainable mining of raw materials from geothermal fluids.”

Coordinator: DEUTSCHES GEOFORSCHUNGSZENTRUM GFZ – HELMHOLTZ-ZENTRUM POTSDAM (Germany)

Start date: 1 July 2022 - End date: 30 June 2026

Description: The energy and digital transitions require a large amount of mineral raw materials, some of which are considered ‘critical’ by the European Union. These Critical Raw Materials (CRM) are predominantly imported from non-European countries where environmental and ethical standards may be less strict than in the EU. However, the EU has largely untapped resources at its disposal in geothermal fluids, some of which contain significant amounts of CRMs.

The EU-funded CRM-geothermal project therefore proposes to combine the extraction of mineral raw materials and geothermal heat, a renewable energy resource from the ground that is available 24 hours per day. The technology solution developed by CRM-geothermal will thus help Europe fulfil the strategic objectives of the EU Green Deal and the Agenda for Sustainable Development while reducing dependency on imported CRM.

Objective: Although CRM are known to occur in geothermal fluids, there are still many uncertainties concerning their occurrence in different geological settings and the sustainability of their extraction. The actual extraction process is also a major challenge requiring technology development.

Hence, the CRM-geothermal project has the following objectives:

- Establish an overview of the potential for raw materials in geothermal fluids for a large range of CRM elements across the EU and third countries

- Determine the source of selected CRM, their mobility and potential for sustained extraction from geothermal brines
- Develop and optimise innovative extraction technologies for selected CRM from geothermal brines that can form a business case for new EU SMEs
- Assess the environmental-social-economic viability, create transparent and traceable value chains, and foster ethical sourcing of CRM
- Demonstrate at a pilot site the extraction technology for at least one CRM in field at the scale of a miniplant and evaluate the total sustainability of system.



EXCEED EU-funded project

Cost-effective, sustainable and responsible extraction routes for recovering distinct critical metals and industrial minerals as by-products from key European hard-rock lithium projects

“Cost-effective, sustainable and responsible extraction routes for recovering distinct critical metals and industrial minerals as by-products from key European hard-rock lithium projects”

Coordinator: VTT (Finland)

Start date: 1 January 2023 - End date: 31 December 2026

Description:

Europe is 100% reliant on imports of Li for the Li-ion batteries that are central to decarbonising the energy and mobility sectors. Some fraction of our needs can come from recycling the batteries already in use, but realistically, primary supply will still have to cover 90% of the Li requirement. Paradoxically, Europe hosts 27 Li hard-rock (pegmatite & Rare-Metal Granite) deposits, representing vast lithium resources (8.8–21.7 Mt Li₂O). However, the identified potential remains largely untouched, which is partly due to a reluctant attitude towards primary (Li) mining in Europe. Europeans are very enthusiastic about EVs, but rather less so about the necessary mining & refining of Li-bearing ores to realise them. By upscaling and integrating results from earlier projects, EXCEED’s 15 partners develop a new mining paradigm, i.e. zero-waste, multi-metal/mineral mining. This will be combined with sustainable mineral processing to provide us with additional critical raw materials (CRMs: rare earths, Nb, Ta, W, Be) and industrial minerals (quartz, feldspar and micas), coming from 4 lithium mines (as case studies) in Finland (Keliber), Portugal (Savannah), France (Imerys) and the UK (Imerys).

The project adopts a mineral-centric, integrated methodology based on an innovative predictive and forensic geometallurgy, supported by enhanced in-line characterisation tools and the development of digital twins. EXCEED develops, upscales and demonstrates cost-effective, sustainable and responsible extraction routes for recovering CRMs and industrial minerals (the latter for use as low-carbon ceramics and cements), as by-products from the 4 Li-bearing hard-rock ores.

EXCEED’s long-term impact includes the replication of the EXCEED solutions to the other 23 European pegmatite and Rare-Metal Granite deposits, thus boosting domestic CRM production (up to 21.7 Mt Li₂O & 1.5 Mt of other CRMs), in a way that gains public support by respecting the environment and creating local jobs.

Objectives:

Recover by-product CRMs and industrial minerals during Li production from LCT-pegmatite and (low-grade) Rare-Metal Granite (RMG) hard-rock deposits through a mineral-centric, integrated approach based on increased orebody knowledge, the use of predictive & forensic geometallurgy and the development of online technologies to provide real-time mineralogical information for process optimization.

Develop new, energy-, material- and cost-efficient flowsheets for recovering CRMs (Nb, Ta, W, Nd/Pr, Be), Sn and industrial minerals (quartz, feldspar, mica) as by-products from two LCT-pegmatite ores (Rapasaari/Syväjärvi, Keliber Oy; Mina do Barroso, Savannah), two Rare Metal Granite ores (St Austell, Beauvoir) and monazite tailings (St Austell's kaolin operations).

Valorise the mineral side-streams (quartz, feldspar, mica) from processing of LCT-pegmatite & RMG ores, as secondary raw materials in construction applications (alkali-activated & supplementary cements; ceramics; lightweight aggregates (LWA) for concrete), ensuring safety & environmental feasibility in line with standardisation practices.

Remove any PHEs (U/Th) and, subsequently, separate and refine the distinct (non-Li) critical metals (Ta, Nb, W, Nd/Pr, Be) and other valuable metals (Sn) that are present in the CRM-bearing concentrates obtained from mineral processing of LCT-pegmatite and RMG ores.

Integrate EXCEED's innovative solutions into near-zero-waste, multi-metal/mineral mining and refining process concepts and to demonstrate them in pilots at TRL6–7, supported by the integration of the digital twins.

Make a novel, integrated Life-Cycle, Techno-Economic and Human Impact Assessment, which will incorporate Social License to Operate (SLO) principles for the newly developed, mineral-centric, integrated processing routes for LCT-pegmatites and RMGs.

Other Objective(s)

Develop a framework of best corporate practices to achieve a SLO, thereby improving the public awareness, acceptance and trust in next-generation, zero-waste mining and sustainable metallurgical processing in Europe.

Cluster EXCEED with projects from the HORIZON-CL4-2022-RESILIENCE-01-07 call, the previous HORIZON-CL5-D2-01-01 call and related calls from the Destination "Increased autonomy in key strategic value chains for resilient industry" as well as on-going H2020 projects on next-generation batteries (call H2020-BAT-2019) + contributing to Batteries Europe and the objectives of the European Raw Materials Alliance.

Communicate in a gender-balanced way the relevance of EXCEED and disseminate the project results to diverse audiences, while improving the public awareness, acceptance and trust with respect to next-generation, zero-waste mining and sustainable metallurgical processing of Li-pegmatite/RMG hard-rock deposits and mines in Europe.

Exploit the results of the project and increase the competitiveness of the Li-producing industry in Europe as well as create new business models for multi-metal (CRM/)/mineral mining of LCT-pegmatite and RMG/greisen deposits.

PROCEEDINGS CLUSTERING WORKSHOP PRODUCTION OF RAW MATERIALS FOR BATTERIES FROM EUROPEAN RESOURCES

Monday, 14 November, during the first day of the 2022 edition of the Raw Materials Week, eight EU funded projects participated in the Clustering workshop Production of raw materials for batteries from European resources.

Due to the increasing usage of batteries for electric vehicles (EVs) and energy storage systems generated by the EU's mission to limit climate change, the demand for many metals relevant for batteries is expected to grow by more than 1000% by 2050. Held in a hybrid format, the workshop provided participants with the opportunity to discover innovation routes followed by the clustering projects on their pathway to secure sustainable and responsible sourcing of raw materials for battery production. The objective of the workshop was to create an environment that could foster knowledge exchange on different approaches for the recycling and recovery for battery applications. Co-organised by [CROCODILE](#), [RHINOCEROS](#) and [LICORNE](#), with the participation of the EU funded projects [BATRAW](#), [RESPECT](#), [RELIEF](#), [FREE4LIB](#) and [ENICON](#), the workshop gathered nearly 100 organisations driving the production and the recycling of raw materials for battery applications from primary and secondary resources.

Nearly three hours packed with presentations provided stakeholders with essential information about each project, from the main objectives and expected outcomes, to the lessons drawn from the activities carried out.



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