ERA•MIN 3

RAW MATERIALS
FOR THE SUSTAINABLE DEVELOPMENT
AND THE CIRCULAR ECONOMY

ERA-MIN JOINT CALL 2021

CATALOGUE OF PROJECTS

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OVERVIEW OF THE 22 TRANSNATIONAL R&I PROJECTS SELECTED FOR FUNDING

ERA-MIN3 comprises a progressive, innovative and flexible pan-European network of 24 public research funding organisations from **16 EU MS countries** (BNSF – Bulgaria; TA CR – Czech Republic; Business Finland – Finland; ETAg – Estonia; ADEME – France; ANR – France; JÜLICH – Germany; GSI – Ireland; MUR – Italy; NCBR – Poland; FCT – Portugal; UEFISCDI – Romania; CDTI – Spain; AEI – Spain; SAS – Slovakia; MIZS – Slovenia; Vinnova – Sweden), **3 EU MS regions** (Hermesfond – Belgium/Flanders; FWO – Belgium/Flanders; SPW – Belgium/Wallonia; CFNA – Spain/Navarra), **one EU Associated country** (TUBITAK – Turkey), and **two non-EU countries** (PRIMA-Québec- Canada; DSI - South Africa).

Built on the experience of the EU project ERA-MIN (2011-2015) and ERA-MIN 2 (2016-2021), ERA-MIN3 aims to support the objectives of the European Innovation Partnership on Raw Materials (EIP RM), the EU Raw Materials Initiative and further develop the raw materials (RM) sector in Europe through funding of transnational research and innovation (R&I) activities, fully aligned with initiatives to support the EU's transition to a Circular Economy in many fields, such as the Circular Economy Action plan, the Battery Action Plan, and the European Green Deal, by moreover answering to the United Nations Sustainable Development Goals. This will be achieved through one EU co-funded call for R&I proposals in 2021, one additional call in 2023 and a potential third one, designed and developed specifically for the non-fuel, non-food raw materials sector.

ERA-MIN3 scope of the joint transnational calls is needs-driven research on non-fuel, non-food raw materials (metallic, construction and industrial minerals) that clearly demonstrate potential to promote the sustainable and responsible supply, exploration, extraction, processing technologies, production, consumption and recycling of primary and secondary minerals and metals, as well as substitution of critical raw materials, in a circular economy. There is a focus on resource efficient production and recycling that has low environmental impact and is economically feasible in the short-term. A crucial challenge is to consider societal impact and public perception, health and safety issues related to the different stages of the whole raw materials value chain. New business models and digital technologies will be crucial for transferring research results to the market.

INTRODUCTION

PUBLISHABLE SUMMARIES OF FUNDED PROJECTS

Topic 1 - supply of raw materials from exploration and mining

AI-COSTSQO
FUTURE
PEGMAT
SEEMS DEEP

Topic 2: Circular Design

Cider
CO2TREAT
POTASSIAL
RecMine
2BoSS

Topic 3: Processing, Production and Remanufacturing

ABtomat
PHOSTER
TailingR32Green

Topic 4: Recycling and Re-use of End-of-Life products and assets

ACROBAT
INN4MIN
MW4REMAM
PHIGO
PG2CRM
RecycleBIM
Recycl3D
Rendering3D
RecyLIB

Topic 5: Cross-Cutting Topics

Scandere


CO2

Introduction

The ERA-MIN Joint Call 2021 on ***"Raw materials for sustainable development and the circular economy"*** is a two-stage submission procedure and is the EU co-funded Call for proposals organised by ERA-MIN3 which began on the 1st December 2020.

The present report is a summary of the 22 R&I projects that were selected and recommended for funding. It also includes the overall statistics of the call from the submitted pre-proposals up to the final successful 22 recommended for funding, including the main call topic and sub-topics addressed by the proposals.

The joint selection list of the projects to be funded and the call statistics prepared by task leader will be published on the ERA-MIN website and on the websites of the participating funding organisations.

ERA-MIN Joint Call 2021 was open on 15th January 2021. The scope of the Joint Call is needs-driven research on non-fuel, non-food raw materials (primary and secondary minerals and metals) addressing one or several areas of the circular economy.

The call began with a total of 146 pre-proposals out of which 142 met the Call eligibility criteria. After the consensus meetings of the Call Steering Committee (CSC) to finalise the stage 1 pre-proposal assessment, a list of 48 eligible pre-proposals that met the score thresholds were invited to submit a full proposal for Stage 2.

The eligibility check was performed to verify the compliance of the pre-proposals with the eligibility criteria of the Call as described in the Call Text. Additionally, the funding organisations as members of the CSC performed the eligibility check according to their national/regional funding regulations, in parallel with the scientific assessment of pre-proposals. As a result, 39 pre-proposals were declared not eligible by the national/regional assessment; 59 eligible pre-proposals were rejected and were not invited to stage 2 and finally, 48 eligible pre-proposals were selected to stage 2. Of these, an additional 3 were also deemed not eligible for stage 2 full-proposal, which produced a final number of full-proposals of 45 for a centralised scientific assessment.

Topic 1

Supply of raw materials from exploration and mining

Project title

Artificial Intelligence and Combined Survey Techniques for Stone Quarries Optimization

Main topic

Topic 1: Supply of raw materials from exploration to mining

Sub-topics

Sub-Topic 1.1: Exploration

Sub-Topic 1.2: Mining operations

Sub-Topic 5.1: New business models (implementing circular economy aspects)

Keywords

Stone Quarries, DFN Model, Artificial Intelligence, Process Optimization, Computer Graphics

Coordinator (partner 1) and consortium partners

1. BAY E Bilişim Danışmanlık Eğitim Bilgisayar Sanayi ve Ticaret Limited Şirketi (Turkey)

2. Geological Institute of Romania; University of Petrosani (Romania)

3. Faculty of Information Studies in Novo mesto (Slovenia)

4. UNIBO - University of Bologna (Italy)

5. Geological Institute of Romania (Romania)

Project duration

36 Months

Total Costs

679,092 €

Total Requested Funding

598,972 €

Project acronym

AI-COSTSQO

Publishable abstract

AI-COSTSQO partners come together to create an eco-efficient and sustainable stone exploitation by using non-invasive survey, optimize production, reducing waste, energy and water usage. Thus, the degree of negative social effects of mining activities, which have increased in recent years, will also be reduced. The interest area of the project will cover both currently operating mines and non-operating deposits. With the project work, an effort will be made to evaluate the current situation, to predict the financial profitability of virgin deposits and the amount of waste to be produced. The project, which has an interdisciplinary character, consists of academic people who are experts in their fields. These people have a lot of projects and academic studies related to the subject, and they are completely locking at the target. The operability of the stone deposit as a rock mass is mostly assessed by the presence of discontinuities. Our project will be primarily the basis on the modelling of the existence of these using Analytical, Mathematical, Statistical, Machine Learning and Big Data solutions. In addition, realistic survey methods will be used as mainly data. The innovative model will be created combining several approaches, like calculating the maximum cuboid volumes that fit into natural polyhedrons and the orientation of the cutting grid, considering discontinuities and planning to cut directions and spatial position of general planning of quarry using block dimension distributions. In this concept, six work packages have been designed and distributed to the partners according to their specialisation. Although there is no exact data for natural stone quarries recovery rates, it is well known these rates may be decreased to about 10% in many quarries. We believe that the project outcomes, combined innovative survey methods and new optimization algorithms, will significantly improve the recovery rates and decrease waste production in stone quarries.

Project title

Fiber-optic sensing and uav-platform techniques for innovative mineral exploration

Main topic

Topic 1: Supply of raw materials from exploration to mining

Sub-topics

Sub-Topic 1.1: Exploration

Keywords

Minerals, Innovation, Seismics, DAS, UAV

Coordinator (partner 1) and consortium partners

1. University of the Witwatersrand, Johannesburg (South Africa)
2. Uppsala University (Sweden)
3. Geological Survey of Sweden (Sweden)
4. Politecnico di Torino (Italy)
5. Nordic Iron Ore AB (Sweden)
6. South Deep Gold Mine (South Africa)
7. University of Venda (South Africa)
8. Sercel Innovation (France)

Project duration

24 Months

Total Costs

1.164,571 €

Total Requested Funding

732,236 €

Project acronym

FUTURE

Publishable abstract

New metal and mineral resources must be discovered to supply the raw materials for emerging technologies and the push for decarbonisation (e.g., wind and solar energy, fast rechargeable batteries with high power-density, fuel cells) and to meet the expectations of billions of people in the developing world for higher living standards. The geological conditions of both Europe and Africa have proven potential to host resources of target metals and minerals. These include, but are not limited to, critical raw materials, which are usually found as associate minerals. However, the mineral exploration sector must improve its capability to image the subsurface: penetration depth, sensitivity and resolution must be increased, while the environmental impact and cost must be reduced. The FUTURE project seeks to develop innovative, environmentally friendly and cost-effective technologies for deep exploration, primarily in the challenging in-mine environment. We plan to develop a prototype system that will allow long-duration synchronized data acquisition on the surface, in mine tunnels, and in boreholes. We will extend the capabilities of well-established surface and borehole fiber-optic DAS and wireless sensing technologies to allow imaging using mode-converted signals and make more accurate near-surface static corrections and characterizations. The high-resolution UAV-Mag-EM surveys will help to optimally orientate a new seismic profile to study the lateral extent of the deposits and possible major fault systems in the area in 3D. We anticipate that the FUTURE project will advance high-resolution imaging and modeling of the host rock and any mineralization between tunnels and the surface, and in the down-dip direction. We will demonstrate these technologies using two exploration targets, viz. iron-oxide deposit (in Sweden), and gold-bearing conglomerates (reefs) overlain by volcanic rocks with contrasting density and seismic velocity (in South Africa).

Project title

Evolved magmatic and pegmatitic systems as sources of critical raw materials and industrial minerals

Main topic

Topic 1: Supply of raw materials from exploration to mining

Sub-topics

Sub-Topic 1.1: Exploration

Keywords

Pegmatite, granite, rare elements, critical raw materials, industrial minerals

Coordinator (partner 1) and consortium partners

1. Masaryk University (Czech Republic)

2. Brgm (France)

3. Geological Institute of Romania (Romania)

4. Geological Institute, Bulgarian Academy of Sciences (Bulgaria)

5. G E T s.r.o; K M K GRANIT a.s. (Czech Republic)

6. Earth Science Institute Slovak Academy of Sciences (Slovakia)

7. K M K GRANIT a.s. (Czech Republic)

Project duration

36 Months

Total Costs

964,757 €

Total Requested Funding

808,892€

Project acronym

PEGMAT

Publishable abstract

Rare metal granites (RMG) and pegmatites typically show a strong enrichment in various metals and critical raw materials (CRM; e.g. Li, Ta, Nb, Sn, W, Be, Cs and REEs) and industrial minerals that are of great interest for Europe. Variscan orogeny in Europe produced multiple districts of RMG, related greisens and pegmatites; in the Carpathian-Balkan area, it is illustrated by I- to S- type granites and rare-element pegmatites with uncertain origin. Also, some Permian granites show promising rare-metal potential. The area potential for CRM is still weakly explored. The PEGMAT project aims to: (i) identify the pegmatites and RMG in the studied area and assess their geological features; (ii) understand processes and structural constraints leading to their formation; (iii) assess raw material content evolution in time and understand their distribution; (iv) characterize internal processes of their formation; (v) determine areas with high potential for exploration. The work planned includes (i) review of available data; (ii) field work, detailed mapping and sampling; (iii) characterization and age dating of the main bodies, including bulk and mineral composition; (v) advanced 3D modelling; (vi) assessment of metallogenic processes; (vii) evaluation of usability of minerals at selected localities. All research institution partners will be involved in all tasks of the project; industrial partners will be involved especially in the applied usability study and field work.

Expected project outcomes and benefits include enhanced knowledge on deposits of CRM, new knowledge on deposit-forming processes, new regional data available for both research and industry, transfer of knowledge and experience; enhanced international cooperation. The project results will primarily serve as a base for evaluation of pegmatite and RMG potential as sources for critical metals according to the National and European Strategies for sustainable development.

Project title

Seismic and electromagnetic methods for deep mineral exploration

Main topic

Topic 1: Supply of raw materials from exploration to mining

Sub-topics

Sub-Topic 1.1: Exploration

Keywords

Geophysics, joint interpretation, seismic, electromagnetic, exploration

Coordinator (partner 1) and consortium partners

1. Geological Survey of Finland (Finland)

2. Uppsala University (Sweden)

3. Bureau des Recherches Géologiques et Minières (France)

4. Institute of Geophysics, Polish Academy of Sciences (Poland)

5. Geopartner Geofizyka sp. z o.o. (Poland)

6. GRM-Services (Finland)

7. IRIS Instruments (France)

Project duration

36 Months

Total Costs

2.182,518 €

Total Requested Funding

1.281,758€

Project acronym

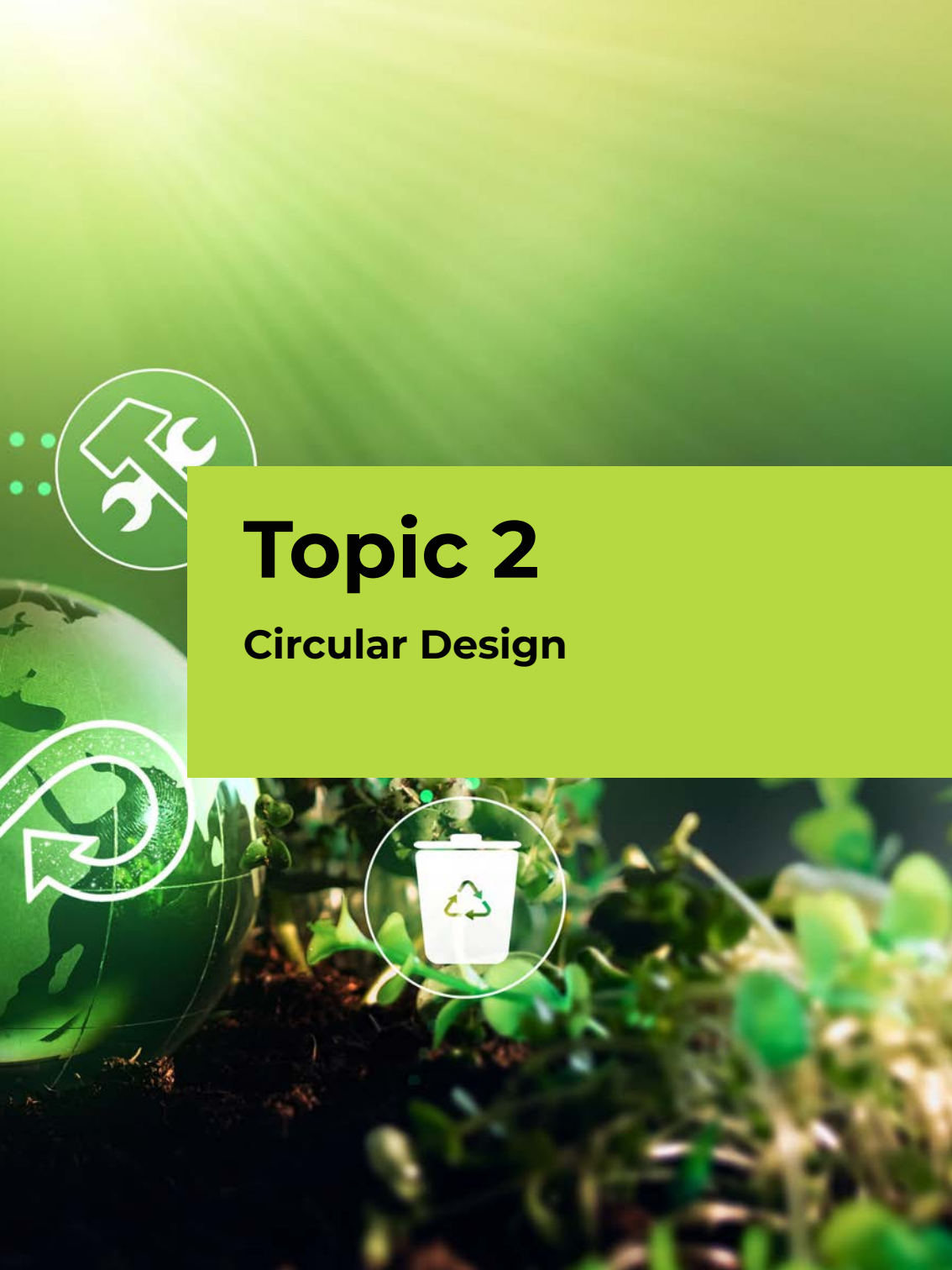
SEEMS DEEP

Publishable abstract

SEEMS DEEP (Seismic and Electromagnetic Methods for Deep mineral exploration) is addressing the challenge of high costs of mineral exploration as well as poor success rates in discovering new deep-seated ore deposits through development of a novel workflow integrating seismic and various electromagnetic (EM) methods. Field data acquisition is planned jointly, and data processing will follow the SEEMS DEEP workflow where EM data is utilized in velocity model building for seismic reflection data while seismic data is used to constrain EM inversion. The test area of SEEMS DEEP is the Koillismaa Layered Igneous Complex in Finland that has potential to host several minerals included in the EU critical raw material list, especially battery related. SEEMS DEEP will develop geomodelling methods for battery mineral exploration and will benefit from petrophysical measurements from a 1.7 km deep drill hole. SEEMS DEEP analysis produces high confidence earth models that add more value to the exploration project than several drill holes that might miss the exploration target and provide only point like data. SEEMS DEEP will acquire seismic reflection profiles to achieve large scale information about the geological architecture of the study area, while 3D seismic and EM surveys provide more detailed information about the target. The Koillismaa deep drill hole provides geological information that will be used as a boundary condition for the EM and seismic data inversion and enables establishing empirical relations between conductivity and seismic velocity. Feedback from these surveys will help to define best practices to industry. Key innovations expected from the SEEMS DEEP project are related to optimized survey design, developments in data acquisition and improved imaging. SEEMS DEEP addresses Europe's goal for raw materials self-sufficiency by increasing the possibilities of successful discovery of new mineral deposits at greater burial depths with lower environmental impact.

Topic 2

Circular Design



Project title

Circular product design for automotive components made from recycled and sustainable composite material

Main topic

Topic 2: Circular Design

Sub-topics

Sub-Topic 2.3: Product design to promote recycling

Sub-Topic 4.4: Recovery of raw materials from End-of-life products

Sub-Topic 5.2: Improvement of methods or data for environmental impact assessment

Keywords

Recycling, composites, circular design, automotive, carbon fibre

Coordinator (partner 1) and consortium partners

1. Fraunhofer IGCV (Germany)

2. Arkema, ADEME (France)

3. AUTOTECH ENGINEERING SPAIN S.L (Spain)

4. Forward Engineerin (Germany)

5. IRT M2P (France)

6. Autefa Solutions Germany GmbH (Germany)

7. Rexhi GmbH (Germany)

8. Plastic Omnium New Energies (France)

9. Tallinn University of Technology Mechanical and Industrial Engineering R&D (Estonia)

Project duration

24 Months

Total Costs

1.851,291 €

Total Requested Funding

920,432 €

Project acronym

Cider

Publishable abstract

A major milestone to achieve a circular economy is to include the product's end-of-life option into the product design. Therefore, a well functioning recycling process as well as appropriable design for recycling principles must be in place. The project Circular product Design for automotive components made from Recycled and sustainable composite material (CIDER) aims to substitute heavy steel designed automotive parts and for a higher acceptance of recycled carbon composites. This involves new approaches into the design of a semistructural automotive parts and additionally improve the recycling process as well as the Life cycle assessment of automotive parts. Hence two topics of the ERA-MIN3 call will be addressed.
On the one side, CIDER will create a circular design (Topic 2.3) for semi-structural automotive parts promoting and determining the recycling process for the produced part at design stage. This will be done by the use of a 100% recyclable composite, saving CO2 in the life cycle, as well as providing a superior recycling strategy compared to conventional steel, aluminium, CFRP or GFRP approaches.
The second topic is addressing the recovery of all material used for the composite parts (Topic 4.4). The recycling of all materials as well their circularity will be demonstrated to showcase that a 100% circular economy for composite structures within the automotive and transportation industry is feasible.

Project title

Accelerated CO2 Treatment of alkaline residues for low carbon binders – CO2TREAT

Main topic

Topic 2: Circular Design

Sub-topics

Sub-Topic 2.1: Product design for increased raw material efficiency

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components

Sub-Topic 5.4: Health safety issues

Keywords

Resource efficiency, carbonation, CO2 emission savings, low carbon binder, industrial residues

Coordinator (partner 1) and consortium partners

1. VITO (Belgium/Flanders)

2. RWTH Aachen University (Germany)

3. Slovenian National Building and Civil Engineering Institute (Slovenia)

4. ArcelorMittal Belgium (Belgium/Flanders)

5. HeidelbergCement AG (Germany)

6. Schüring-Beton GmbH (Germany)

Project duration

36 Months

Total Costs

1.537,736 €

Total Requested Funding

1.103,037 €

Project acronym

CO2TREAT

Publishable abstract

The main aim of the CO2TREAT project is to design resource-efficient, low-carbon binder products for durable concrete and civil engineering applications by partially substituting Portland cement with secondary resources beneficiated by treatment with CO2. The following specific objectives are defined to reach the project goal:

O1: Beneficiation of 3 high-volume, alkaline industrial residues (BOF steel slag, lignite fly ash, co-combustion ash) by CO2 treatment to an intermediate product usable as supplementary cementitious material (SCM) in cement and concrete. · O2: CO2 utilisation at a rate of 25-200 kg/tonne of beneficiated residue by chemically converting CO2 captured from industrial flue gases or CO2 from the atmosphere in thermodynamically stable mineral products. · O3: Recovery of 1-2% metallic iron from BOF steel slags by comminution and physical separation. · O4: Design of 3 sustainable binders comprising the CO2 -treated products complying to national performance and durability standards for cement, concrete and civil works. · O5: Characterisation and modelling of the hydration processes of the new sustainable binders. · O6: Immobilise substances of concern (heavy metals, anions) in the beneficiated residues and the final products and applications keeping release rates below strict thresholds imposed by local environmental legislation and occupational exposure requirements. · O7: Quantification of the sustainability of the use of the CO2 -beneficiated in low-carbon cement, concrete and civil works by a TechnoEconomic Analysis (TEA) and Life Cycle Analysis (LCA) of the environmental impact. CO2TREAT aspires to contribute to meet the EU 2050 Climate change and CO2 reduction targets by designing low carbon durable products from beneficiated residues. By forging new industrial symbiosis linkages between the steel, energy and cement industries, CO2TREAT will enhance the circularity and the competitiveness of the EU energy intensive industries.

Project title

Zero-waste valorisation of feldspathic ores: Green application and sustainable sourcing of strategic raw materials

Main topic

Topic 2: Circular Design

Sub-topics

Sub-Topic 2.1: Product design for increased raw material efficiency,

Sub-Topic 3.1: Increase resource efficiency in resource intensive production processes

Keywords

Feldspathic ores, Sustainable sourcing, Zero-waste valorisation, Advanced materials, CO2 sequestration

Coordinator (partner 1) and consortium partners

1. İnönü University (Turkey)

2. Firat University (Turkey)

3. Muğla Sıtkı Koçman University (Turkey)

4. Luleå University of Technology Department of Civil, Environmental and Natural Resources Engineering (Sweden)

5. Institute of Geotechnics/Slovak Academy of Sciences (Slovakia)

6. Eti Aluminium Inc. (Turkey)

7. Element Six Inc. (United Kingdom)

Project duration

36 Months

Total Costs

694,858 €

Total Requested Funding

557,860 €

Project acronym

POTASSIAL

Publishable abstract

Feldspathic ores containing mainly K-Feldspar ($KAlSi_3O_8$) will be valorised by applying several hydro- and pyrometallurgical processes at which KCl, Al_2O_3, and SiO_2 will primarily be produced without generating any solid waste. Objective is to provide new resources for potash and alumina. Targets are to produce fertilizer-grade KCl, high purity Al_2O_3, synthetic SiO_2, Ca-Silicate, and SiC from one ore and to sequester CO_2 on the same ore. Although there are many studies for K and Al_2O_3 recovery from feldspars and clays, there are no notable commercial attempt to date. Unlike the other KCl and Al_2O_3 production methods suggested in the literature, manufacturing KCl, Al_2O_3, SiO_2, Ca-Silicate and SiC from the same ore without generating any waste is the novelty of this project. Thus, innovative aspect of the project is that feldspathic ores will be processed as a source of high value-added materials for the first time and with zero-waste approach, thus increasing the economic value ofthe proposed process. Also, CO_2 sequestration capability of the feldispatic ores will also be verified to enhance the economic importance those types of resources.

For increased raw materials efficiency, a novel, hybrid and zero-waste processing method will be put forward. This will be established by exploiting the ores, other than bauxite and natural potash ores, and by applying environmentally sensitive production processes.

The project will unlock substantial volume of various raw materials from deposits that cannot be economically or environmentally exploited within or outside the EU through enabling the better efficiency of exploitation of raw materials' resources and increasing the range and yields of recovered raw materials; and push Europe to the forefront in the area of raw materials processing technologies and increase availability of recovered raw material and create added value products through reducing the amounts of industrial tailings to be disposed or landfilled.

Project title

Environmental footprint reduction through eco-friendly technologies of mine tailings recycling

Main topic

Topic 2: Circular Design

Sub-topics

Sub-Topic 2.2: Product design for reuse or extended durability of products

Sub-Topic 2.3: Product design to promote recycling

Sub-Topic 2.4: Product design for critical materials substitution

Sub-Topic 3.1: Increase resource efficiency in resource intensive production processes

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components

Keywords

Waste management, geopolymers, refractories, 3D printing, life cycle assessment

Coordinator (partner 1) and consortium partners

1. Gheorghe Asachi Technical University Iasi (Romania)

2. Universidade da Beira Interior (Portugal)

3. University of Chemical Technology and Metallurgy (Bulgaria)

4. Middle East Technical University (Turkey)

5. OBRAS Y SERVICIOS TEX, S.L. (Spain/Navarra)

Project duration

24 Months

Total Costs

623,489 €

Total Requested Funding

402,906 €

Project acronym

RecMine

Publishable abstract

The aim of this project is the valorisation of high-volume mineral residues from mining and different industrial residues (such as coal combustion by-products (CCP) and demolition waste (DW)) for the development of (i) new geopolymers with low CO2 footprint, and (ii)advanced refractories, suitable for 3-D printing applications. This will be done through the development of two innovative processing techniques that will be able to make the mine tailings and the industrial wastes suitable for replacing the concrete based on Ordinary Portland Cement (OPC), reducing the requirements of primary raw materials, the waste generation and landfilling. It will be ensured that the developed materials (the geopolymers and the refractories) match the technical and environmental criteria for its use in steel industry or civil engineering applications and develop appropriate business models to secure profitability and sustainability. Accordingly, the overall objective of the project is to use wastes from five different European countries (Romania, Bulgaria, Portugal, Turkey and Spain) for the obtaining of new green materials, considering the advantages introduced by 3D printing method. Therefore, it is expected to obtain technological progress in the manufacture of geopolymers and refractories which use mine tailings and industrial wastes (CCP and/or DW) as raw materials, due to the presence of a SME as end-user. Moreover, knowing that the synthesis of the materials with similar characteristics (Ordinary Portland cement-based materials) involves consumption of virgin raw materials (kaolin, limestone, sand, gravel, clays) or high temperatures for curing or calcination, the project aims the improvement of currently developed materials by obtaining ambient cured geopolymers with 100% recycled raw materials and self-flowing refractories (high-temperature ceramics)with low or ultra-low cement content that are suitable for 3D-printing.

Project title

Toward sustainable batteries based on silicon, sulfur and bio-mass derived carbon

Main topic

Topic 2: Circular Design

Sub-topics

Sub-Topic 2.1: Product design for increased raw material efficiency

Sub-Topic 2.2: Product design for reuse or extended durability of products

Sub-Topic 2.3: Product design to promote recycling

Sub-Topic 2.4: Product design for critical materials substitution

Keywords

Energy storage, battery, silicon recycling, bio-sourced carbon, lithium-sulfur battery

Coordinator (partner 1) and consortium partners

1. FUNDACIO INSTITUT DE RECERCA DE L'ENERGIA DE CATALUNYA (Spain)

2. Politecnico di Torino (TU Turin) (Italy)

3. Commissariat à l'énergie atomique et aux énergies alternatives (France)

4. Cleopa Gmbh (Germany)

Project duration

36 Months

Total Costs

1.002,683€

Total Requested Funding

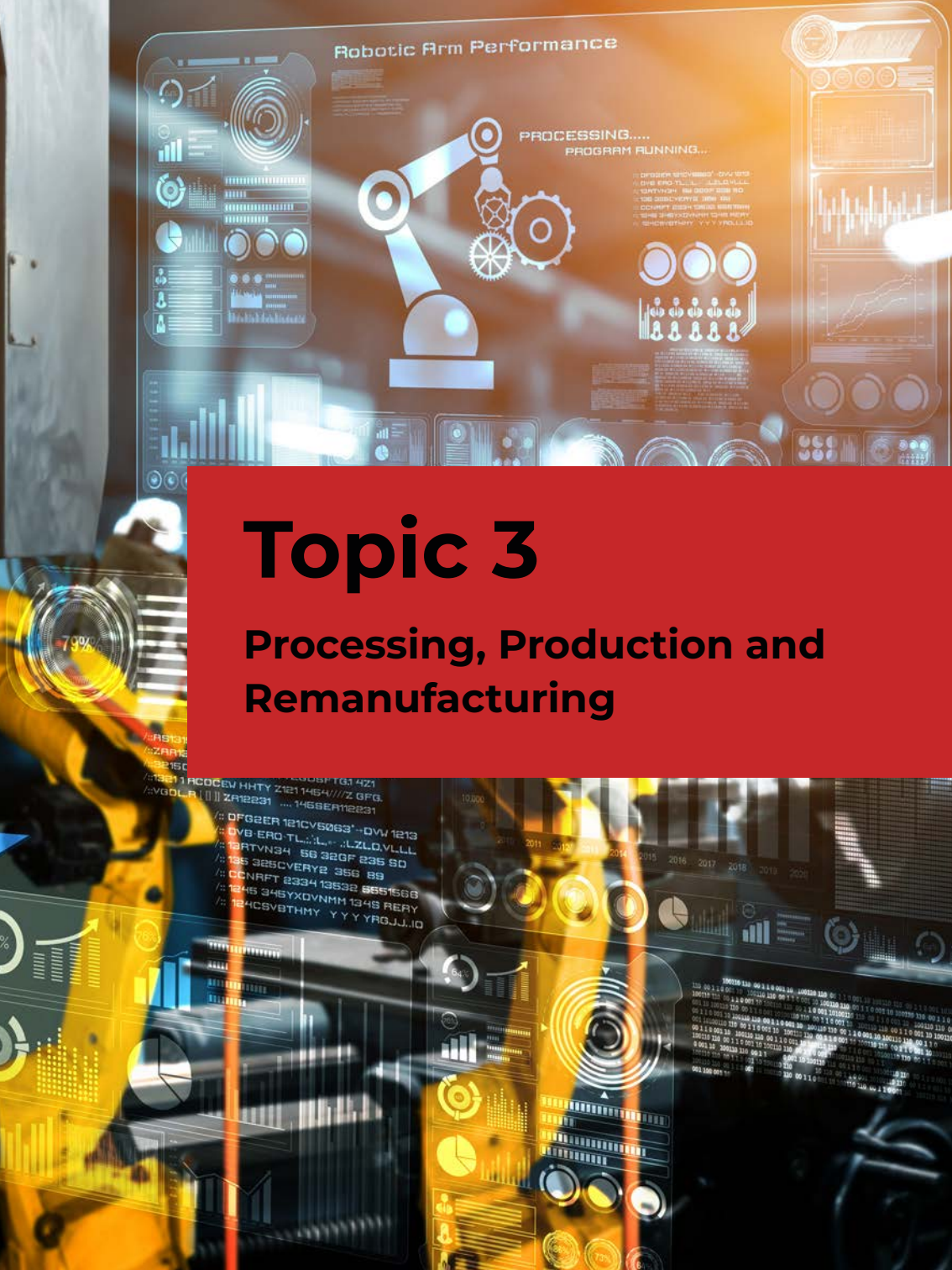
812,453€

Project acronym

2BoSS

Publishable abstract

The recycling of raw materials to manufacture new components, hence closing the circular economy loop, is especially critical in a fastgrowing and strategic sector such as energy storage. The sustainable production of batteries requires securing the availability of raw materials, and the use of effective strategies for their recycling. Given the intrinsic limitations of current lithium-ion batteries, a new sustainable battery technology is needed. 2BoSS will develop sustainable batteries compatible with the circular economy by: 1) validating a silicon-sulfur battery technology designed to minimize the use of CRMs, provide optimized performance, and enable the circular use of material resources. 2) validating effective recycling strategies for the separation and reuse of raw materials; 3) assessing the cost, life cycle, and environmental, health and safety impact; and 4) designing high-performance products and their scaled-up manufacturing. 2BoSS will validate a battery technology supported on a cobalt-free Li2S-based cathode and a graphite-free silicon-based anode, using nitrogen-doped carbon cloths obtained from organic waste as current collector. Besides improving performance and minimizing the use of CRMs, a key advantage of the battery technology here proposed is the easier recycling of its raw materials. 2BoSS batteries are designed to use no metal collector and to incorporate no metal additive at the cathode, anode and electrolyte, which will allow a more effective and economical separation of the two key raw materials. 2BoSS will design, validate and define the up-scaling of effective lixiviation strategies to separate and regenerate the battery key elements. Additionally, life cycle assessment and social life cycle assessment will be carried out to better understand environmental and social impacts of the developed technology along the life cycle and to provide valuable feedback to optimize their contribution to a more circular economy.



Topic 3

Processing, Production and Remanufacturing

Project title

Utilization of aluminium bearing raw materials for the production of aluminium metal, other metals and compounds

Main topic

Topic 3: Processing, Production and Remanufacturing

Sub-topics

Sub-Topic 2.3: Product design to promote recycling

Sub-Topic 3.1: Increase resource efficiency in resource intensive production processes

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components

Sub-Topic 4.3: Reuse, repair, refurbishing, repurposing and remanufacturing of End-of-Life products

Sub-Topic 5.1: New business models (implementing circular economy aspects)

Sub-Topic 5.2: Improvement of methods or data for environmental impact assessment

Keywords

Bauxite substitutes, Green material recovery processes, Material and Waste Circularity, Sustainable Metallurgy, Life Cycle Cost Assessment

Coordinator (partner 1) and consortium partners

1. University of Chemical Technology and Metallurgy (Finland)

2. KTH Royal Institute of Technology (Sweden)

3. Istanbul Technical University (Turkey)

4. Yeditepe University (Turkey)

5. ETI Aluminyum (Turkey)

6. United Energy, a. s. (Czech Republic)

7. Bowmen Consulting, s. r. o. (Czech Republic)

8. Sokolovská uhelná, právnínástupce, a.s. (Czech Republic)

9. AV EKO Color, s. r. o. (TA CR)

10. Public University of Navarra (UPNA) (Spain/Navarra)

11. TALLINN UNIVERSITY OFTECHNOLOGY (Estonia)

12. Arslan Aluminyum (Turkey)

Project duration

36 Months

Total Costs

1.002,683€

Total Requested Funding

812,453€

Project acronym

ABtomat

Publishable abstract

Bauxite is the primary ore in World primary aluminium production. About 90% of global bauxite supplies are found in tropical and subtropical areas. Bauxite was announced as a critical raw material in the CRM list 2020 of the EU. Bauxite has critical importance for the sustainability of the European economy and industry. The reserve of Bauxite is declining, its quality is degrading, and availability decreasing. Importance of ensuring a sufficient and secure supply of Bauxite, or finding an adequate replacement, is key to maintaining the EU's independence and self-sufficiency. While producing alumina compounds from Bauxite, the dross and red mud are the waste-by-product from the processes. Disposal and resource utilisation of red mud is restricted due to its high alkalinity and harmful elements. ABTOMAT aims to find and assess Bauxite alternatives, considering regional characteristics in Central Europe and Turkey, focussing on the design and development of multi-products flexible metallurgical processes for Alumina, A2O3 -based compounds and Aluminium production from lowgrade raw and secondary materials. The diaspore, dross, red mud, clay, dust, and topaz are analysed.
The emphasis will be placed on the holistic approaches related to the circular economy, zero-waste and Life Cycle Cost Assessment (LCCA) principles. ABTOMAT investigates the novel concepts that decrease environ. the footprint of primary aluminium production through dross utilisation as raw material and red mud as bed material, oxygen carrier and catalyst in biomass gasification to promote biomass conversion and thereby efficient recovering Fe and other metals. Further, The ABTOMAT will deliver an LCCA framework, a unique data set, and a business model to establish symbiotic multi-products production systems in the Czech Republic and Turkey. It also strengthens Sweden's climate initiatives by providing waste materials that can be used in clean energy conversion to recover valuable materials from it.

Project title

Phosphorus and magnesium recovery from waste streams for production of highvalue renewable fertilizers

Main topic

Topic 3: Processing, Production and Remanufacturing

Sub-topics

Sub-Topic 2.4: Product design for critical materials substitution

Sub-Topic 3.1: Increase resource efficiency in resource intensive production processes

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components

Keywords

Critical raw materials recovery, sewage sludge, mining by-products, sustainable fertilizers, circular economy

Coordinator (partner 1) and consortium partners

1. Politecnico di Milano (Italy)

2. University of Ljubljana (Slovenia)

3. Timac Agro Italia S.p.A. (Italy)

4. Magnesitas Navarras, S.A. (Spain/Navarra)

5. REA Dalmine SpA (Italy)

6. MM Spa (Italy)

Project duration

30 Months

Total Costs

747,142 €

Total Requested Funding

457,000 €

Project acronym

PHOSTER

Publishable abstract

To comply with sustainable development goals, fertilizers and related supply chains based on primary raw materials are considered a major challenge in terms of sustainability and security of supply. Similar challenges are emerging also within established waste-management practices, revolving around increasing adoption of wastewater sludge incineration across EU as well as extensive disposal of mining by products. PHOSTER tackles these challenges simultaneously and delivers a sustainable, replicable and scalable circular economy solution (TRL 4) for the recovery of secondary minerals and metals from incinerated sludge ashes and mining industry by-products to substitute primary critical raw materials (phosphate rock, phosphorus, magnesium) in the manufacturing of fertilisers. The methodology is based on an integrated assessment of the production process for high value finished product recovery aimed at optimising technical, economic, environmental, and social performance of the production process and recovered products already from the inception phase onwards. The redeveloped concept for critical material recovery on which PHOSTER focuses encompasses co-precipitation of phosphorus extracted from mono-incinerated sewage sludge and magnesium-rich mining by-products for recovery of nutrient-rich material. All relevant stakeholders (i.e., waste producers and managers, mining industry, fertiliser manufacturers, technology developers, experts in sustainability.

PHOSTER aims to (i) develop a new manufacturing route for high-value secondary resources in fertiliser industry obtained from waste streams, (ii) improve the environmental performance of sewage sludge disposal by introducing a circular loop closure through sustainable recycling of phosphorus to the food chain, (ii) improve the environmental performance of involved production chains, and (iv) create locally replicable circular supply chain.

Project title

Mine tailings Reprocessing, Revalorization and Risk reduction connecting innovations in metal recovery, geopolymerization, ceramics & sealing layers

Main topic

Topic 3: Processing, Production and Remanufacturing

Sub-topics

Sub-Topic 1.2: Mining operations

Sub-Topic 1.3: Mine closure and reclamation

Sub-Topic 3.1: Increase resource efficiency in resource intensive production processes

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components

Sub-Topic 5.1: New business models (implementing circular economy aspects)

Sub-Topic 5.4: Health safety issues

Keywords

Mine tailings revalorization and reuse, critical raw elements recovery, construction bricks from mine tailings, geopolymeric sealing layers, Green economy-based new business model.

Coordinator (partner 1) and consortium partners

1. Universidad de Huelva (Spain)

2. University of Aveiro (Portugal)

3. Central University of Technology (South Africa)

4. Basque Center for Materials, Applications & Nanostructures (Spain)

5. University of the Free State (South Africa)

6. National University del Altiplano (Peru)

Project duration

36 Months

Total Costs

932,755 €

Total Requested Funding

627,911 €

Project acronym

TailingR32Green

Publishable abstract

TailingR3 2Green ultimate goal is to develop a New Business Model based on a circular and zero-toxic approach to revalorize and reuse the mine tailings while minimizing their environmental impact. This green economy and zero toxic approach will lead to (1) the full bio-recovery of critical raw elements as REE and Co diluted in secondary sources as mine tailings, (2) the revalorization of mineral by-products as construction bricks and (3) the mine tailing sealing by in-situ geo-polymerization process to create sealing layers that will prevent the water percolation and pollutant lixiviation to the surrounding ecosystems. TailingR3 2Green approach is flexible and adaptable to the geochemical and mineralogical nature of the mine tailings, and in parallel, it has been designed to maximize the economic gain minimizing the environmental impact. The global challenge pursued by in TailingR3 2Green is easily understood if it is considered the potentials of the current inactive and active tailing deposits worldwide jointly with the increasing pressure of the critical raw elements (CRE) market. The connection of the CRE recovery, mineral by-products revalorization, and environmental impact minimization is essential to build up new economic business models that evaluate the benefits balancing the economic, societal and environmental gains of the process. The innovative and circular approach pursued in the project will have concrete and measurable direct and side impacts specifically mentioned on this call, like (1) greener mining technology development, (2) secondary CRE resources revalorization, (3) founding business parallel opportunities thanks to mineral by-products reshaping, (4) securing CRE supply for EU, and (5) gaining the trust of the society on the need of a future green-mining and its importance to secure the transition to a green-energy and circular society.

Topic 4

Recycling and Re-use of End-of-Life products and assets

Project title

Advanced crms Recycling from spent LFP Batteries

Main topic

Topic 4: Recycling and Re-use of End-of-Life products and assets

Sub-topics

Sub-Topic 2.3: Product design to promote recycling

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components

Sub-Topic 4.2: End-of-life products pre-processing: pre-treatment, dismantling, sorting, characterisation

Sub-Topic 4.4: Recovery of raw materials from End-of-life products

Sub-Topic 4.6: Increase recycling or reuse through information and communication technologies (ICT)

Sub-Topic 5.1: New business models (implementing circular economy aspects)

SubTopic 5.4: Health safety issues.

Keywords

End-of-life, recycling, lithium-ion batteries, lithium iron phosphate, critical raw materials

Coordinator (partner 1) and consortium partners

1. Vlaamse Instelling voor Technologisch Onderzoek (VITO) (Belgium/Flanders)

2. KU Leuven (Belgium/Flanders)

3. Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) (Italy)

4. Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (Gemany)

5. Accurec Recycling GmbH (Germany)

Project duration

24 Months

Total Costs

1.548,796 €

Total Requested Funding

1.124,296 €

Project acronym

ACROBAT

Publishable abstract

Globally, olivine-type lithium iron phosphate (LiFePO4 , LFP) batteries have gained a considerable share within the lithium ion battery (LIB) market (23-36% in 2015-2016). However, no dedicated, economically-viable, industrial-scale recycling process exists for LFP type LIBs in Europe or elsewhere. Nevertheless, LFP batteries contain three critical raw materials (CRMs), namely 0.8 wt.% lithium, 2.5 wt.% phosphorus and 16 wt.% graphite on battery cell basis. Efficient recycling of LFP LIBs is also required from an environmental point of view as the electrolyte contains toxic agents. ACROBAT aims to recycle end-of-life LFP LIBs via efficient, innovative and environmentally-friendly processes and separation techniques to recover a maximum amount of EU-CRMs as high-value products and base metals (ferrous and Cu/Al fractions). The specific ACROBAT objectives are to research, develop and validate (i) LFP-dedicated pre-treatment (i.e., shredding, mechanical separation) of EoL LFP LIBs with reduced cross-contamination; (ii) continuous, contact-free, in-line characterisation of LFP black mass; (iii) extractive recovery of electrolyte materials (i.e., conducting salts, organic solvents); (iv) recovery of graphite by froth flotation; (v) recovery of lithium as battery-grade lithium hydroxide monohydrate by HCl-based hydro-/solvo metallurgy; and (vi) direct recycling of LFP black mass by tandem hydrometallurgy-hydrothermal synthesis. The sustainability of the ACROBAT flowsheet is evaluated by a life cycle assessment. Overall, the ACROBAT consortium (VITO, ENEA, Fraunhofer ILT, KU Leuven, Accurec) aims to recover 90% of the EU-CRMs (i.e. Li, P and graphite) and recycle LFP cathode material, graphite and electrolyte, respectively up to 5.4, 6.2 and 4.4 kt/y by 2030 in Europe. This would represent an overall value of 180 M€. ACROBAT's Industrial Advisory Board (Umicore, Aurubis, Bebat, Sorbat and Electrocycling) will catalyse the industrial valorisation of the project results.

Project title

Development of innovative and sustainable approaches applied to the recovery of gold and critical elements from ores and spent printed circuit boards

Main topic

Topic 4: Recycling and Re-use of End-of-Life products and assets

Sub-topics

Sub-Topic 3.1: Increase resource efficiency in resource intensive production processes

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components

Sub-Topic 4.2: End-of-life products pre-processing: pre-treatment, dismantling, sorting, characterisation

Sub-Topic 4.4: Recovery of raw materials from End-of-life products

Sub-Topic 5.3: Social acceptance and trust/public perception of raw materials.

Keywords

Gold Processing, Sustainable and Innovative Processes, Hybrid Hydrometallurgy of Gold, Electric Pulse Fragmentation, Recycling of PCBs

Coordinator (partner 1) and consortium partners

1. Faculty of Engineering of University of Porto (Portugal)

2. BRGM (France)

3. G.E.O.S. Ingenieurgesellschaft mbH (Germany)

4. INOVA+ Innovation for growth (Portugal)

5. National Laboratory for Energy and Geology (Portugal)

Project duration

36 Months

Total Costs

1.034,316 €

Total Requested Funding

536,858 €

Project acronym

INN4MIN

Publishable abstract

INN4MIN pretends to implement a strict I&D methodology to promote best practices in the recovery of gold from ore deposits (primary resources) and printed circuit boards PCBs (secondary resources), supported by a technological monitoring plan. Innovative methods will be investigated having as main drivers the reduction of environmental impacts, improvement of mineral processing efficiency and promotion of good practices in mining industry. Ore deposits are becoming poorer and complex. PCBs exhibits a high gold content, but their availability cannot be consistent to justify the investment on a processing plant. In line with this, INN4MIN will focus on the following topics: study of innovative comminution techniques to increase gold liberation from complex ores; use of greener reagents in the froth flotation and leaching stages; development of a cost-effective device to remove sterile material from the PCBs; design a hybrid hydrometallurgical approach for gold processing from ores and PCBs; recovery of critical elements during the hydrometallurgy of gold; improve the public perception regarding the mining industry. The project will start with the preparation and characterization of the material that will be studied (WP1). Then, comminution based on EPF will be compared to the conventional comminution pathway (WP2). This would be followed by the assessment of EPF effect on subsequent separation processes, by the study of greener flotation reagents and by the development of a prototype to reject sterile material from PCBs (WP3). The hydrometallurgy of gold will be studied to develop a hybrid process based on the use of greener leaching solutions. Moreover, the feasibility of a staged leaching process to recover critical elements would be assessed (WP4). An action plan to face the public perception regarding mining industry will be implemented during the project (WP5). WP6 is devoted to the project management, ensuring the timely delivery and dissemination of the project results.

Project title

Microwave enhanced recovery of rees and plastic from WEEE and re-use in Additive Manufacturing of novel magnetic components

Main topic

Topic 4: Recycling and Re-use of End-of-Life products and assets

Sub-topics

Sub-Topic 2.4: Product design for critical materials substitution

Sub-Topic 5.2: Improvement of methods or data for environmental impact assessment

Sub-Topic 5.3: Social acceptance and trust/public perception of raw materials

Keywords

Rare Earths; Microwave technology; Liquid metal extraction; mechano-synthesis; Additive Manufacturing

Coordinator (partner 1) and consortium partners

1. FADDTORY SPRL (Belgium/Flanders)

2. Institute of Catalysis - Bulgarian Academy of Sciences (IC-BAS) (Bulgaria)

3. SIRRIS (Belgium/Wallonia)

4. Daily Sources and Research Srl (Romania)

5. National R&D Institute for Nonferrous and Rare Metals-IMNR (Romania)

6. Travelec SA (Belgium/Wallonia)

Project duration

36 Months

Total Costs

646,812 €

Total Requested Funding

553,410 €

Project acronym

MW4REMAM

Publishable abstract

Rare Earths Elements (REE) are essential materials in connected and electrical technologies, and the transition to a decarbonisation and greener economy, due to their unique properties making them suitable for use in various high tech applications. The main objective of the MW4REMAMproject is to develop an innovative technology for efficient recovery of both rare earth metals and plastics from end-of-life WEEE and urban mines. Then re-use them as raw material for fabrication of plastic-RE composite filaments and create new magnetic components via additive manufacturing. The objective is fully in line with topic 4. Recovery of raw materials from End-of-life products, sub-topic 4.The specific objectives of the project are:Elaboration of a microwave technology enabling to separate and recover plastic and REE from end-of-life NdFeB magnets in WEEE with high efficiency and low environmental impact;obtaining nano and microcrystalline RE powders using mechanochemical processing; obtaining of plastic-RE composite filaments from recycled materials and demonstrate the capabilities to be re-used in additive manufacturing of new magnetic components via fused deposition modelling technology; estimation of the environmental effect of the new technologies, in order to comply with the objectives of Green Deal; aawareness of the great public about the environmental and economic benefits of the recycling of REE from WEEE and the innovative potential of re-use in additive manufacturing of magnets. The proposed project is highly innovative at European level by the two methods that will be developed: plastic; RE recovery by microwave technology as a major step forward in economic and environmental treatment of NdFeB small magnets from WEEE and the re-use of both plastics and RE in micro/nano powders for obtaining filaments for Additive Manufacturing technology (FDM) and the re-design of new magnetic parts by AM.

Project title

Thermal Processing of P-rich ashes aiming for HIGH-GRADE PHOSPHORUS Products

Main topic

Topic 4: Recycling and Re-use of End-of-Life products and assets

Sub-topics

Sub-Topic 2.1: Product design for increased raw material efficiency,

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components,

Sub-Topic 4.4: Recovery of raw materials from End-of-life products,

Sub-Topic 5.1: New business models (implementing circular economy aspects)

Keywords

Phosphorus recovery, P-rich ashes, critical materials, incineration, thermal extraction

Coordinator (partner 1) and consortium partners

1. Swerim (Sweden)

2. Ege University (Turkey)

3. Porto University, Faculty of Sciences (Portugal)

4. Central Mining Institute (Glowny Instytut Gornictwa) (Poland)

5. University of Brescia (Italy)

6. P.U.P.H „PROGEO" Sp. z o.o. (Poland)

7. University Politehnica of Bucharest (Romania)

Project duration

36 Months

Total Costs

1.108,109 €

Total Requested Funding

758,234 €

Project acronym

PHIGO

Publishable abstract

The EU phosphorus requirements are supplied by import from Mideast, Russia and China. Due to its economic importance and supply risk, the European Union included the phosphorus and phosphate rocks (PR) in the “List of critical raw materials (CRM) for the EU”. Phosphorus is also difficult to be substituted. One of the most sustainable options to secure future P supply within EU is recovery of P from food production and consumption chain which is also the EU P strategy. The 1st pillar of the strategy is biowastes incineration which will enrich the P-content by 6-7 times to a P-rich fraction and at the same time produce green energy. The innovative PHIGO solution aims to optimize the incineration step (the 1st pillar of the strategy) and to develop a sustainable technology for efficient P-extraction from the P-rich ashes (the 2nd pillar of the strategy) and thereby enabling closing the P loop in the EU P-strategy. The project will be realized via a cross-discipline approach with experts in incineration processes (University of Ege with industrial actors GURES and INEVA, Turkey), material characterizations and evaluation (University of Porto, Portugal), thermal extraction processes (Swerim, Sweden and University Politehnica of Bucharest, Romania), evaluation of products, processes and zero waste approaches (GIG and PROGEO, Poland) and sustainability assessment (University of Brescia, Italy). The main contributions of the PHIGO to the Strategic Implementation Plan of the European Innovation Partnership on Raw Materials and the ERA-MIN Research Agenda include: - Recovery of critical material (CRM) P and reduced import of another CRM phosphate rock; - A sustainable EU P-strategy to secure the P need and close the P-Loop within EU. The PHIGO solution will also contribute, in the future, to a more secured food supply on a global level as PR is nonrenewable and limited primary resource and P is an indispensable element for the food industry.

Project title

Phosphogypsum Processing to Critical Raw Materials

Main topic

Topic 4: Recycling and Re-use of End-of-Life products and assets

Sub-topics

Sub-Topic 4.4: Recovery of raw materials from End-of-life products

Keywords

Phosphorus recovery, P-rich ashes, critical materials, incineration, thermal extraction

Coordinator (partner 1) and consortium partners

1. École des Mines de Saint-Étienne (France)
2. Freiberg University of Mining and Technology (Germany)
3. Institute of Nuclear Chemistry and Technology (Poland)
4. Universidad de Huelva (Spain)
5. NOVA.ID.FCT/ NOVA School of Science & Technology (Portugal)
6. Czech University of Life Sciences Prague (Czech Republic)
7. Biopolinex Sp. Z. o.; (Poland)
8. ALFERROCK GmbH (Germany)
9. OCP S.A. (Morocco)

Project duration

36 Months

Total Costs

2.576,988 €

Total Requested Funding

1.826,828 €

Project acronym

PG2CRM

Publishable abstract

More than three-quarters of phosphate fertilizers produced globally are produced using phosphoric acid as an intermediate product, leaving4–6 t low-radioactive phosphogypsum (PG) per t P2O5 produced, as relevant by-product/waste. About 85% of the 5.6–7.0 billion t PG produced globally over the lifetime of the phosphate industry are disposed of in stacks in 52 countries worldwide. The largest stacks in the EU are found in Lithuania, Poland, Spain, Greece, Bulgaria, Serbia and Kosovo, the Netherlands, Belgium, Portugal and Finland. 3-4 billion tare accessible for recovery worldwide and approximately 2 billion t are accessible for recovery in Europe. At the current rate of production, these stacks of low-radioactive material are growing by some 200 million t per year. From a regional environmental point of view, PG maybe the single most critical processing issue of fertilizer production today. The objective of the project “Phosphogypsum Processing to Critical Raw Materials” (PG2CRM) is to further develop an innovative process for REE recovery from PG that has recently been patented by the coordinator from TRL 4-5 (lab-scale experiments) which is the current state to TRL 7-8 (continues pilot plant operation). The focus will be on the comprehensive use of PG and besides the opportunity to recover REEs from it, the remaining gypsum matrix will be used as an inexpensive material in construction/sound insulation.

Project title

Integrated Planning and Recording Circularity of Construction Materials through Digital Modelling

Main topic

Topic 4: Recycling and Re-use of End-of-Life products and assets

Sub-topics

Sub-Topic 4.5: Recovery of raw materials from End-of-life immovable assets, e.g. buildings

Sub-Topic 4.6: Increase recycling or reusethrough information and communication technologies (ICT)

Keywords

Construction Industry, BIM, Open-source tool, multi-criteria optimisation, database and case studies

Coordinator (partner 1) and consortium partners

1. University of Minho (Portugal)

2. Technische Universität Darmstadt (Germany)

3. Universidade de Vigo (Spain)

4. Stellenbosch University (South Africa)

5. ACCA software S.p.A. (Italy)

6. Südhessische Wertstoffrückgewinnungs GmbH (Germany)

7. University of the Western Cape (South Africa)

8. LEZAMA DEMOLICIONES S.L. (Spain)

9. Lafarge Centre de Recherche (France)

10. Technische Universität Darmstadt (Germany)

11. Newton (Portugal)

12. Gaiurb EM (Portugal)

13. Marta Campos – Architecture (Portugal)

Project duration

36 Months

Total Costs

2.001,664 €

Total Requested Funding

1.102,492 €

Project acronym

RecycleBIM

Publishable abstract

The project intends to make a multi-national and multi-stakeholder effort towards the creation of an integrated framework for circularity ofraw materials of construction, leveraged on the wealth of information that is brought about by 'Building Information Modelling'. Theframework includes five main aspects: (i) development of a new methodology of survey of constructions to-be-demolished, based on state ofthe art methods (e.g. handheld laser scanning) to allow semi-automated digital twins of buildings to be created at a controlled cost; (ii)establish adequate BIM modelling rules (and information requirements) that allow the BIM model to host all the relevant information for thefull deconstruction analysis, including health and safety aspects, deconstruction phasing/techniques and quantity take off regarding thematerials available for reuse and recycling; (iii) create an IFC-based tool for multi-criteria optimisation of deconstruction strategies andmaterials, so that designers of new construction, or planners of deconstruction of 'to-be-demolished' can have their BIM models analysed ina platform that manages an integrated multi-criteria optimisation procedure for deconstruction phasing and strategies, including LCA/LCCanalysis (with distinct peculiarities when making Design for Deconstruction, or when solely planning the demolition of an existing building);(iv) strategic and optimised use of recycled demolition waste in 3D printed concrete for local digital construction practice; (v) make all theprevious developments together with a specific set of tools for Municipalities to use in their process of issuing both deconstruction and newbuilding permits based on BIM models (openBIM), as to manage better focus in municipal approvals based on traceable data, and at thesame time, keeping accurate records of material circularity at a local level (enabling global optimisation strategies at municipal level).

Project title

Recycled aggregates for 3D printed concrete structures

Main topic

Topic 4: Recycling and Re-use of End-of-Life products and assets

Sub-topics

Sub-Topic 2.1: Product design for increased raw material efficiency

Sub-Topic 2.2: Product design for reuse or extended durability of products,

Sub-Topic 4.1: End-of-life products collection and (reverse) logistics

Sub-Topic 4.4: Recovery of raw materials from End-of-life products

Sub-Topic 4.5: Recovery of raw materials from End-of-life immovable assets, e.g., buildings

Sub-Topic 4.6: Increase recycling or reuse through information and communication technologies (ICT)

Keywords

Construction & Demolition Waste, fine reycled aggregates, 3D printing, recycled concrete, additive manufacturing

partners

1. University of Salerno (Italy)

2. Universitat Politècnica de Catalunya (Spain)

3. c5Lab (Portugal)

4. LNEC (Portugal)

5. West Pomeranian University of Technology in Szczecin (Poland)

6. BETOTEST POLSKA Sp. z o.o. (Poland)

7. Federal University of Rio de Janeiro (Brazil)

8. Arizona State University (USA)

Project duration

36 Months

Total Costs

1.427,580 €

Total Requested Funding

772,939 €

Coordinator (partner 1) and consortium

Project acronym

Recycl3D

Publishable abstract

Construction & Demolition Waste (CDW) represents one of the most relevant materials flows globally and ambitious goals for its management were set by the EU. Nonetheless, market uptake of recycling and recovery products from CDW is still lacking. In particular, the fine recycled aggregates (fRA) are still the most under-used component without a clear entry point into the circular economy model. The recovery/recycling of CDW can be improved by developing its use in higher-grade applications through innovation and emerging technologies. In this context, the Recycl3D (Recycled aggregates for 3D printed concrete structures) project aims at maximizing the recovery of fRA derived from CDW and valorizing it as an essential constituent in the fabrication of new concrete elements through innovative 3D printing technologies. Therefore, Recycl3D tackles the challenges of sustainability (circular economy) and innovation (additive manufacturing) of current relevance for the construction industry. The actions within Recycl3D will facilitate the entry of fRA from CDW into the circular economy value-chain and at the same time increase the material efficiency and lead to higher added value. Then, the mechanical, durability and service-life of 3D-RAC elements (considering also their recoverability and recyclability) could be consistently predicted and, consequently, the barriers for future market uptake can be addressed by designing and optimizing 3D-RAC structural prototypes and testing them in relevant environments. These outcomes will directly impact both the scientific and industrial communities at both the global/European level and the national/regional one. The project consists of Applied/Industrial Research activities in the fields of sustainable construction materials & structures and additive manufacturing performed by a carefully tailored Consortium that ensures a multidisciplinary and complementary expertise needed to significantly advance current knowledge.

Project title

Recycling End of Life permanent magnets by innovative sintering and 3D printing

Main topic

Topic 4: Recycling and Re-use of End-of-Life products and assets

Sub-topics

Sub-Topic 4.3: Reuse, repair, refurbishing, repurposing and remanufacturing of End-of-Life products

Keywords

Critical raw materials, Rare Earths magnets, Neodymium, Recovery, Recycling

Coordinator (partner 1) and consortium partners

1. Università di Genova (Italy)

2. Consiglio Nazionale delle Ricerche – CNR (Italy)

3. NKAD PRINTERS (France)

4. University of the Basque Country UPV/EHU (Spain)

5. Universite de Paris (France)

Project duration

24 Months

Total Costs

808,135 €

Total Requested Funding

571,720 €

Project acronym

Rendering3D

Publishable abstract

The global demand of NdFeB permanent magnets (PMs), increased enormously in these last years due to the huge production of machines in which NdFeB magnets are key components: wind turbines, electric and hybrid vehicles and others. Since the world Rare Earth (RE) market is China's controlled, one of the most promising solution for the future independence of Europe from the Chinese monopoly, is the reuse or recycle of RE-based PM from End of Life (EoF) magnets. The recent directives of the European Commission in terms of reducing dependence from imports and increased capability to produce and use raw materials, is focused on the Strategic Implementation Plan, in which one of the action areas is "Recycling of raw materials from products, buildings and infrastructure" . The present project Recycling End of Life permanent magnets by innovative sintering and 3D printing (Rendering3D) is addressed to the development of a scientific and technical base for a route to recycle EoL NdFeB PMs in order to produce new magnets with similar or even better magnetic features. It involves the controlled milling of EoL magnets to a powder, which is fed to two pipelines. The "sintering" line leads to sintered magnets while the "3D printing" line leads to 3D printed bonded magnets. These processes mainly entail mechanical processing and no costly chemical or thermal process. with large environmental footprint. are involved. The general aim outlined above requires achievement of several particular goals: Processes to optimize a protocol to achieve submicrometric high quality magnetic powders from EoL magnets for the production of different types of magnets; and Products to obtain either isotropic and anisotropic sintered magnets and 3D printed customized shape bonded magnets. Finally, this project seeks to raise the awareness of companies using permanent magnets to contribute to the recovery of these magnets in a European Circular Economy Path, totally independent from third parties.

Project title

Direct Recycling of Lithium-Ion Batteries

Main topic

Topic 4: Recycling and Re-use of End-of-Life products and assets

Sub-topics

Sub-Topic 2.2: Product design for reuse or extended durability of products

Sub-Topic 2.3: Product design to promote recycling

Sub-Topic 2.4: Product design for critical materials substitution

Sub-Topic 3.1: Increase resource efficiency in resource intensive production processes

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components

Sub-Topic 4.2: End-of-life products pre-processing: pre-treatment, dismantling, sorting, characterisation

Sub-Topic 4.3: Reuse, repair, refurbishing, repurposing and remanufacturing of End-of-Life products

Sub-Topic 4.4: Recovery of raw materials from End-of-life products

Sub-Topic 4.6: Increase recycling or reuse through information and communication technologies (ICT)

Sub-Topic 5.1: New business models (implementing circular economy aspects)

Sub-Topic 5.2: Improvement of methods or data for environmental impact assessment

Sub-Topic 5.3: Social acceptance and trust/public perception of raw materials

Sub-Topic 5.4: Health safety issues

Keywords

Direct recycling, remanufacturing, dry electrode coating, sustainability assessment, Lithium-Ionbattery

Coordinator (partner 1) and consortium partners

1. Fraunhofer Institute for Silicate Research ISC (Germany)

2. HUTCHINSON SA, ADEME (France)

3. Ghent University (Belgium/Flanders)

4. ImpulsTec GmbH (Germany)

5. Bavarian Research Alliance GmbH (Germany)

6. Carl Padberg Zentrifugenbau GmbH (Germany)

Project duration

36 Months

Total Costs

1.148,888€

Total Requested Funding

937,210€

Project acronym

RecyLIB

Publishable abstract

Motivated by the economically and ecologically intriguing perspective of utilizing up to 40 % of recycled materials in the battery production by 2050, more and more manufacturers put the integration of recycled materials on their R&D roadmaps. These activities are emphasized by the European Commission's intention to create a closed-loop economically viable supply chain. The global objective of RecyLIB is the research on a novel process chain of direct recycling of Li-ion batteries with subsequent reintegration of the recovered electrode material into new electrodes via melt manufacturing processes and the performance evaluation in battery cells. The contribution of this concept to a circular value chain will be assessed. With a work plan covering all relevant process steps for the manufacturing, testing and recycling, RecyLIB addresses the need for an integrated manufacturing process for battery electrodes utilizing battery active material recovered by a low-energy, high-yield recycling process for the direct reuse of battery active materials. Active dissemination of the project results via social media and high-impact, peer reviewed scientific journals as well as a dedicated stakeholder engagement workshop are planned. With an expected reuse of up to 25 wt% of recycled electrode material in the electrode manufacturing process and the waiver of toxic solvents without detrimental effects on the cell performance, RecyLIB will have a direct impact on the growing EU battery production ecosystem. The recovery of electrode materials with a high yield using low energy and low CO2 emission processes, enabling the recovery of Critical Raw Materials will leverage the transition towards a closed-loop circular economy in Europe. In a nutshell, the benefit of RecyLIB will be an electrode manufacturing process designed for recyclability flanked by an electrode recycling process designed for the re-manufacturability.

Topic 5

Cross-Cutting Topics

Project title

Scaling up a circular economy business model by new design, leaner remanufacturing, and automated material recycling technologies

Main topic

Topic 5: Cross-Cutting Topics

Sub-topics

Sub-Topic 2.1: Product design for increased raw material efficiency

Sub-Topic 2.2: Product design for reuse or extended durability of products

Sub-Topic 2.3: Product design to promote recycling

Sub-Topic 3.2: Increase resource efficiency through recycling of residues or remanufacturing of used products and components

Sub-Topic 3.3: Increase resource efficiency using information and communication technologies (ICT)

Sub-Topic 4.1: End-of-life products collection and (reverse) logistics

Sub-Topic 4.2: End-of-life products pre-processing: pre-treatment, dismantling, sorting, characterisation

Sub-Topic 4.3: Reuse, repair, refurbishing, repurposing and remanufacturing of End-ofLife products

Sub-Topic 4.6: Increase recycling or reuse through information and communication technologies (ICT)

Sub-Topic 5.1: New business models (implementing circular economy aspects

Keywords

Product-as-a-service, holistic perspective, systemic design, technology, non-technological framework condition

Coordinator (partner 1) and consortium partners

1. Linköpings Universitet (Sweden)

2. Elektrorecykling S.A. (Poland)

3. Poznan University of Technology (Poland)

4. Compliance and Risks (Ireland)

5. Katholieke Universiteit Leuven (Belgium/Flanders)

6. Institut Polytechnique de Grenoble (France)

7. BSH Hausgeräte GmbH (Germany)

8. Asociatia ECOTIC (Romania)

Project duration

36 Months

Total Costs

1.495,494 €

Total Requested Funding

1.251,224 €

Project acronym

Scandere

Publishable abstract

Securing the supply of raw materials is one of Europe's biggest challenges. The Commission has identified 30 critical raw materials (CRMs), which are adopted by products in many sectors. Today, most of the products are processed in the "make-sell-use-dispose" paradigm, where original equipment manufacturers (OEMs) intend to sell a higher number of products and lose control of the products after their sales. The product-as-a-service (PaaS) model, which provides OEMs with a reverse incentive, is emerging as a promising concept in several sectors and creating a potential for increasing the CRM efficiency by a factor of two or more. However, to raise and upscale the adoption of CRM-efficient PaaS business models, a major challenge is to holistically address the inter-dependent activities occurring in different points both temporally and geographically: product design, remanufacturing, and recycling. Therefore, front runners in European industry and academia, including the need owners and solution providers, will join forces in this project to tackle this challenge taking consumer electrical and electronic equipment as an example. The objectives are to 1) create three demonstrators with improved product designs, leaner remanufacturing, optimized recycling and adapted regulations in a CRMefficient PaaS business model from the three pillars of sustainability using indicators with the lifecycle perspective and 2) improve knowledge for product design, remanufacturing, and recycling including their interplays among them in a whole CRM-efficient PaaS offering. The major outcomes will showcase three CRM-efficient PaaS offerings with enhanced sustainability as a European model to business leaders and policy makers. The major expected impacts are 1) increasing the CRM efficiency and security from the EU's interest, 2) decoupling economic growth and resource use and 3) improving innovation capacity for further enhancing CRM-efficient PaaS business models.

RAW MATERIALS
FOR THE SUSTAINABLE DEVELOPMENT
AND THE CIRCULAR ECONOMY

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