E R A•M I N 2

RESEARCH & INNOVATION PROGRAMME ON RAW MATERIALS
TO FOSTER CIRCULAR ECONOMY

Acronym: ERA-MIN 2
Title: Implement a European-wide coordination of research and innovation programs on raw materials to strengthen the industry competitiveness and the shift to a circular economy
Grant Agreement number: 730238
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Start date: 1st December 2016
Duration: 60 months

DELIVERABLE D7.4

LIST OF FUNDED PROJECTS CALL 2018

WP 7: Joint Calls without EU co-funding
Task 7.3: Implementation of joint call(s)
Task Leader: Vinnova
Lead beneficiary: Vinnova
Type: Website
Dissemination level: Public
Author(s): Susanne Gylesjö (Vinnova) and Dina Carrilho (FCT)
Due date: M34
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ERA-MIN 2 comprises a progressive, pan-European network of 21 public research funding organisations from 18 countries/regions (Argentina, Belgium-Flanders, Brazil, Chile, Finland, France, Germany, Ireland, Italy, Poland, Portugal, Romania, Slovenia, South Africa, Spain, Spain-Castilla y Léon, Sweden and Turkey).

Built on the experience of the EU project ERA-MIN (2011-2015), **ERA-MIN 2** aims to enhance and strengthen the coordination of research and innovation programmes in the field of non-energy, non-agricultural raw materials (construction, industrial and metallic minerals) to support the European Innovation Partnership on Raw Materials, the EU Raw Materials Initiative and further develop the raw materials sector, in Europe and globally, through funding of transnational research and innovation (R&I) activities.

ERA-MIN 2 will support demand driven research on primary and secondary resources, and substitution of critical raw materials under a circular economy approach, to give the opportunity to the R&I community to apply to world-wide coordinated funding, gaining access to leading knowledge and new markets, while reducing fragmentation of R&I funding across Europe and globally. This will be achieved through one EU co-funded call for R&I proposals in 2017 and two additional calls, in 2018 and in 2019, designed and developed specifically for the non-energy, non-agricultural raw materials sector.

Publishable summary: The report contains the list of the 12 projects selected for funding under ERA-MIN Joint Call 2018 without EU co-funding. It includes the call statistics, data on each project and their publishable abstracts. This information is public and available at the ERA-MIN 2 website.

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1 INTRODUCTION

A total of 24 funding organisations participated in the second **ERA-MIN Joint Call 2018** on "*Raw materials for the sustainable development and the circular economy*" launched on 31st October 2018. This call was a one-step submission procedure and considered the lessons learnt from Call 2017 as well as input from the Advisory Board. Six new funding organisations from Brussels, Wallonia, Calabria, Greece, Slovakia and Québec joined this call of ERA-MIN 2 and a total budget of €14.5 million was committed. The proposal submission deadline was 31st January 2019. Considering the ranking list of proposals as recommended by the Scientific Evaluation Board and the available national and regional public funds, the Call Steering Committee selected 12 transnational R&I projects for funding. The results were communicated on 4th June and the projects will start November 2019 at the latest and run for 24-36 months.

More information on the Call topics and procedures is available at a dedicated webpage: https://www.era-min.eu/joint-call/era-min-joint-call-2018 (Figure 1).

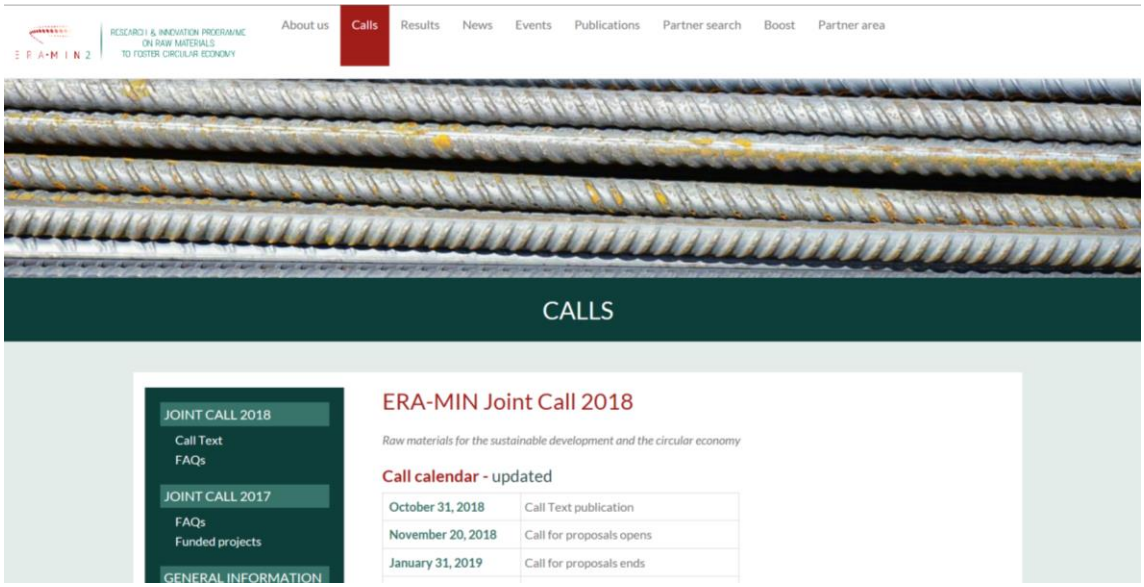

Figure 1 - ERA-MIN 2 webpage dedicated to ERA-MIN Joint call 2018

This report contains the information published at the ERA-MIN 2 website including call statistics, the funded projects and their publishable abstracts.

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2 CALL STATISTICS

The **ERA-MIN Joint Call 2018** was focused on needs-driven research on non-energy, non-agricultural raw materials (metallic, construction and industrial minerals), with a circular economy approach.

The five main thematic areas of the call were based on the challenges and priorities identified in the ERA MIN Research Agenda covering both primary and secondary resources and substitution of Critical Raw Materials:

1. **Supply of raw materials from exploration and mining;**
   - 1.1. Exploration
   - 1.2. Mining operations
   - 1.3. Mine closure and reclamation
2. **Design;**
   - 2.1. Product design for increased raw material efficiency
   - 2.2. Product design for reuse or extended durability of products
   - 2.3. Product design to promote recycling
   - 2.4. Product design for critical materials substitution
3. **Processing, Production and Remanufacturing;**
   - 3.1. Increase resource efficiency in resource intensive production processes
   - 3.2. Increase resource efficiency through recycling of residues or remanufacturing of used products and components
   - 3.3. Increase resource efficiency using information and communication technologies (ICT)
4. **Recycling and Re-use of End-of-Life products;**
   - 4.1. End-of-life products collection and (reverse) logistics
   - 4.2. End-of-life products pre-processing: pre-treatment, dismantling, sorting, characterisation
   - 4.3. Recovery of raw materials from End-of-life products
   - 4.4. Increase recycling of End-of-Life products through information and communication technologies (ICT)
5. **Cross-Cutting Topics.**
   - 5.1. New business models
   - 5.2. Improvement of methods or data for environmental impact assessment
   - 5.3. Social acceptance and trust/public perception of raw materials

The thematic areas are in line with the integrated strategy proposed in the EU Raw Materials Initiative, the Strategic Implementation Plan of the European Innovation Partnership on Raw Materials and the EU Circular Economy Package.

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2.1 STATISTICS OF SUBMITTED PROPOSALS

The Joint Call had a one-stage submission process and generated submission of 51 proposals. After an eligibility check for compliance with both ERA-MIN 2 rules as well as national/regional regulations 40 proposals were sent to a centralised independent international scientific assessment.
The submitted 51 proposals involved 280 applicants of which 62 were enterprises (22%), requesting around €36 million of total public funds and total costs of €49 million (Figure 2).

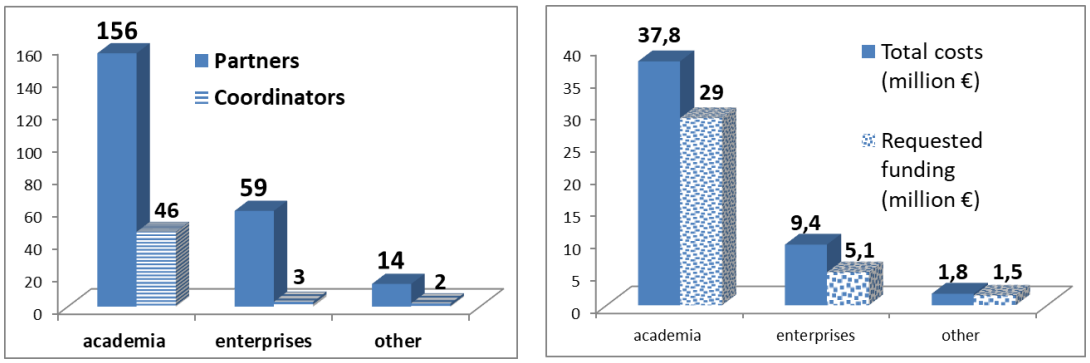

Figure 2 - Number of coordinators and partners, total costs and requested funding by type of organisation: academia, enterprises and other.

In Figure 3, the distribution of the applicants (coordinators and partners) by country or region/funding organisation is presented.

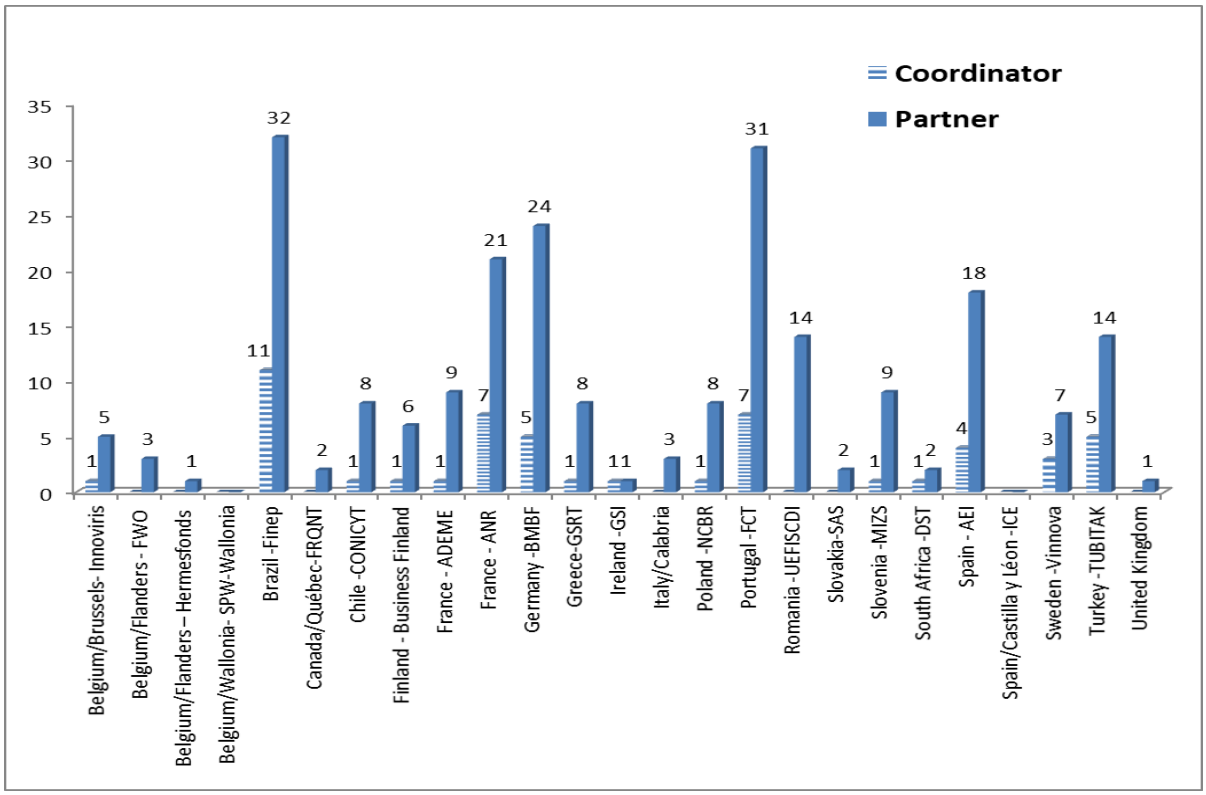

Figure 3 - Number of coordinators and partners in submitted proposals per country/region and funding organisation.

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Figure 4 shows sub-topics addressed by the submitted proposals expressed as the percentages of the thematic area they belong to. Sub-topics in thematic area #4 and #3 are the ones most addressed and area #1 are the less addressed. It was possible to address more than one sub-topic per proposal.

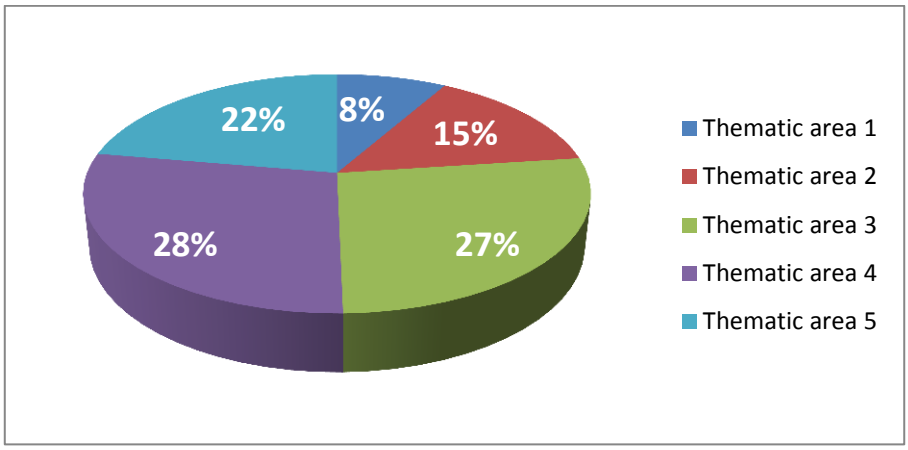

Figure 4- Percentage of each thematic area addressed in submitted proposals.

The distribution of thematic areas addressed by the submitted proposals per each funding organisation is shown in Figure 5.

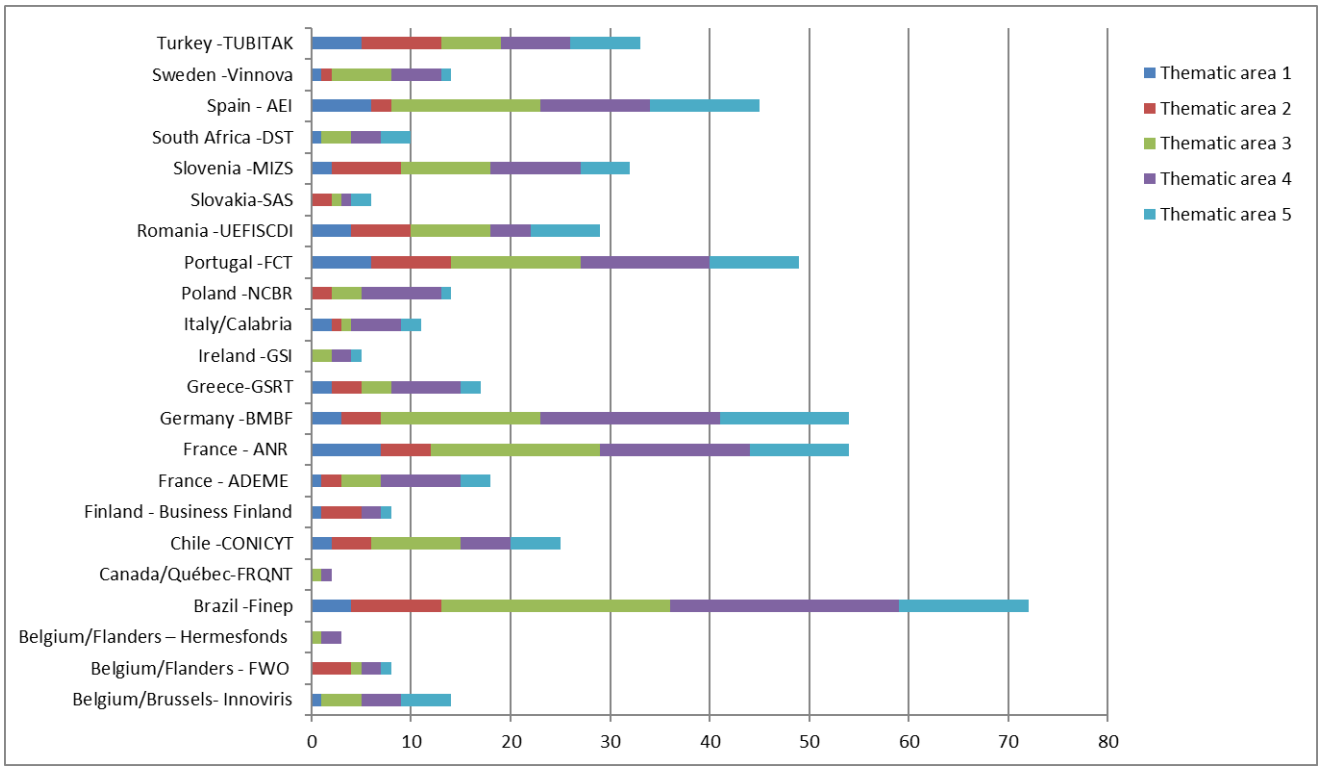

Figure 5 – Thematic area addressed by submitted proposals in each country/region/funding organisation.

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2.2 STATISTICS OF FUNDED PROJECTS

12 transnational projects were selected and recommended for funding out of 40 eligible peer-reviewed proposals. These projects involved a total of 61 organisations of which 17 were enterprises. The total allocated public funding was €8.8 million and the total projects' costs were €12.7 million.

These 12 projects are funded by 15 out of 24 participating funding organisations.

Figure 6 shows the distribution of project coordinators and partners by type of organisation.

Figure 7 presents the distribution of totals costs and requested funding by type of organisation.

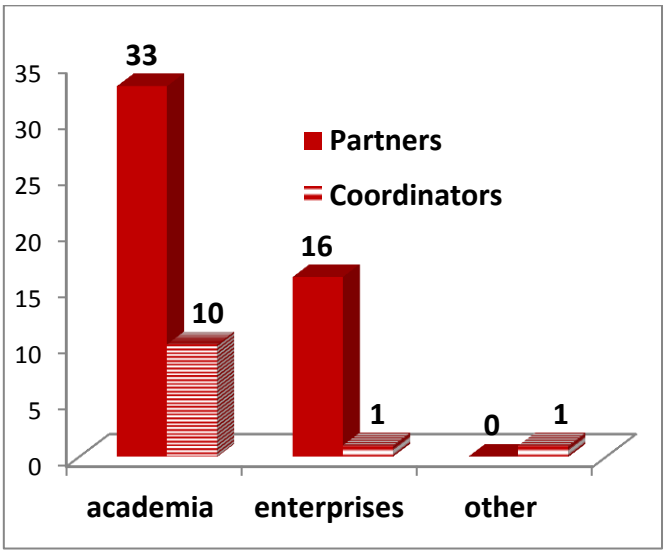

Figure 6 - Number of coordinators and partners in funded projects by type of organisation.

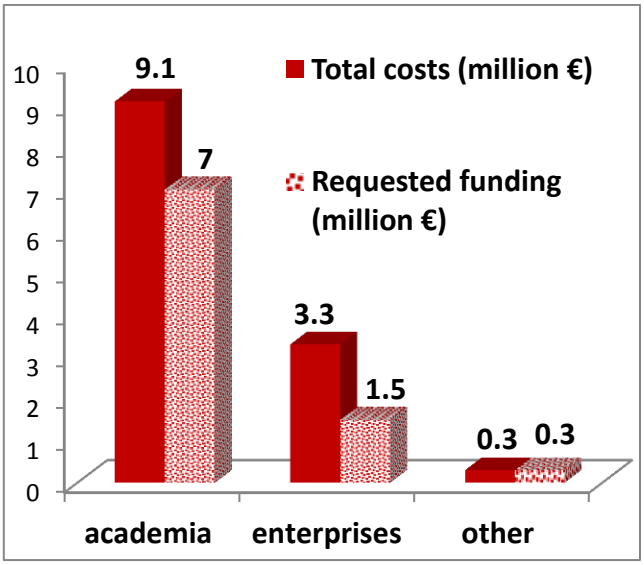

Figure 7 – Distribution of total costs and requested funding by type of organisation.

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The number of transnational projects supported by each funding organisation from a country or region is presented in Figure 8. Germany, France (ANR) and Portugal support 4 transnational R&I projects each whereas Chile, France (ADEME) and Sweden support 3 projects each. It is worth noting that Calabria region who has participated for the first time is supporting two transnational R&I projects.

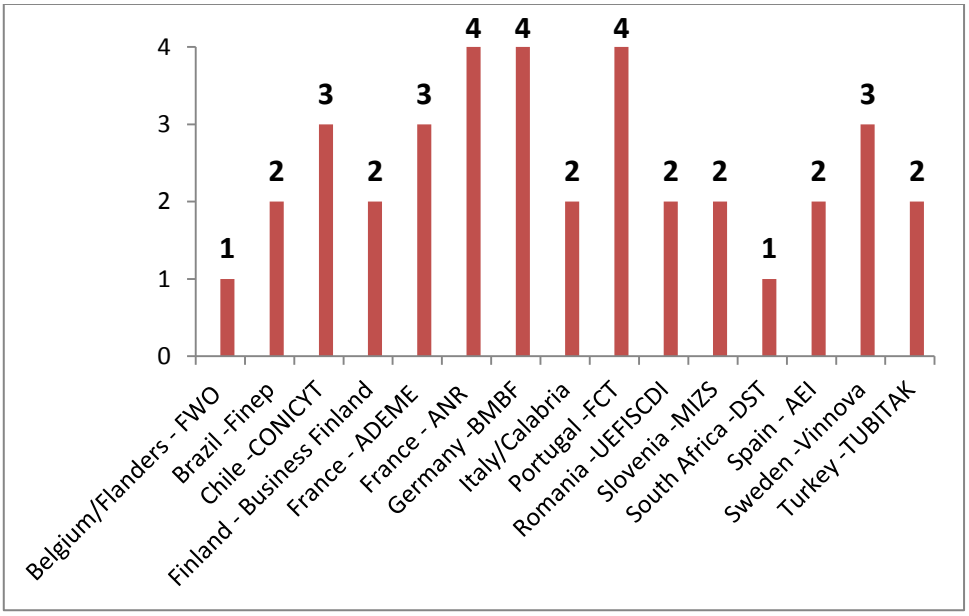

Figure 8 – Number of funded projects by country/region.

Figure 9 shows the number of beneficiaries as partners or coordinators in funded projects distributed by country/region.

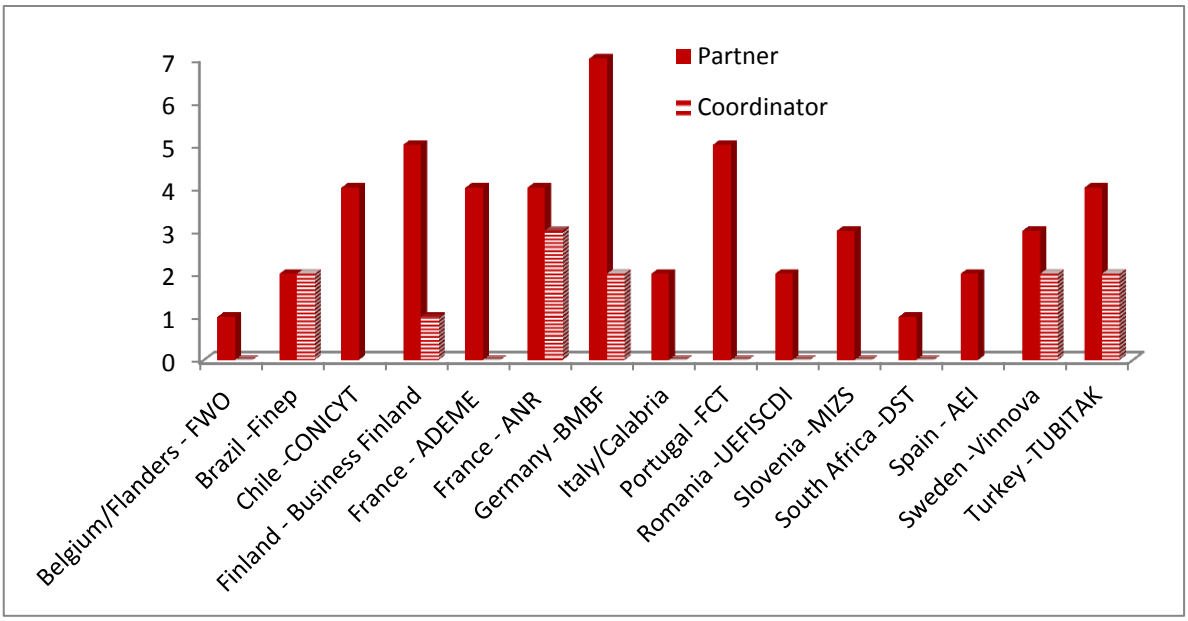

Figure 9 – Number of beneficiaries as coordinator and as partner in funded projects.

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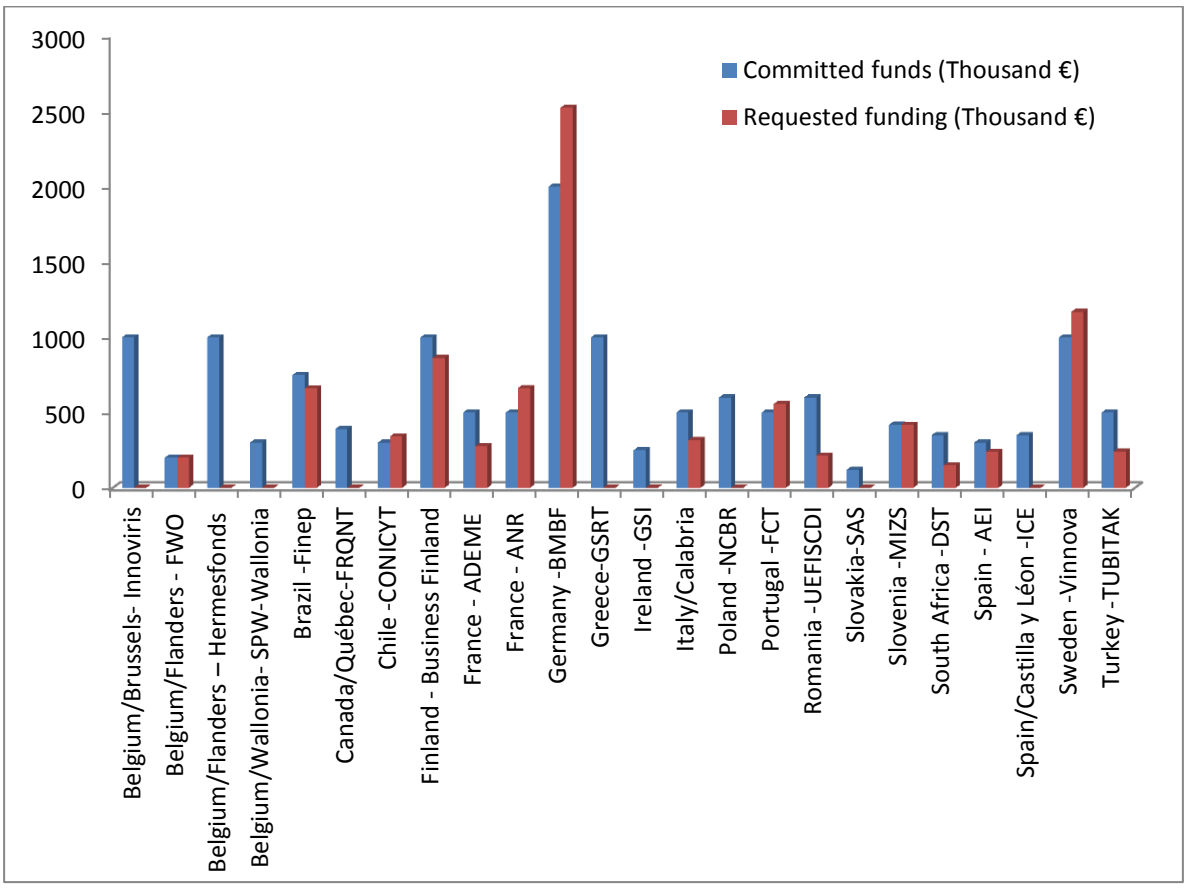

Figure 10 – Comparison between national/regional committed funds and requested funding by funded projects.

The distribution of requested funding by funded projects compared to the national/regional committed funds by the participating countries/regions can be seen in Figure 10.

The 12 selected projects were funded by 15 public research and innovation funding organisations of 8 EU countries, 2 EU region, 1 EU Associated Country and 3 non-EU countries.

All the thematic areas of the Joint call were addressed by one or more of the 12 funded projects (Figure 11). The thematic area #1 was the least addressed area in funded projects. The sub-topics covered by the funded projects are shown in Figure 12.

The thematic areas addressed by the funded projects in each country/region/funding organisation are presented in Figure 13.

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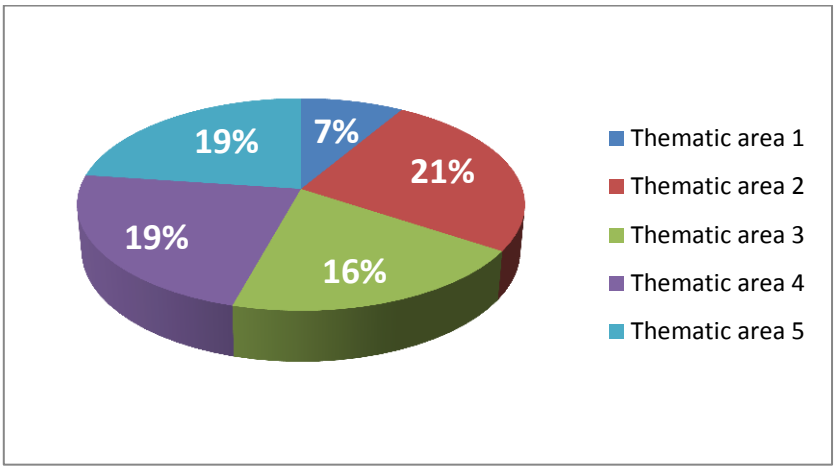

Figure 11 – Thematic areas in percentages addressed by the 12 funded projects.

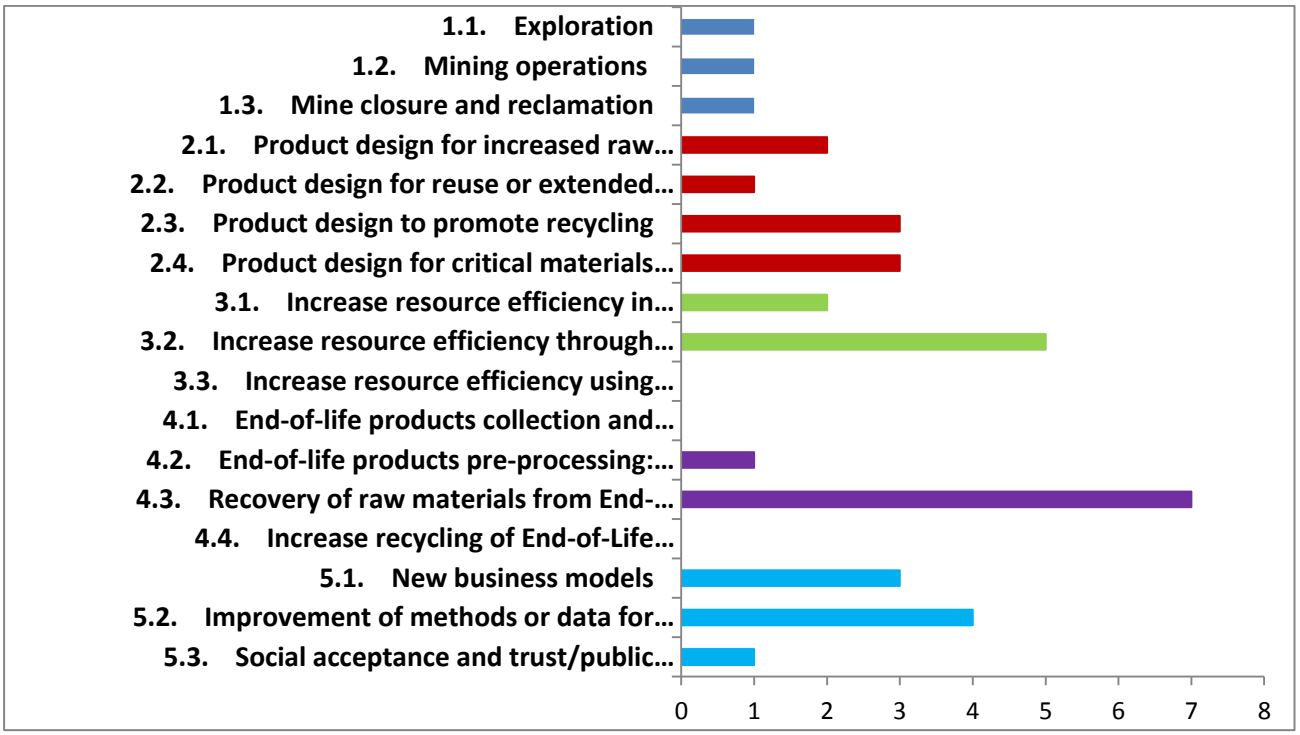

Figure 12- Sub-topics covered by the 12 funded projects.

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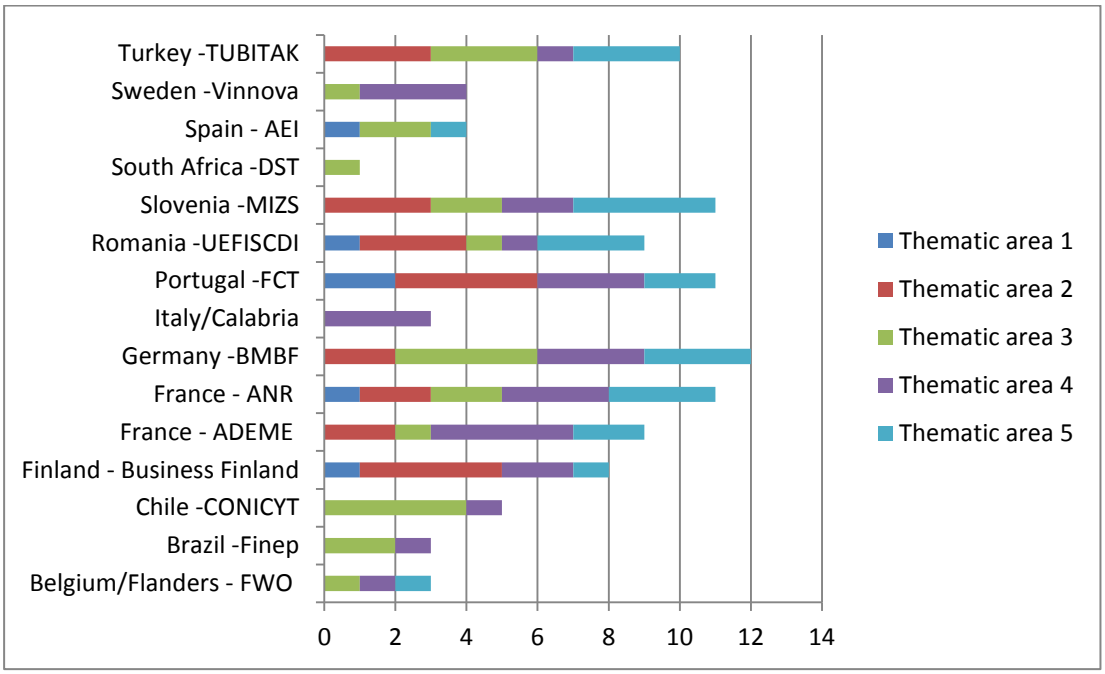

Figure 13- Thematic areas addressed by funded projects per funding organisation.

The overall success rate of the ERA-MIN Joint Call 2018 is 23.5 % (12/51) but varies for the 24 funding organisations.

All the information on the statistics of the ERA-MIN Joint Call is public and available at the ERA-MIN 2 website under the “Publications” menu.

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3 PUBLISHABLE ABSTRACTS OF FUNDED PROJECTS

Following tables are public and available on the ERA-MIN 2 web site in the «News» menu, in the document "Publishable abstracts of the 12 projects funded under ERA-MIN Joint Call 2018". They can also be accessed through the « Call Results » menu.

Project acronym	MIWACUT		
Project title	Investigating the microwave assisted cutting of carbonate rocks		
Main topic	1. Supply of raw materials from exploration and mining		
Sub-topics	1.2 Mining operations		
Keywords	Carbonate rocks, microwave assisted cutting, specific energy, numerical modelling		
Publishable abstract	In order to make the excavation of hard rocks possible by mechanical excavators except the tunnel boring machines (TBM) or to increase cutting rate and decrease wear rate during cutting very hard rocks, recently, the research on some innovative methods such as microwave assisted (MWA) rock cutting have been drawing attention. However, there is no currently MWA cutting machine used in the laboratory or in the field. In this study, the cuttability of carbonate rocks by an integrated MWA linear cutting machine will be investigated. Carbonate rocks are excavated by drilling and blasting that is a challenging method compared to the mechanical excavation. However, the mechanical excavation of carbonate rocks is generally impossible or inefficient. The objective of this proposal is to reveal the cuttability of carbonate rocks by MWA-continuous miners (CMs). The linear cutting tests without and with microwave assistance will be carried out on the samples from Turkey and Romania and the specific energy values will be determined. The performances of CMs will be estimated using the specific energy and discontinuity properties for without and with microwave assisted cutting conditions, and the results will be compared. Finally, the excavation cost will be calculated for CM without and with microwave assistance and compared to the current drilling and blasting method. The partners of the proposal consist of one corporation and four engineering disciplines such as Mining Engineering, Mechanical Engineering, Geological Engineering, and Electrical and Electronic Engineering. After successfully completing the project, the suitability and the eco-efficiency of the MWA-CMs will be proven for the excavation of carbonate rocks. Using the MWA-CMs for the excavation of carbonate rocks will increase the efficiency and decrease the crushing and grinding costs. The environmental problems of blasting will disappear when using the MWA-CMs.		
Participating organisations	Hacettepe University (Turkey) University of Petrosani (Romania) University of Ankara (Turkey) PAMUKKALE UNIVERSITY (Turkey) Nigde Omer Halisdemir University (Turkey) KEMPAR Ltd. (Turkey)		
Project duration	36 months		
Total Costs	271.650 €	**Total Requested Funding**	182.300 €

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Project acronym	AUREOLE		
Project title	tArgeting eU cRitical mEtals (Sb, W) and predictability of Sb-As-Hg envirOnmentaL issuEs		
Main topic	1. Supply of raw materials from exploration and mining		
Sub-topics	1.1 Exploration 5.2 Improvement of methods or data for environmental impact assessment		
Keywords	antimony, tungsten, resources, environment, assessment		
Publishable abstract	Antimony (Sb), a critical metal for Europe strategic for the European (EU) aircraft industry & battery manufacturing plants, is widely used in industrial operations. Its most promising use may be for rechargeable Li- & Na-ion batteries. The project is based on disruptive concepts: i) new 3D large-scale metallogenic model integrating deep-seated processes to determine the spatial distribution of ore deposits; ii) the use of mineral prospectivity data weighted by surface data to determine the probability of environmental risk over large areas. Despite a high EU potential, the knowledge on Sb remains poorly constrained. EU remains under the threat of the Chinese supply. In parallel, metalloids (Sb, As, Hg) of geogenic origin are recognised as a global threat for human health. Then, a large-scale identification of these areas should be a priority. In this 3 year project, it will produce i) a new 3D metallogenic model that will contribute to the understanding of the mineralising processes; ii) a new understanding of surface processes that control the mobilisation & transport of metalloids; iii) a new large-scale mineral prospectivity and iv) a new large-scale environmental risk assessment by weighting mineral prospectivity with earth surface properties. The consortium of 4 leading research entities from 3 EU countries in the field of ore genesis and environmental risk assessment is completed by the Antea Group, whose core business is the analysis and quantification of environmental risk. The expected outcomes will result in high impact deliverables devoted to the targeting of new Sb deposits and a new large-scale environmental assessment maps for decision-making dealing with human health. Long term expected impacts would be an increase of EU Sb resources & sustainable supply. The project will provide new results to the SCRREEN, IMP@CT, FRAME projects and will interact with consortiums about electromobility such as the EU Lithium Institute and the EU Battery Alliance.		
Participating organisations	Bureau de Recherches Géologiques et Minières (France) Institut des Sciences de la Terre d'Orléans (ISTO) (France) University of Castilla-La Mancha (Spain) University of Porto – FCUP (Portugal) Antea Group (France)		
Project duration	36 months		
Total Costs	1.113.697 €	**Total Requested Funding**	454.122 €

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Project acronym	MINECO		
Project title	New Eco-innovative Materials for Mining Infra		
Main topic	2. Design		
Sub-topics	1.3 Mine closure and reclamation 2.1 Product design for increased raw material efficiency 2.2 Product design for reuse or extended durability of products 2.3 Product design to promote recycling 2.4 Product design for critical materials substitution 5.2 Improvement of methods or data for environmental impact assessment		
Keywords	tailings cover systems, AMD, sustainability, alkali activation, backfill		
Publishable abstract	The aim of the MINECO project is to develop new eco-innovative product solutions for mining infrastructures based on waste materials resulting from the mining operation, thus contributing sustainable development. Vast amounts of mining related materials, such as tailings and waste rock, are left behind when the mine is finally closed, thus requiring sustainable treatments which, ideally, should include very high recycling rates. Sulfidic mining waste, being generated from the production of base metals as Cu, Pb, and Zn, represents the largest volume of extractive waste in Europe (ca. 600 Mtn/yr), causing a serious potential Acid Mine Drainage (AMD) hazard. In addition, the mining and processing of oil shale (OSA) produces about 18 Mtn/yr of mostly hazardous waste, in Estonia alone, and a total average of 25 Mtn/yr or stainless-steel slags (argon oxygen decarburization and electric arc furnace, AOD/EAF) are produced in Europe, most of which is landfilled. The proposed project intends to develop alternative methods to recycle sulfidic tailings, for application in infrastructures and, also, in the construction and mining industries. The combination of the excellent mechanical properties of the tailings with sustainable binders will create integrated, technically competent and environmentally optimized materials. The binders will be generated by the alkali activation technique, forming what is currently known as 'alkali activated cements', or AAC.		
Participating organisations	Kajaani University of Applied Sciences (Finland) ECOnsulting Oy (Finland) UTAD- University of Trás-os-Montes e Alto Douro (Portugal) Ecolan Oy (Finland) Soilmetric Oy (Finland) University of Porto - Faculty of Engineering (Portugal)		
Project duration	36 months		
Total Costs	1.285.861 €	**Total Requested Funding**	779.187 €

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Project acronym	Sb-RECMEMTEC		
Project title	Electro-electrodialysis technology on the copper minerals processing industry to the recovery of antimony from mining tailings and recycling the solution media		
Main topic	3. Processing, Production and Remanufacturing		
Sub-topics	3.1 Increase resource efficiency in resource intensive production processes 3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components		
Keywords	Antimony, Electrodialysis, Copper Primary Production, Critical Raw Materials, Recycling		
Publishable abstract	The main objective of Sb-RECMEMTEC project is the recovery of antimony (Sb), a Critical Raw Material, from wastes and effluents generated during the pyro- and hydrometallurgical processing of copper (Cu) using membrane separation processes (MSP): electrodialysis (ED) and electro-electrodialysis (EED). While Sb is of fundamental importance to newly developed technologies, it is generally obtained as a by-product of other metallic ores. Therefore, the current and future supply of Sb depends not only on Sb production, but also on the efficient recovery of other primary ores. Sb-RECMEMTEC will address the challenging subject of applying MSP in the processing of Cu-low-grade mining tailings and of Cu-sulphide minerals, not only to concentrate/purify the electrolytes, but also to recover Sb and acid solutions. ED/EED processes will be studied, using the circular economy approach, to the primary Cu-production, avoiding Sb losses and minimizing the generation of effluents. Sb-RECMEMTEC consortium consists of a multidisciplinary team, bringing together 5 partners from 3 countries (Chile, Brazil and Spain). Wastewaters, containing, besides Cu, elements of added-value, such as Sb, will be managed by the company TRANSDUCTO (Chile), being characterized by the USACH group (Chile). ED/EED processes will be evaluated with commercial membranes and with membranes produced at FEEVALE (Brazil). The UPV group (Spain) will carry out the scientific studies of the Sb electrorecovery on different cathodes and the characterization of the ion transport through the membranes provided by FEEVALE. The group of UFRGS (Brazil) will be responsible for performing small-scale pilot studies of ED/EED in order to demonstrate its feasibility for recovering acid solutions and Sb. USACH and TRANSDUCTO will incorporate the results obtained to implement a new production process. A high enhance innovation capacity is expected, since a new process will be incorporated directly on the copper line production.		
Participating organisations	Universidade Federal do Rio Grande do Sul (Brazil) Universidad de Santiago de Chile (Chile) Universitat Politècnica de Valencia (Spain) ASPEUR / Feevale (Brazil) Transducto S.A. (Chile)		
Project duration	36 months		
Total Costs	1.185.595 €	**Total Requested Funding**	577.900 €

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Project acronym	MiCCuR		
Project title	Microbial Consortia for enhanced Copper Recovery		
Main topic	3. Processing, Production and Remanufacturing		
Sub-topics	3.1 Increase resource efficiency in resource intensive production processes		
Keywords	Chalcopyrite bioleaching, resource efficiency, pilot plant, copper recovery, microbial community		
Publishable abstract	Biomining is the biotechnological process for metal extraction from sulphidic ores. This process exploits the ability of acidophilic microorganisms to catalyse chemical oxidation of insoluble metal sulphides to acid soluble sulphates. Bioleaching of copper minerals is usually performed in engineered heaps and this technology accounts for approximately 15-20% of the worldwide copper production. Presently there is an increase in the European demand for metals. However, commercial biomining of chalcopyrite (CuFeS2; the largest copper resource in the world) is not extensively employed due to slow metal release and limited copper recoveries. Instead, chalcopyrite is generally treated by environmentally polluting and energy demanding ore concentration followed by high temperature metallurgical processes. In this study, two laboratory-scale, proof-of-concept experiments to increase the efficiency of industrial bioleaching of chalcopyrite will be scaled up to ultimately reach demonstration in an industrial pilot bioheap. The applicants will use stirred tank and column reactors to move to larger scale before the most promising strategy will be tested in the pilot plant. The consortium will cover the process in terms of innovation and research and will comprehensively study engineering, chemical, microbiological, molecular biological and 'omics' methods. This project contributes to the RMI and EIP strategies on raw materials through the enhanced resource efficiency achieved for both copper resources in Europe and those globally with potential to supply Europe. In achieving this, the project addresses the circular economy as well as the implementation of low carbon process options for copper recovery. By incorporating a German company and having two associated companies, the knowledge of these stakeholders will contribute to the progress in the project. In turn, this also results in new insights having a substantially greater probability to be applied in the mining sector.		
Participating organisations	Linnaeus University (Sweden) Technische Universität Bergakademie Freiberg (Germany) Ruhr University Bochum (Germany) University of Cape Town (South Africa) Pontificia Universidad Católica de Chile (Chile) G.E.O.S. Ingenieurgesellschaft mbH (Germany)		
Project duration	36 months		
Total Costs	1.616.153 €	**Total Requested Funding**	1.258.406 €

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Project acronym	RedOxRec		
Project title	Reduction/ Oxidation Recycling		
Main topic	4. Recycling and Re-use of End-of-Life products		
Sub-topics	3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components 4.3 Recovery of raw materials from End-of-life products 5.1 New business models		
Keywords	Decentralized Recycling, Noble metals, Mild hydrometallurgy, WEEE, Production Residues		
Publishable abstract	Our vision is to enable a more distributed recycling chain, where Small-Medium Enterprises (SME), individual production plants and municipalities become the main stakeholders of the recycling process chain. This shift in the recycling paradigm hinges on the dissemination of green recycling solutions throughout the territory. The core-innovation is the development of a medium-scale, environmentally friendly and low-cost hydrometallurgical process for the extraction of noble metals from End-of-Life products (e.g. electronics waste). Based on this technological breakthrough, we expect to trigger multiple ramifications from the technical, economic, social and environmental point of view. The cornerstone of this new hydrometallurgical recycling process is a completely new concept for noble metals chemical extraction by exploiting the so-called transient dissolution. This mechanism is a well-known degradation mechanism for all electrochemical applications and, opposite to conventional hydrometallurgy, does not require extremely aggressive conditions, but only a repeating change in surface (electro-) chemical potential. We intend to transfer this, so far, the purely electrochemistry-related process to a chemical reactor (TRL 5) and to validate experimentally the process for real scrap, e.g., manufacturing refuse from electronics production. In order to assess the impact on the overall value chain, the project will deal with the evaluation of the recycling process in a decentralized network and the identification of the corresponding technological solutions for disassembly, pre-treatment and logistics. In conclusion, the data obtained the TRL5 reactor will serve as input data to verify the economic feasibility of our innovative chemistry and to assess the environmental benefits this new recycling scenario by means of state-of-the-art Life Cycle Costing and Analysis (LCC and LCA).		
Participating organisations	Robert Bosch GmbH (Germany) Forschungszentrum Jülich GmbH (Germany) National Institute of Chemistry (Slovenia) University of Antwerp (Belgium/Flanders)		
Project duration	36 months		
Total Costs	1.619.617 €	**Total Requested Funding**	1.132.835 €

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Project acronym	NEXT-LIB		
Project title	Novel Circular Economic Approaches for Efficient Extraction of Valuables from Spend Li-Ion Batteries		
Main topic	4. Recycling and Re-use of End-of-Life products		
Sub-topics	4.2 End-of-life products pre-processing: pre-treatment, dismantling, sorting, characterisation 4.3 Recovery of raw materials from End-of-life products		
Keywords	Spent LIBs, Valuable Metals, Graphite Separation, Li Recovery, Recycling		
Publishable abstract	The existing dominating technology applied in Europe is the Umicore process which is simple and efficient with main focus on recovery the high value metals like Co, Ni and Cu. The other critic materials like lithium and graphite are lost. Lithium is diluted in a slag phase while graphite and electrolyte are burnt to hazardous gases. The dominating technology applied in China consists of shredding, thermal processing for removal of electrolyte and binders followed by leaching processes. In both cases, the graphite is not just lost it also causes to major difficulties for the subsequent metal recovery processes. Shredding of LiB is another major challenging. Though a number of technologies are used in commercial scale, they are often slow or have to be operated under a carefully arranged inert system (like liquid N2 cooling, shredding in water etc) in order to minimize the fire risk due to high content of flammable electrolyte in the LiBs. The NEXT-LIB project has the intention to develop a number of new technologies to meet the challenges addressed above which will enable safe shredding operation, possible electrolyte recovery, graphite recovery and Li-enrichment by pyrometallurgical approaches etc. The project aims for developing technologies for an over 20% increased overall recovery efficiency comparing to the current processes. The project will be realized via a cross-discipline approach with experts in material characterization, mineral processing, pyro- and hydrometallurgy, sustainability analysis, from leading universities, research institutes, SME, major battery recycler and metal producer located in Sweden, Finland, France, Italy and Portugal. The project has an economic potential of at least 1 billion €, thereby a possibility to create >2000 jobs for the EU and an energy saving potential of >1000 GWh on a global perspective.		
Participating organisations	Swerim AB (Sweden) Luleå University of Technology (Sweden) Extracthive (France) INSTM- RU University Mediterranea of Reggio Calabria (Italy) Geological Survey of Finland (GTK) (Finland) CEA (France) uRecycle Battery Materials Oy Filial i Sverige (Sweden) Faculdade de Ciências da Universidade do Porto (Portugal) Boliden (Finland)		
Project duration	36 months		
Total Costs	1.529.684 €	**Total Requested Funding**	1.227.517 €

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Project acronym	Siderec		
Project title	Siderophores assisted Biorecovery of Technology Critical Elements: Gallium (Ga), germanium (Ge) and indium (In) from end-of-life products		
Main topic	4. Recycling and Re-use of End-of-Life products		
Sub-topics	3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components 4.3 Recovery of raw materials from End-of-life products		
Keywords	Technology critical elements, end-of-life products, circular economy, green processes, low concentrated wastewaters		
Publishable abstract	High techs such as communications, renewable energies, displays are heavily dependent on metals such as germanium (Ge), indium (In) and gallium (Ga). These metals are used in photovoltaics, fiber optics, liquid crystal displays – among others. The supply of these metals is essential for the continuous supply of high-tech devices. However, due to the export control and hoarding, the supply of these metals to the high-tech industry of Europe is not assured and hence, European Commission has listed these metals supply as critical. Recycling of these metals from their end-of-life (EOL) products is a way to overcome the shortage of these metals. However, there are no technologies available for recycling of these metals due to their low concentrations and presence of large number of contaminants. A highly selective and sensitive solvent, ligand or reaction is needed to recover these metals. Siderophores has been shown to bind selectively bind to Ga, In and Ge even when these metals are present in very low concentrations. Thus, exploiting of siderophores for these metals' recovery can be very interesting. However, no work has been carried out to recovery these metals from their EOL products using siderophores. There are two main challenges in the recovery of metals from their EOL products using siderophores. The challenges are 1) Right selection and production of siderophores, 2) Access of siderophores to the target metals in EOL products. Upon successful leaching of target metals and siderophore complexes, the decomplexation, and recovery of metals and siderophores will be carried out as by implementing the GaLIophore technology. This project aims to develop ambitious and highly innovative technology for the recovery of these critical elements. This project will fill the technology gap where no technology exists. This project will help in improving EU competitiveness in resource recovery and recycling.		
Participating organisations	Institut de Physique du Globe de Paris (France) Universidad Catolica del Norte (Chile) Helmholtz-Zentrum Dresden-Rossendorf (Germany) ASA Spezialenzyme GmbH (Germany)		
Project duration	36 months		
Total Costs	835.325 €	**Total Requested Funding**	781.285 €

Co-funded by the Horizon 2020 programme of the European Union

Project acronym	LIMEX		
Project title	Innovative Membrane Extraction of Lithium for Spent Lithium-Ion Battery Recycling		
Main topic	4. Recycling and Re-use of End-of-Life products		
Sub-topics	4.3 Recovery of raw materials from End-of-life products		
Keywords	Lithium, Recovery, Battery Recycling, Membrane, Green Solvents		
Publishable abstract	Lithium-ion batteries (LIBs) having a high energy-density are commonly used to provide power to consumer electronics and electric vehicles. In the last years, they have emerged as crucial component of modern energy storage. The storage of renewable energy plays a key role in the global shift toward a cleaner and more sustainable energy economy. Therefore, the demand for lithium (Li), the essential ingredient for LIBs, is increasing exponentially. In addition, the consumption of other metals for batteries, viz. cobalt and nickel, also is increasing. It is well known that mining and ore processing has a negative effect upon the environment. These activities generate a large amount of waste, consume resources and can liberate harmful materials into the biosphere. In this context, the LIMEX project proposes an innovative and clean technology for recovering metals from secondary resources such as batteries. The overall objective is to evaluate its technical feasibility and economic and environmental impacts when using solvent extraction and membrane separation for the recovery of target metals from the leach liquors formed during the recycling of spent LIBs. This objective constitutes a real scientific and technical challenge due to complex matrices with different levels of metal concentrations. Thus, LIMEX responds the axis N° 4 of the ERA-MIN 2 call “Recycling and Re-use of the End-of-life products” and proposes a multidisciplinary approach combining organic synthesis (Partner 2), solution chemistry (Partner 1, 2), membrane process design (Partner 1, 3, 4) and environmental impact assessment (Partner 1, 4).		
Participating organisations	CNRS (France) Chalmers University of Technology (Sweden) University of Porto (Portugal) Euro Dieuze Industrie (France)		
Project duration	36 months		
Total Costs	793.294 €	**Total Requested Funding**	578.389 €

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Project acronym	RECEMENT
Project title	Re-generating (raw) materials and end-of-life products for re-use in Cement/Concrete
Main topic	4. Recycling and Re-use of End-of-Life products
Sub-topics	2.1 Product design for increased raw material efficiency 2.3 Product design to promote recycling 2.4 Product design for critical materials substitution 3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components 4.3 Recovery of raw materials from End-of-life products 5.1 New business models 5.2 Improvement of methods or data for environmental impact assessment 5.3 Social acceptance and trust/public perception of raw materials
Keywords	Re-generation, construction debris, cement, recycling, circular economy
Publishable abstract	Understanding the complex reactions that occur upon cement (de)hydration is the key to re-generating end-of-life (EOL) materials as sources of cementitious minerals. The cement industry generates 8% of the total global CO2 emission, or 0.87 kg CO2 per kg of cement formed. However, it is the glue that enables concrete, which is ubiquitous in urban life. To reduce CO2 emission evolving during Portland clinker production, it can be replaced in part by supplementary cementitious material (SCM). Although the most common ones, fly ash and slag, have limited availability, urban demolition and mineral deposit quarries can be found everywhere, and these contain high percentages of potential SCMs. By developing mechanical and thermal treatment procedures to destabilize the pozzolanic-active phases, we can reactivate these zero-value remnants. We reduce the introduction of new raw materials sources into the value-chain of cement production, the CO2 emission, and the energy consumption, as well as reduce the adverse environmental impact of landfill contributions. The key innovation in RECEMENT is developing the re-generation of high SCM-content EOL materials, while the main objective is to replace at least 30% of the Portland clinker in cement with re-generated SCMs. We aim to produce recipes for re-generated cement blends in mortar with equivalent performance and durability. The team responsible for this interdisciplinary project has precisely the broad range of expertise for realizing the engineering of cement—geochemical and mineralogical understanding of reject materials and advanced (in-situ) structure-chemistry characterization of pozzolanic reaction pathways and their final products. The output of RECEMENT is foreseen to have a high impact as a paradigm for transforming locally sourced end-of-life materials into remanufactured cement, i.e. from a linear into a circular concrete economy.
Participating organisations	Sabanci University (Turkey) University of Ljubljana (Slovenia) Jozef Stefan Institute (Slovenia) University Politehnica from Bucharest (Romania)

Co-funded by the Horizon 2020 programme of the European Union

Project duration	36 months		
Total Costs	482.720 €	**Total Requested Funding**	482.720 €

Co-funded by the Horizon 2020 programme of the European Union

Project acronym	LICOBAT		
Project title	Lithium and Cobalt recovery from batteries coming from the reverse logistics chain of WEEE		
Main topic	4. Recycling and Re-use of End-of-Life products		
Sub-topics	4.3 Recovery of raw materials from End-of-life products		
Keywords	Lithium, Cobalt, Batteries, Raw Material, Recovery		
Publishable abstract	In 2013, approximately 200,000 tonnes of portable batteries were placed on the EEA and Swiss market, with this high volume and short battery life increasing the disposal flow of end-of-life batteries. In Brazil about 400 million per year of smartphone batteries are sold, of which only 1% is destined correctly. The rest ends up in the common waste, putting at risk public health due to the risks of contamination with heavy metals. In this context, the central issue is represented by the development of processes that allow the recovery of the material from batteries at the end of life, the main objective of this project is to drive the Lithium-ion battery reverse chain toward a circular economy, with a focus on the recovery of Lithium and Cobalt. The scientific basis of the project is the patented hydrometallurgical process (European patent EP2450991) by Eco Recycling srl. The proposed process integrates mechanical pre-treatment with a chemical (hydrometallurgical) treatment route to recover plastics, ferrous and non-ferrous metals. The process will be demonstrated by the construction and operation of the pilot plant with capacity to process 100 kg of batteries per day. For this, the consortium of this project has specialists in mechanical processes, hydrometallurgical processes, reverse logistics and entrepreneurs with great experience in the solid waste management market. This project also aims at a positive social impact, important in emerging countries such as Brazil, where part of WEEE reverse logistics is carried out by Recyclable Material Collectors, people who work manually collecting waste materials without healthcare and security and social dignity.		
Participating organisations	Centro da Tecnologia da Informação 'Renato Archer' (Brazil) BIOSYS - Gestão em Meio Ambiente Ltda (Brazil) Ecosistem srl (Italy)		
Project duration	30 months		
Total Costs	855.241 €	**Total Requested Funding**	545.854 €

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Project acronym	SupplyPBM		
Project title	Securing the Supply chain for rare earth Polymer-Bonded Magnets by recycling		
Main topic	4. Recycling and Re-use of End-of-Life products		
Sub-topics	2.3 Product design to promote recycling 2.4 Product design for critical materials substitution 3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components 4.3 Recovery of raw materials from End-of-life products 5.1 New business models 5.2 Improvement of methods or data for environmental impact assessment		
Keywords	recycling of rare earth permanent magnets; polymer-bonded magnets; environment-friendly biopolymers; business model for recycled magnets; Life Cycle Assessment analysis for recycled magnets;		
Publishable abstract	The main objective of the project SupplyPBM is the demonstration of a circular economy route for rare earth polymer-bonded magnets. Scrap sintered permanent magnets from End-of-Life (EoL) products will be recycled by rapid solidification and processed to polymer-bonded magnets. Moreover, technologies suitable for recycling of polymer-bonded magnets in a continuous supercritical hydrothermal reactor will be investigated. The aim is to produce polymer-bonded magnets out of recycled magnet powder with the same performance than magnets made from primary material, so that entering the market by these magnets does not require any adaption of the products or systems themselves. Additionally, to the recycling aspect of polymer-bonded magnets, the bio-design of these magnets is addressed, by the first time use of bio-polymers in permanent magnet applications. Finally, the environmental impact of the production and recycling of polymer-bonded magnets will be investigated by a Life Cycle Assessment analysis. SupplyPBM ambitions to achieve a major breakthrough on three technical levels. First, a pathway for recycling of permanent magnets from EoL application by melt-spinning and subsequent production to polymer-bonded magnets will be shown. Second, the recycling of polymer-bonded magnets in a high pressure / high temperature reactor in a continuous supercritical hydrothermal reactor will be demonstrated. Third, bio-based polymers will be used in polymer-bonded magnets for the first time, reducing the impact of polymers from fossil resources. The project SupplyPBM aims at closing materials cycles by recovering and back-feeding valuable rare earth materials to an industrial magnet production within the EU. Within this project, a linear supply chain will be turned into a closed material loop.		
Participating organisations	Fraunhofer ISC, Project Group IWKS (Germany) Veekim AG (Germany) ARELEC (France) ICMCB / CNRS (France) Université de Bordeaux (ISM) (France)		
Project duration	24 months		
Total Costs	1.090.666 €	**Total Requested Funding**	834.370 €

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4 DATA ON FUNDED PROJECTS

Following tables are public and available at the ERA-MIN 2 web site in the « Call Results » menu. Under each project acronym, there is a link to the publishable abstract.

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Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participating countries - Funding organisations	Duration	Total Costs	Total Requested Funding
1. Supply of raw materials from exploration and mining	1.2 Mining operations	**MIWACUT**	Investigating the microwave assisted cutting of carbonate rocks	Hacettepe University	Turkey - TUBITAK	36 months	271.650 €	182.300 €
				University of Petrosani	Romania - UEFISCDI			
				University of Ankara	Turkey - TUBITAK			
				PAMUKKALE UNIVERSITY	Turkey - TUBITAK			
				Nigde Omer Halisdemir University	Turkey - TUBITAK			
				KEMPAR Ltd.	Turkey - TUBITAK			
	1.1 Exploration 5.2 Improvement of methods or data for environmental impact assessment	**AUREOLE**	tArgeting eU cRitical mEtals (Sb, W) and predictability of Sb-As-Hg envirOnmentaL issuEs	Bureau de Recherches Géologiques et Minières	France - ANR	36 months	1.113.697 €	454.122 €
				Institut des Sciences de la Terre d'Orléans (ISTO)	France - ANR			
				University of Castilla-La Mancha	Spain - AEI			
				University of Porto - FCUP	Portugal - FCT			
				Antea Group	France - ANR			

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Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participating countries - Funding organisations	Duration	Total Costs	Total Requested Funding
2. Design	1.3 Mine closure and reclamation 2.1 Product design for increased raw material efficiency 2.2 Product design for reuse or extended durability of products 2.3 Product design to promote recycling 2.4 Product design for critical materials substitution 5.2 Improvement of methods or data for environmental impact assessment	**MINECO**	New Eco-innovative Materials for Mining Infra	Kajaani University of Applied Sciences	Finland – Business Finland	36 months	1.285.861 €	779.187 €
				ECOnsulting Oy	Finland – Business Finland			
				UTAD- University of Trás-os-Montes e Alto Douro	Portugal - FCT			
				University of Porto - Faculty of Engineering	Portugal - FCT			
				Ecolan Oy	Finland – Business Finland			
				Soilmetric Oy	Finland – Business Finland			
3. Processing, Production and Remanufacturing	3.1 Increase resource efficiency in resource intensive production processes 3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components	**Sb-RECMEMTEC**	Electro-electrodialysis technology on the copper minerals processing industry to the recovery of antimony from mining tailings and recycling the solution media	Universidade Federal do Rio Grande do Sul	Brazil - Finep	36 months	1.185.595 €	577.900 €
				Universidad de Santiago de Chile	Chile - CONICYT			
				Universitat Politècnica de Valencia	Spain - AEI			
				ASPEUR / Feevale	Brazil - Finep			
				Transducto S.A.	Chile - CONICYT			

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Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participating countries - Funding organisations	Duration	Total Costs	Total Requested Funding
3. Processing, Production and Remanufacturing	3.1 Increase resource efficiency in resource intensive production processes	**MiCCuR**	Microbial Consortia for enhanced Copper Recovery	Linnaeus University	Sweden - Vinnova	36 months	1.616.153 €	1.258.406 €
				Technische Universität Bergakademie Freiberg	Germany - BMBF / Juelich			
				Ruhr University Bochum	Germany - BMBF / Juelich			
				University of Cape Town	South Africa - DST			
				Pontificia Universidad Católica de Chile	Chile - CONICYT			
				G.E.O.S. Ingenieurgesellschaft mbH	Germany - BMBF / Juelich			
4. Recycling and Re-use of End-of-Life products	3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components 4.3 Recovery of raw materials from End-of-life products 5.1 New business models	**RedOxRec**	Reduction/ Oxidation Recycling	Robert Bosch GmbH	Germany - BMBF / Juelich	36 months	1.619.617 €	1.132.835 €
				Forschungszentrum Jülich GmbH	Germany - BMBF / Juelich			
				National Institute of Chemistry	Slovenia - MIZS			
				University of Antwerp	Belgium / Flanders - FWO			

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Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participating countries - Funding organisations	Duration	Total Costs	Total Requested Funding
4. Recycling and Re-use of End-of-Life products	4.2 End-of-life products pre-processing: pre-treatment, dismantling, sorting, characterisation 4.3 Recovery of raw materials from End-of-life products	**NEXT-LIB**	Novel Circular Economic Approaches for Efficient Extraction of Valuables from Spend Li-Ion Batteries	Swerim AB	Sweden - Vinnova	36 months	1.529.684 €	1.227.517 €
				Luleå University of Technology	Sweden - Vinnova			
				Extracthive	France - ADEME			
				INSTM- RU University Mediterranea of Reggio Calabria	Italy – Calabria Region			
				Geological Survey of Finland (GTK)	Finland – Business Finland			
				CEA	France - ADEME			
				uRecycle Battery Materials Oy Filial i Sverige	Sweden - Vinnova			
				Faculdade de Ciências da Universidade do Porto	Portugal - FCT			
				Boliden	Finland – Business Finland			
	3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components 4.3 Recovery of raw materials from End-of-life products	**Siderec**	Siderophores assisted Biorecovery of Technology Critical Elements: Gallium (Ga), germanium (Ge) and indium (In) from end-of-life products	Institut de Physique du Globe de Paris	France - ANR	36 months	835.325 €	781.285 €
				Universidad Catolica del Norte	Chile - CONICYT			
				Helmholtz-Zentrum Dresden-Rossendorf	Germany - BMBF / Juelich			
				ASA Spezialenzyme GmbH	Germany - BMBF / Juelich			

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Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participating countries - Funding organisations	Duration	Total Costs	Total Requested Funding
4. Recycling and Re-use of End-of-Life products	4.3 Recovery of raw materials from End-of-life products	**LIMEX**	Innovative Membrane Extraction of Lithium for Spent Lithium-Ion Battery Recycling	CNRS	France - ANR	36 months	793.294 €	578.389 €
				Chalmers University of Technology	Sweden - Vinnova			
				University of Porto	Portugal - FCT			
				Euro Dieuze Industrie	France - ADEME			
	2.1 Product design for increased raw material efficiency 2.3 Product design to promote recycling 2.4 Product design for critical materials substitution 3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components 4.3 Recovery of raw materials from End-of-life products 5.1 New business models 5.2 Improvement of methods or data for environmental impact assessment 5.3 Social acceptance and trust/public perception of raw materials	**RECEMENT**	Re-generating (raw) materials and end-of-life products for re-use in Cement/Concrete	Sabanci University	Turkey - TUBITAK	36 months	482.720 €	482.720 €
				University of Ljubljana	Slovenia - MIZS			
				Jozef Stefan Institute	Slovenia - MIZS			
				University Politehnica from Bucharest	Romania - UEFISCDI			

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Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participating countries - Funding organisations	Duration	Total Costs	Total Requested Funding
4. Recycling and Re-use of End-of-Life products	4.3 Recovery of raw materials from End-of-life products	**LICOBAT**	Lithium and Cobalt recovery from batteries coming from the reverse logistics chain of WEEE	Centro da Tecnologia da Informação 'Renato Archer'	Brazil - Finep	30 months	855.241 €	545.854 €
				BIOSYS - Gestão em Meio Ambiente Ltda.	Brazil - Finep			
				Ecosistem srl	Italy – Calabria Region			
	2.3 Product design to promote recycling 2.4 Product design for critical materials substitution 3.2 Increase resource efficiency through recycling of residues or remanufacturing of used products and components 4.3 Recovery of raw materials from End-of-life products 5.1 New business models 5.2 Improvement of methods or data for environmental impact assessment	**SupplyPBM**	Securing the Supply chain for rare earth Polymer-Bonded Magnets by recycling	Fraunhofer ISC, Project Group IWKS	Germany - BMBF / Juelich	24 months	1.090.666 €	834.370 €
				Veekim AG	Germany - BMBF / Juelich			
				ARELEC	France - ADEME			
				ICMCB / CNRS	France - ANR			
				Université de Bordeaux (ISM)	France - ANR			

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