ERA•MIN 3

RAW MATERIALS
FOR THE SUSTAINABLE DEVELOPMENT
AND THE CIRCULAR ECONOMY

ERA-MIN3
2020-2025

Continue strengthening the mineral raw materials community through the coordination of research and innovation programmes on non-fuel and non-food raw materials (metallic, construction, and industrial minerals).

Deliverable 6.3

List of funded projects

(Public Report)

Date: 5th February 2024

This project has received funding under Grant agreement nº 101003575. Funding Scheme ERA-NET Cofund

ERA•MIN 3

RAW MATERIALS FOR THE SUSTAINABLE DEVELOPMENT AND THE CIRCULAR ECONOMY

Acronym: ERA-MIN3
Title: Raw Materials for the Sustainable Development and the Circular Economy
Grant Agreement number: 101003575
Funding scheme: ERA-NET COFUND
Start date: 1st December 2020
Duration: 60 months

Deliverable D6.3
List of funded projects

WP 6: Joint transnational calls without EU co-funding
Task 6.3: Implementation of joint transnational call(s)
Task Leader: Vinnova
Lead beneficiary: Vinnova
Type: Report
Dissemination level: Public
Author: Tobias Kampmann (Vinnova)
Due date: 31st January 2024
Actual submission date: 5th February 2024

ERA-MIN3 comprises a progressive, innovative and flexible pan-European network of 25 funding organisations from 18 EU MS countries/regions (VLAIO – Belgium/Flanders; FWO – Belgium/Flanders; SPW – Belgium/Wallonia; BNSF – Bulgaria; TA CR – Czech Republic; Business Finland – Finland; ETAg – Estonia; ADEME – France; ANR – France; PT JÜLICH – Germany; GSI – Ireland; MUR – Italy; NCBR – Poland; FCT – Portugal; UEFISCDI – Romania; CDTI – Spain; CFNA – Spain/Navarra; AEI – Spain; SAS – Slovakia; MIZS – Slovenia; Vinnova – Sweden), one EU Associated country (TÜBITAK – Turkey), and three non-EU countries (Finep- Brazil; PRIMA-Québec – Canada/Quebec; 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.

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Publishable summary:

The ERA-MIN Joint Transnational Call 2023 is the second call of the ERA-MIN3 network. Additionally to 20 ERA-MIN3 partners, three other funding organisations of EU regions (France/Nouvelle Aquitaine, Spain/Asturias and Spain/Basque Country) have associated to the Call and pooled regional budgets. The total call budget was ca. €13.6 million. The call was conducted without EU co-funding (top-up) and followed a one-stage submission procedure. More information about the call design can be found in Deliverable D6.1.

This report summarizes the call implementation process and the final list of funded projects including some relevant statistics. These data will also be published on the ERA-MIN website (section "Calls") and as part of the ERA-MIN Dashboard.

Forty-nine proposals were submitted to the ERA-MIN Joint Call 2023, 44 of which fulfilled the ERA-MIN and national eligibility criteria and were thus forwarded to the Scientific Evaluation Board (SEB) for expert evaluation. The evaluation resulted in a recommendation for funding of a ranking list of 33 proposals. On the basis of this list and the available national and regional funding, the Call Steering Committee (CSC) selected 9 projects recommended for funding i.e. a funding approval rate of ca. 20%.
These projects have total costs of ca. 10.3M EUR, requested funding of 8M EUR , and own funds of 2.3M EUR mainly provided by industrial partners. The majority of selected projects comprise public-private consortia and address topics along the mining value chain (call topic 1) as well as the circular economy of raw materials (call topic 2). Gender balance (i.e. less than 60% domination by one gender) is achieved among the different groups of applicants except the principal investigators.
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1. INTRODUCTION

A total of 23 funding organisations participated in the ERA-MIN Joint Transnational Call 2023 entitled "*Raw materials for the Sustainable Development and the Circular Economy*" launched on 7th December 2022 using a one-step submission procedure and a total committed budget of 13.6M EUR. The proposal submission deadline was 30th March 2023. Considering the ranking list of proposals as recommended by the international scientific assessment of the Scientific Evaluation Board and the available national and regional public funds, the Call Steering Committee selected 9 transnational R&I projects for funding. The results were communicated on 17th October 2023 and the transnational R&I projects will start 1st April 2024 at the latest.

The 5 main- and 19 sub-topics of the call listed below are in line with the national/regional priorities, the ERA-MIN Research Agenda and the Strategic Implementation Plan of the European Innovation Partnership on Raw Materials:

- Topic 1. Supply of raw materials from exploration to mining.
  - *Sub-topic 1.1 Innovative exploration methods*
  - *Sub-topic 1.2 More sustainable mining operations*
  - *Sub-topic 1.3 Improved environmental management of mines*
  - *Sub-topic 1.4 Efficient mineral processing and metallurgy*
  - *Sub-topic 1.5 Mine closure, remediation and remining of tailings and waste rock*
- Topic 2. Strengthening the circular economy.
  - *Sub-topic 2.1 Product design for resource efficiency, including substitution*
  - *Sub-topic 2.2 End-of-life products pre-processing: collection, logistics, pre-treatment, dismantling, sorting, characterisation*
  - *Sub-topic 2.3 Reuse, repair, refurbishing, repurposing and remanufacturing of end-of-life products*
  - *Sub-topic 2.4 Recovery and urban mining of raw materials from end-of-life products or other wastes*
  - *Sub-topic 2.5 Life-cycle-analysis of raw materials*
  - *Sub-topic 2.6 New business models (implementing circular economy aspects)*
- Topic 3. Processing, Production and ICT.
  - *Sub-topic 3.1 Increase resource efficiency in resource intensive production processes*
  - *Sub-topic 3.2 Increase resource efficiency, recycling and reuse of products using information and communication technologies (ICT)*
- Topic 4. Environmental assessment, climate and policy development for sustainability
  - *Sub-topic 4.1 Improvement of methods or data for environmental, social and health impact assessment (ESHIA)*
  - *Sub-topic 4.2 Policy development for primary and secondary raw material industry*
  - *Sub-topic 4.3 Energy-saving and climate action*
- Topic 5. Social sustainability in health, safety and public perception
  - *Sub-topic 5.1 Social acceptance and trust/public perception of the raw materials industry*

- *Sub-topic 5.2 Health and safety issues*
- *Sub-topic 5.3 Gender equality in the raw materials sector*

More information and all relevant documents about this call are available at a dedicated webpage: https://www.era-min.eu/joint-call/era-min-joint-call-2023 (Fig. 1) as well as in the published deliverable D6.1.

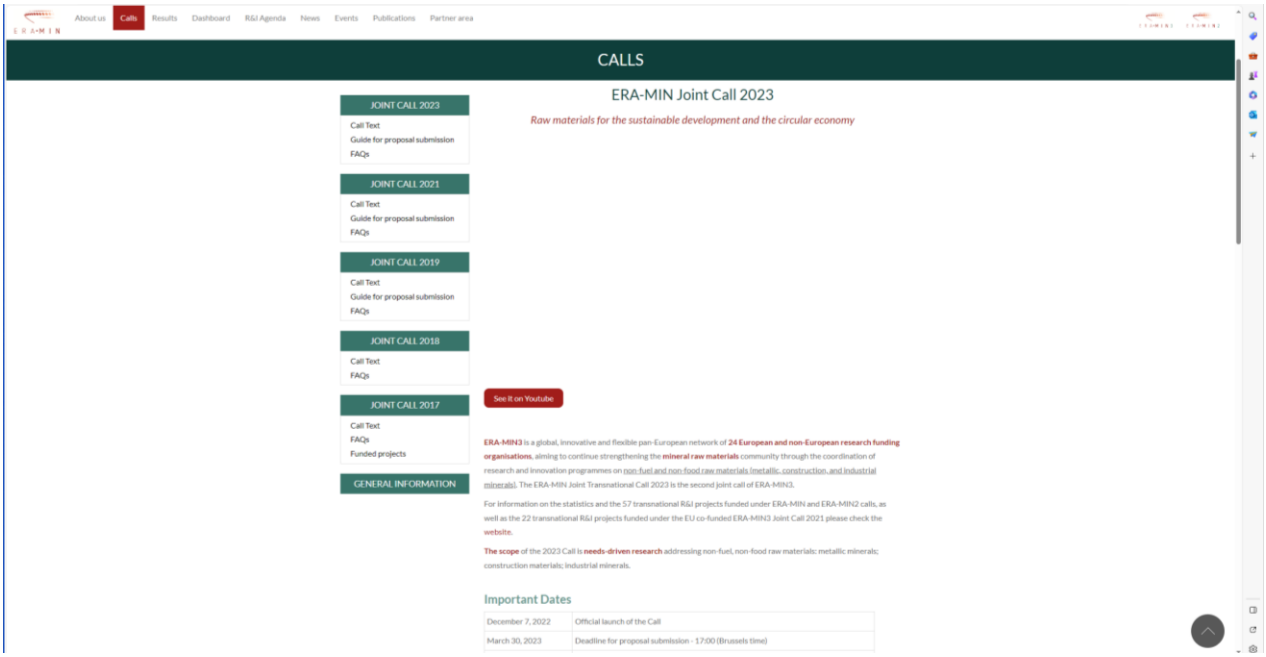

Figure 1. Call website (https://www.era-min.eu/joint-call/era-min-joint-call-2023).

2. CALL IMPLEMENTATION AND STATISTICS

The ERA-MIN Joint Transnational Call 2023 followed a one-stage submission process. By the submission deadline, 49 proposals had been received, 44 of which passed both a centralized ERA-MIN3 eligibility check and additional eligibility checks on national/regional level. These proposals were forwarded to the Scientific Evaluation Board, i.e. an independent and international expert committee, for an evaluation of scientific excellence, impact as well as quality and efficiency of the implementation of the proposed projects.
The scientific evaluation resulted in the unanimous recommendation of 33 proposals for funding, i.e. these proposals fulfilled the scoring threshold necessary for a consideration of funding. The SEB also produced a ranking list of these 33 proposals, which was then used by the Call Steering Committee (CSC; i.e. the involved funding organizations) to make a final selection of projects for funding, following the ranking list (non-binding) based on three main criteria:

1. Top ranking of the proposal on the ranking list
2. maximizing the number of funded projects with the available national/regional budgets.
3. maximizing the number of participating countries/regions with funded projects,

The selection process resulted in an approved funding decision for nine proposals and a rejection of 35 eligible proposals, taken unanimously by the CSC. This corresponds to a funding approval rate of ca. 20% considering all 44 eligible proposals.
The sub-chapters 2.1 and 2.2 below outline some statistics on the 49 initially submitted proposals and on the final selection of 9 proposals, respectively.

2.1 STATISTICS OF SUBMITTED PROPOSALS

The consortia of the 49 submitted proposals include universities, public research organizations, private research organizations, as well as large enterprises, small and medium enterprises, consultancies and other organizations (e.g. public utilities, research centres and non-profit organizations). Whereas proposals constitute mostly public-private partnerships with university, public research organization and industry partners, the majority of proposals are coordinated by universities and public research organizations (Fig. 2A).
The overall own funding rate among all proposals is ca. 18%, a large part of which is provided by the industry partners, whereas the academic partners (universities and research organizations) overall request more than 90% of their project costs as funding (Fig. 2B).

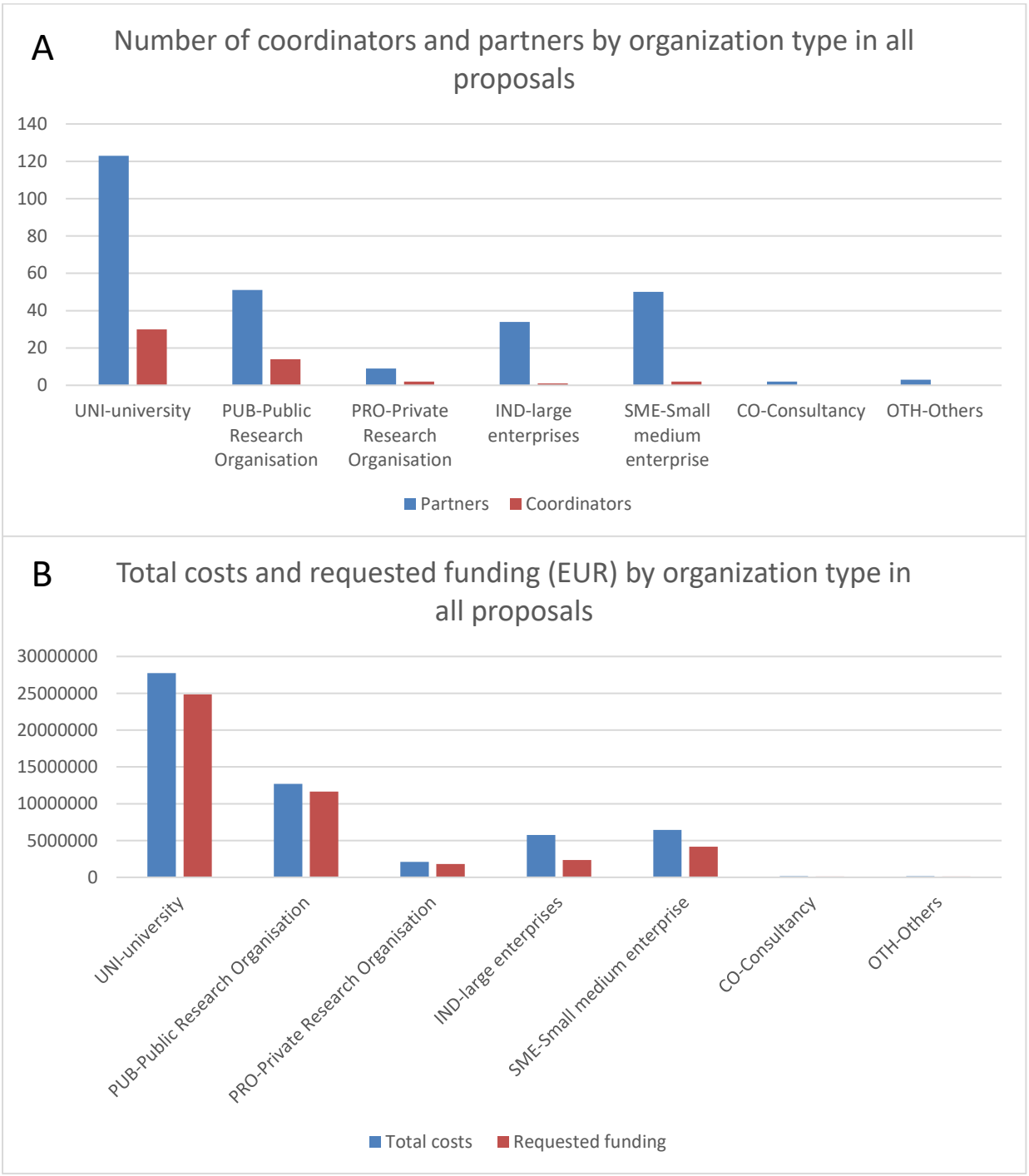

Figure 2. A. Number of coordinators and partners based on all 49 submitted proposals. B. Total costs and requested funding (EUR) by organization type based on all 49 submitted proposals.

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Figure 3 shows requested funding from the individual research funding organizations (countries/regions), as well as own contributions by project partners, from the countries/regions participating in the call. Figure 4 details contribution from associated partners (i.e. partners not requesting funding), which can be organizations from call countries/regions (Fig. 4A) or from countries not participating in the call (Fig. 4B).
Associated project partners from eight call countries/regions (Fig. 4A) as well as from nine European countries not participating in the call (Fig. 4B), joined proposal consortia.
Since there were no applicants requesting funding or contributing to the call from EJ/GV - Innobasque (Spain/Basque Country), this research funding organization was not considered in the statistics.

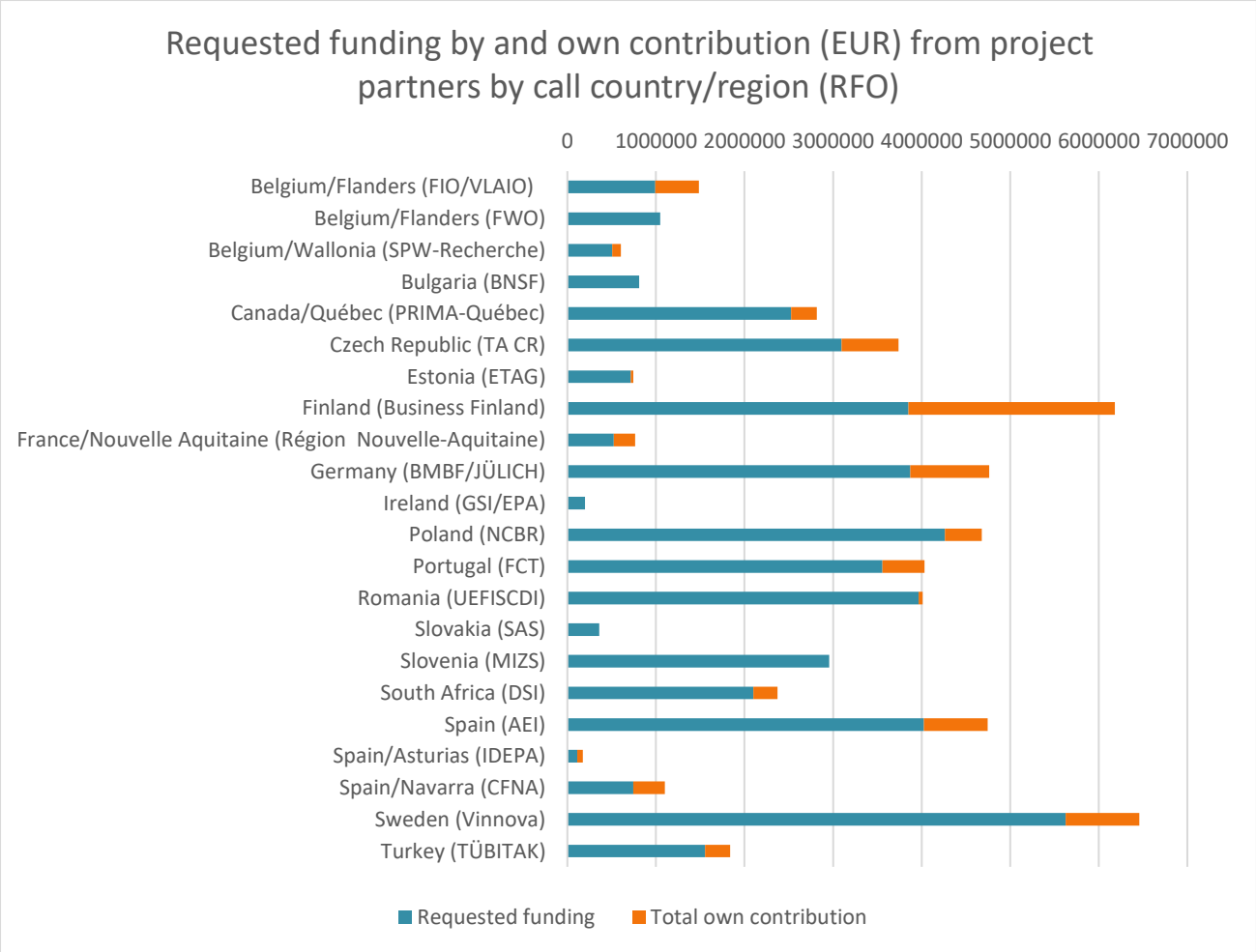

Figure 3. Requested funding and own contribution (EUR) sorted by research funding organization (call country/region) participating in the call. Note that some countries are represented by more than one research funding organization.

Figure 4. A. Own contribution (EUR) by associated partners (not requesting funding) from call countries in the 49 submitted proposals. Note that associated partners from Germany and Poland did not specify any own contribution. B. Own contribution (EUR) by associated partners from countries not participating in the call. Note that the associated partner from Austria did not specify any own contribution.

According to the call design, each proposal must address one of the five main topics of the call (see Introduction), even though sub-topics of any main topic could be addressed additionally. The statistics show what proposals address sub-topics of all five main topics (Fig. 5), with nearly 50% of proposals addressing sub-topics of main topic 2 (*Strengthening the circular economy*), followed by sub-topics of topic 1 (*Supply of raw materials from exploration to mining*). This is in line with previous

ERA-MIN Joint Calls (see corresponding deliverables of ERA-MIN3 EU co-funded call 2021 (Deliverable D3.5) and of calls conducted within ERA-MIN2).

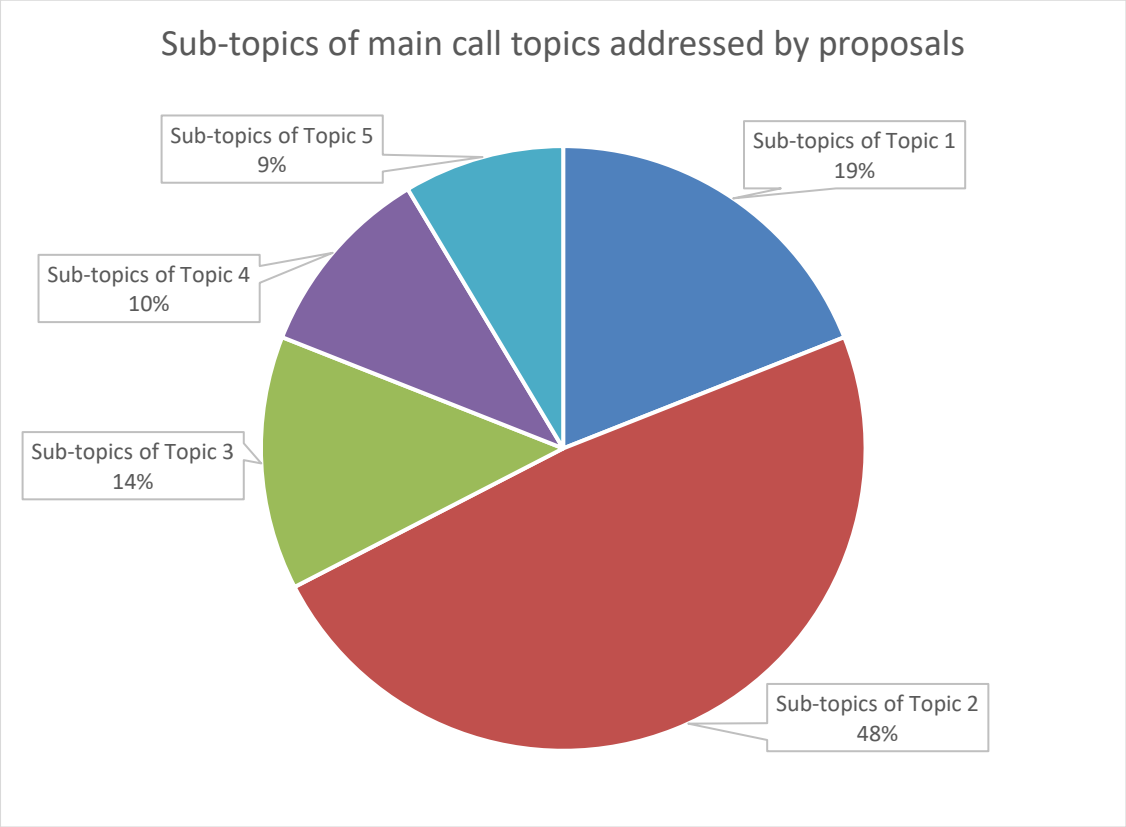

Figure 5. Percentage of sub-topics of main call topics addressed by submitted proposals.

Main topics addressed by proposals include topics 1, 2, 3 and 5 (Fig. 6). Nearly all call countries/regions (20) have proposals addressing topic 2 (*Strengthening the circular economy*), whereas topic 1 (*Supply of raw materials from exploration to mining*) is addressed by proposals with 14 countries/regions.

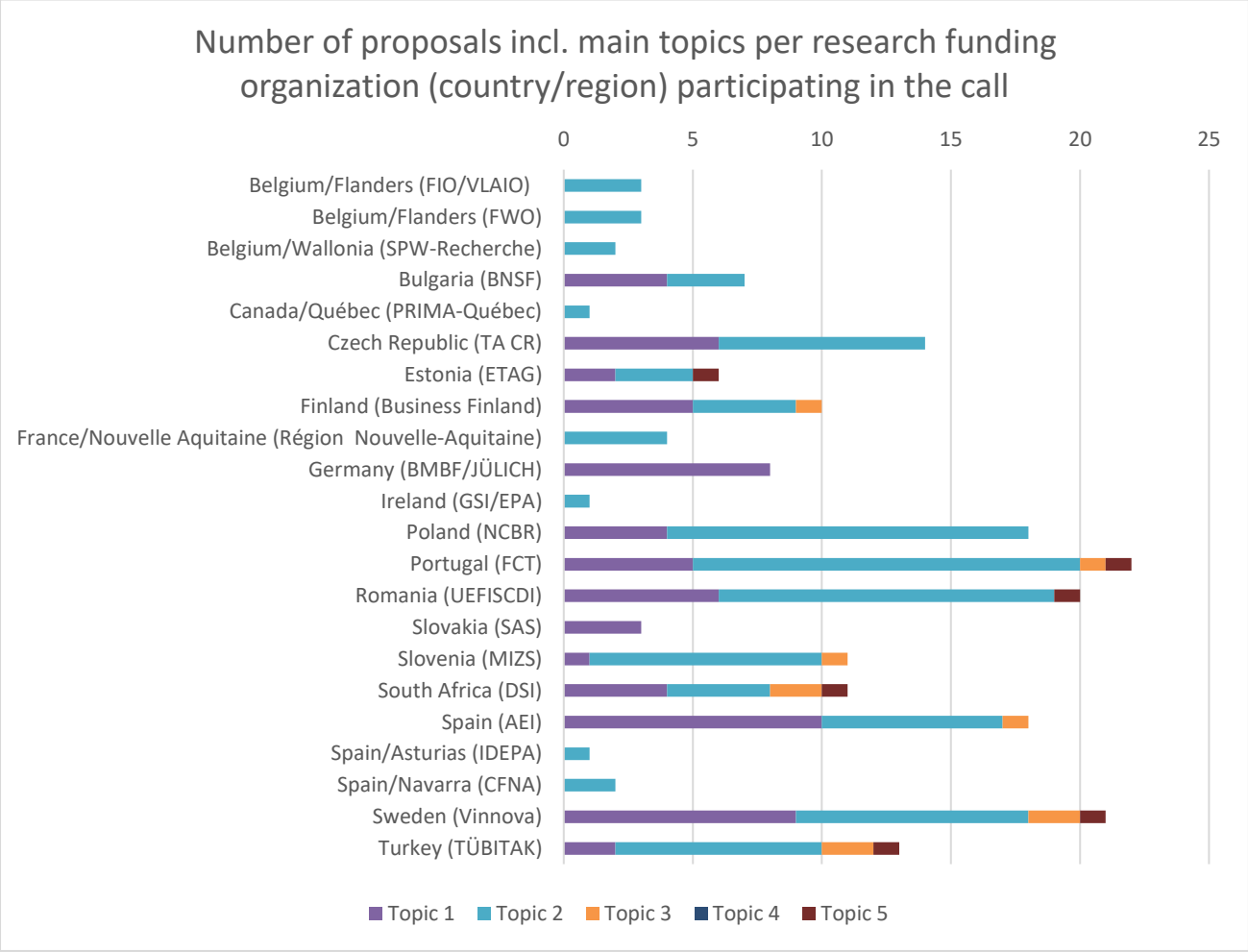

Figure 6. Number of proposals and call main topics addressed by submitted proposals per research funding organization (country/region) participating in the call. Note that some countries are represented by more than one research funding organization.

2.2 STATISTICS OF FUNDED PROJECTS

The nine projects selected for funding have a similar overall relative partner type distribution (Fig. 7A) as observed for all proposals (Fig. 2), with the majority of projects representing public-private partnerships including mainly universities, public research organizations and/or industry (large, medium and small enterprises). Consultancies and other organizations (see above) are not represented in the consortia of the funded projects (Fig. 7A).

The own funding by project partners (overall rate 22%) is provided by all participating partner types except private research organizations, with large enterprises having the highest own contribution rate of ca. 65% (Fig. 7B).

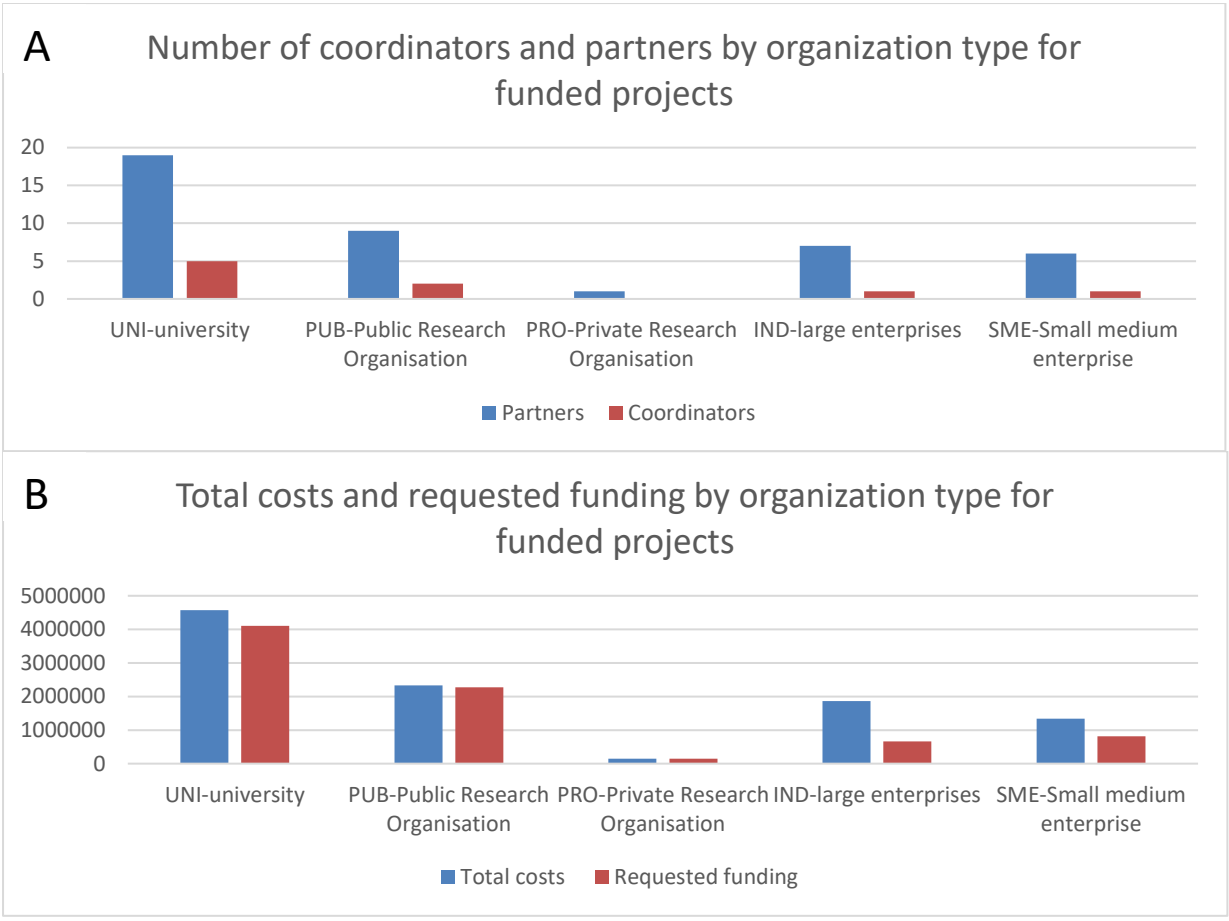

Figure 7. A. Number of coordinators and partners in the nine proposals selected for funding. B. Total costs and requested funding by organization type in the nine proposals selected for funding.

Funded projects address solely topics 1 and 2 as their main topics (Fig. 8), even though sub-topics of all five main topics are included but also dominated by sub-topics of main topics 1 and 2 (Fig. 9). Fourteen research funding organizations, each representing unique countries or regions support the nine funded projects, with four funding organizations having only projects on main topic 1, three funding organizations having only projects on main topic 2, and the remaining seven funding organizations having projects on both main topic 1 and 2 (Fig. 8).

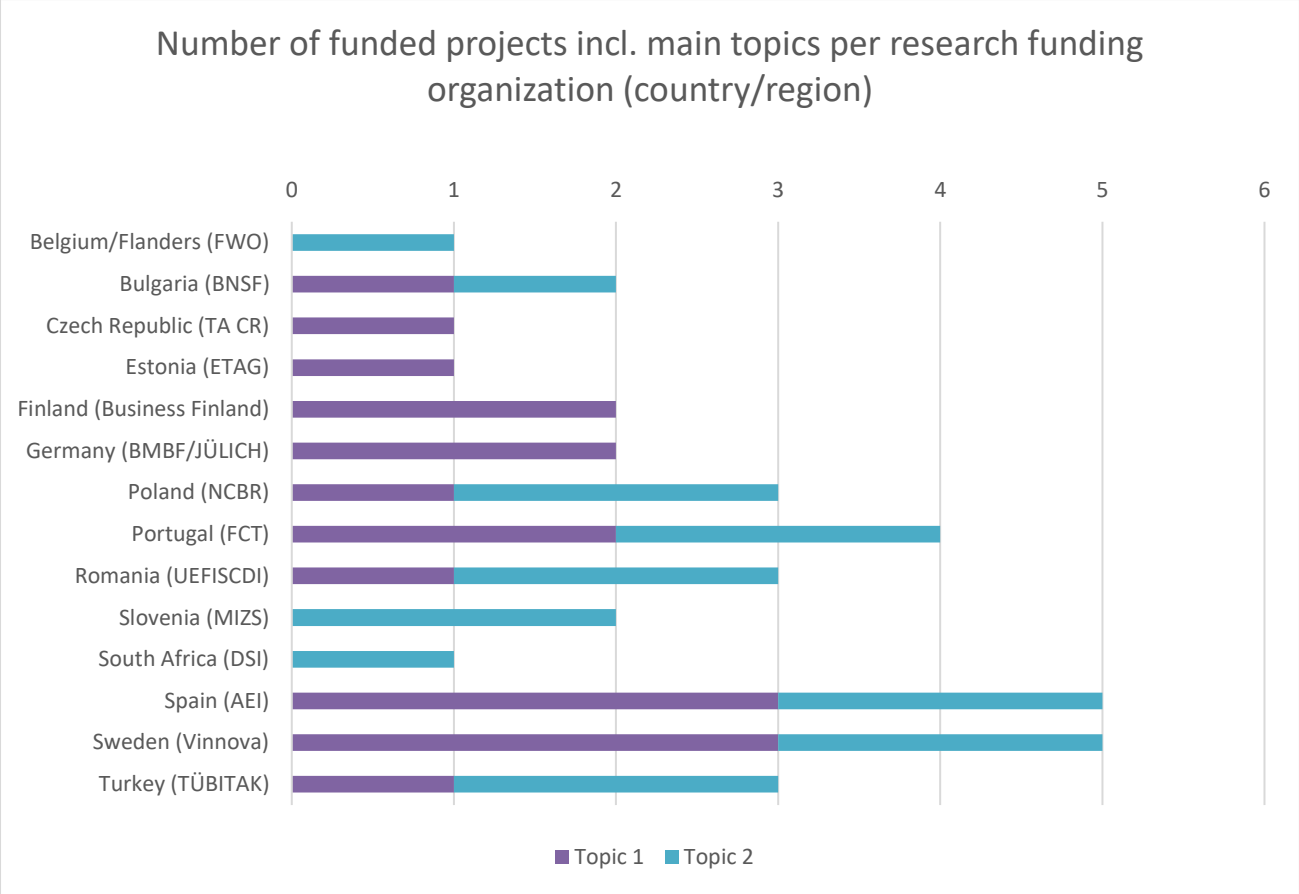

Figure 8. Number of funded projects incl. their main topics per research funding organization (country/region).

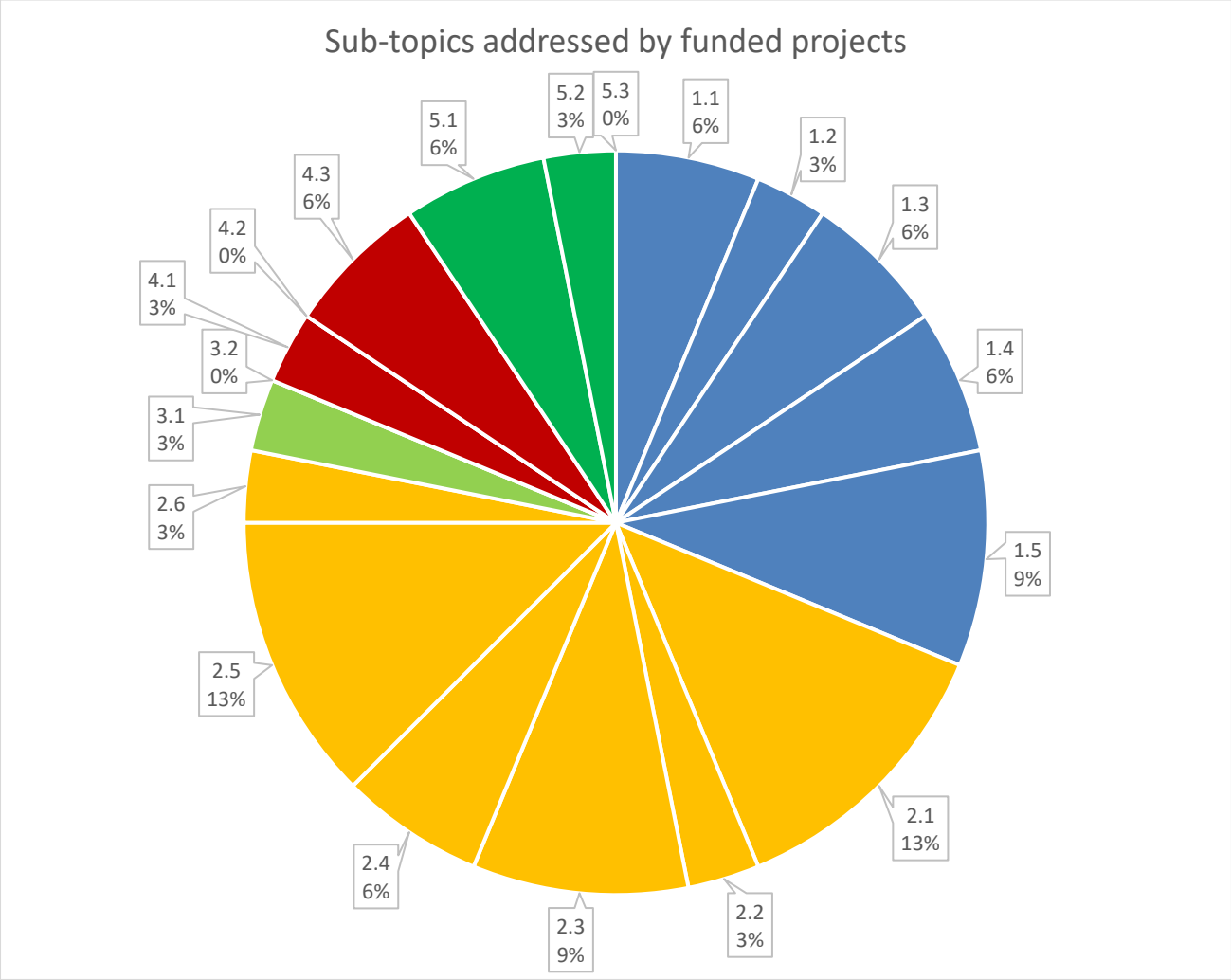

Figure 9. Sub-topics addressed by funded projects. See Introduction for a list of main- and sub-topics of the Call.

Requested funding from the 14 call countries/regions and partner own contribution from these are shown in Figure 10. Eleven countries/regions attracted own contribution from projects between 10% and 57% rate.

Figure 11 summarizes the utilization of national/regional funds in this call. A total of eight funding organizations have committed funds to the call but at the end did not support any of the selected 9 projects, due to low ranking of proposals or due to exhaustion of funds from other funding organisations involved in the projects. Six funding organizations utilized partial indicative committed funds for projects while the remaining six funding organizations utilized all their committed funds. In the latter case, some funding organizations had to increase their initial committed funds to support the high ranked proposals to the largest possible degree.

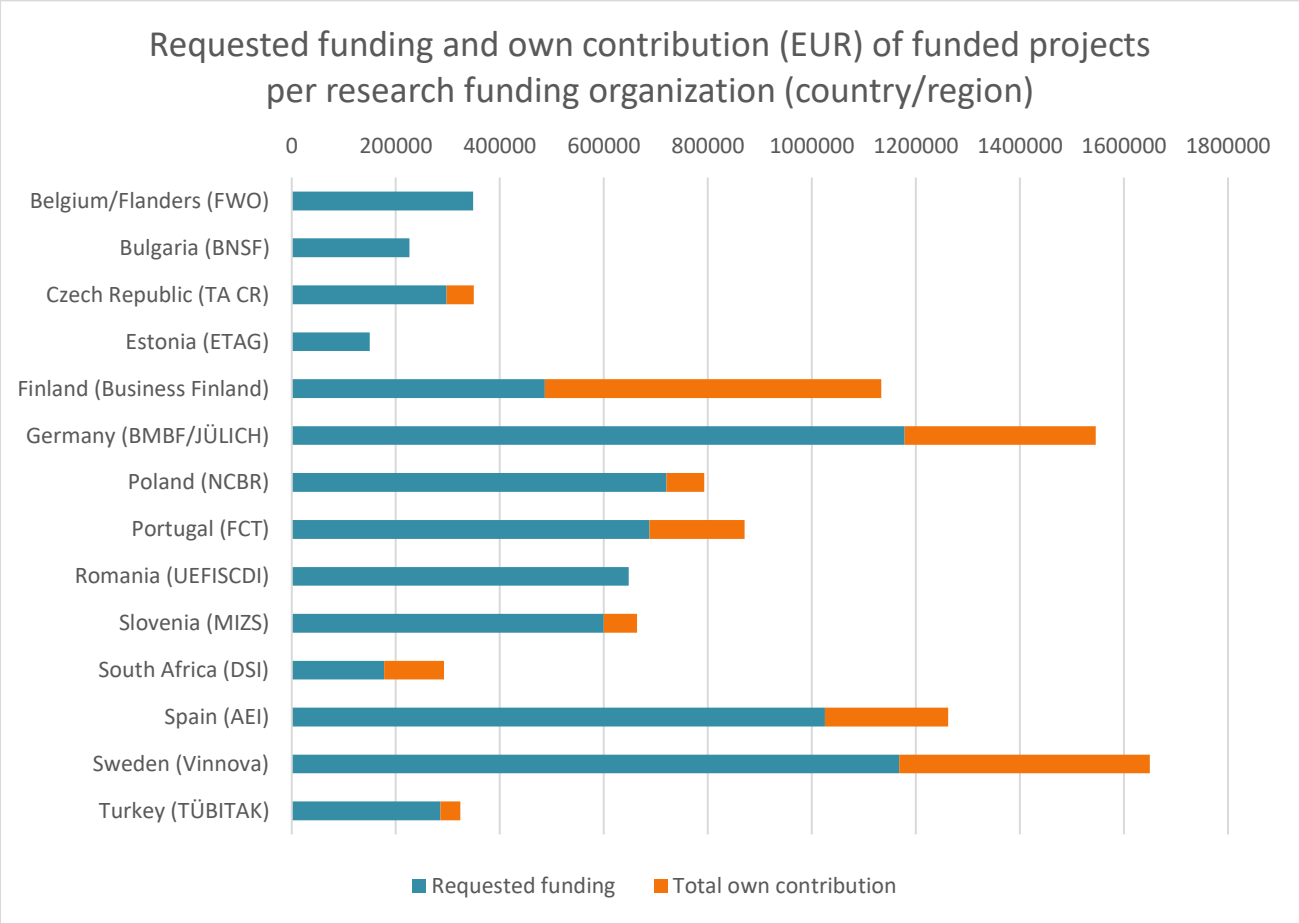

Figure 10. Requested funding and own contribution per research funding organization (call country/region), based on the nine proposals selected for funding.

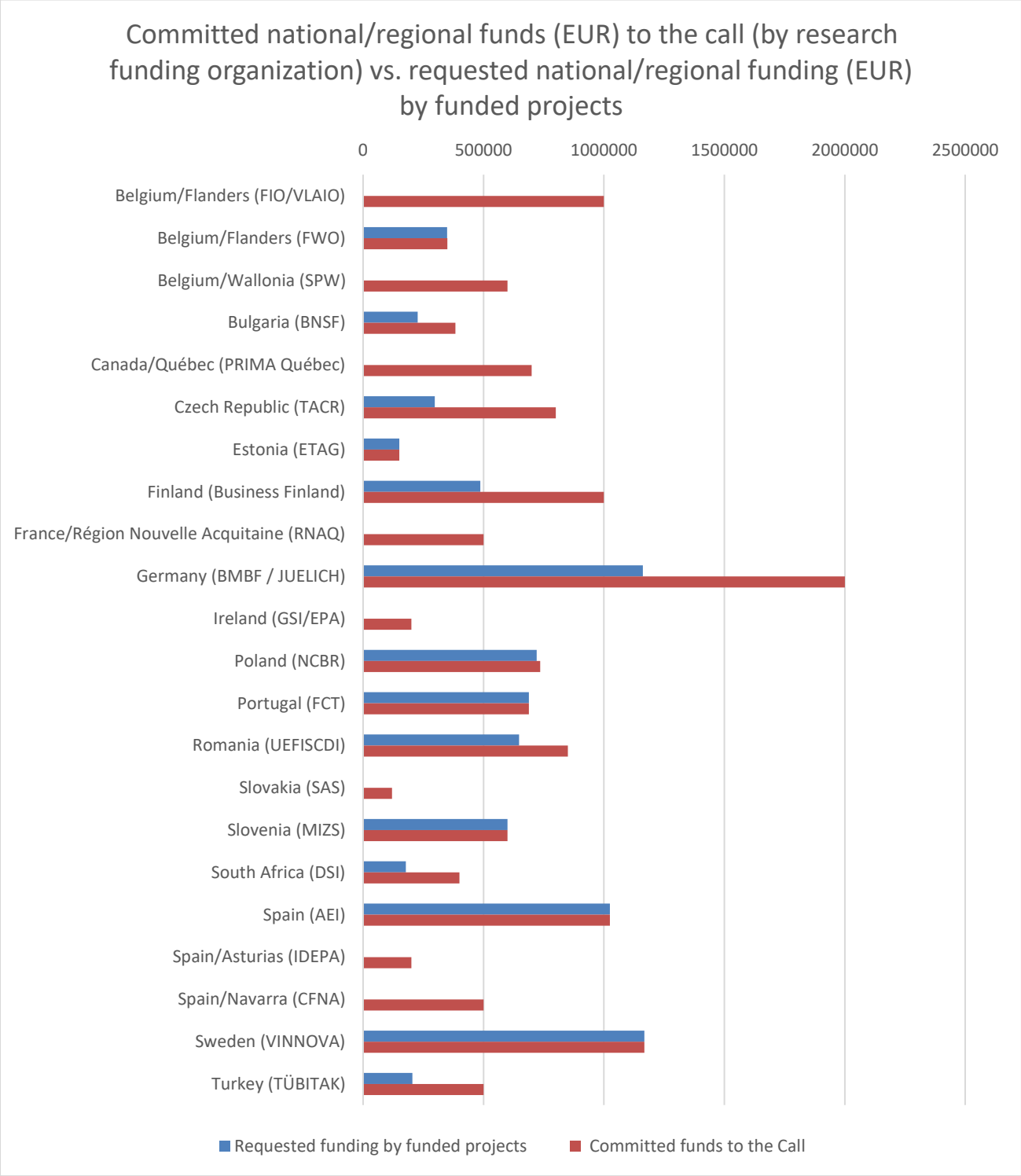

Figure 11. Comparison between national/regional committed funds to the call (by research funding organization) and requested funding by funded projects.

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Considering a 60/40 or more even ratio between male and female participants as a criterion for gender balance, both applicant groups *lead researchers* (i.e. the project leader at a project partner) and *other team members* are balanced regarding gender whereas the group of *principal investigators (*i.e. the lead researchers of the project coordinator) is somewhat male-dominated (33% female).

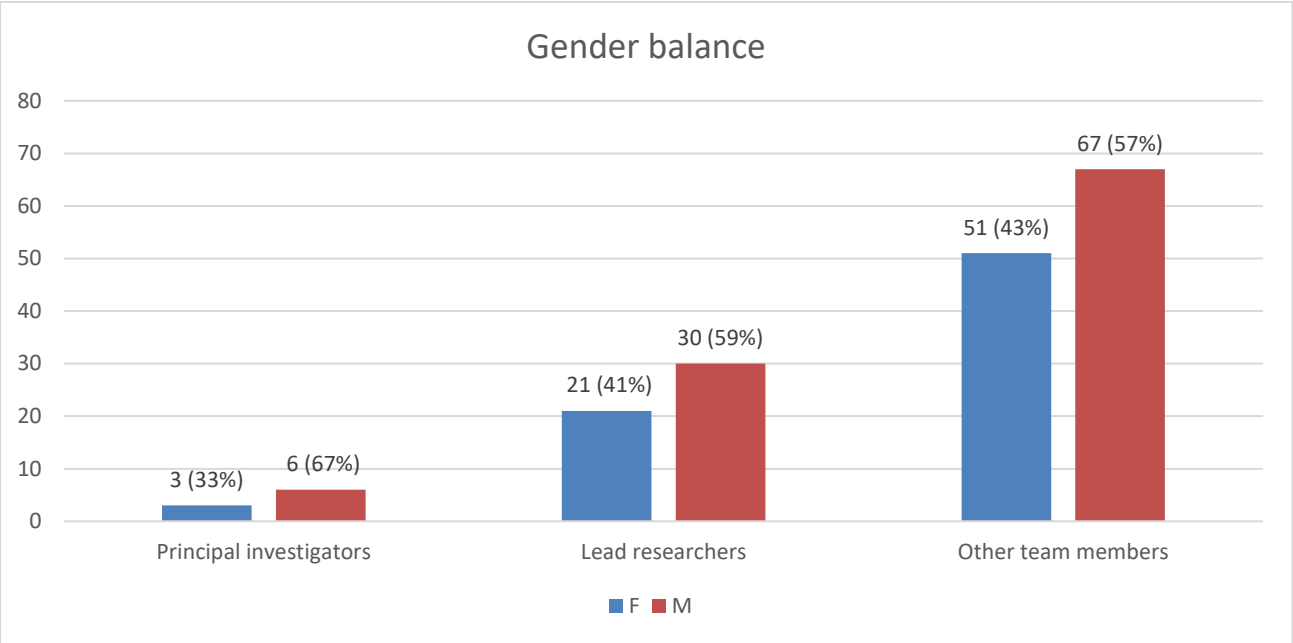

Figure 12. Gender balance (male/female) among principal investigators, lead researchers and other team members. Mutually exclusive datasets.

3. PUBLISHABLE ABSTRACTS OF FUNDED PROJECTS

The following tables are public and available on the ERA-MIN3 website in the « Call Results » menu.

Project acronym	**Cool&SmartTit**		
Project title	A new generation of metallic biomaterials as health solution for a sustainable life		
Main topic	Topic 2: Strengthening the circular economy		
Sub-topics	Sub-Topic 2.1: Product design for resource efficiency, including substitution, Sub-Topic 5.2: Health and safety issues		
Keywords	Metallic biomaterials, health solution, advanced multifunctional materials, characterization, sustainable life		
Publishable abstract	The proposed project "A new generation of metallic biomaterials as health solution for a sustainable life" aims to obtain a new alloys system containing Titanium, Molibdenum, Niobium and Tin (Ti-Mo-Nb-Sn), with characteristics suitable for medical applications. The new generation of biomaterials will overcome the limitations of the titanium, cobalt and stainless-steel alloys as: high elasticity model and low corrosion resistance and biocompatibility. Hence, to achieve long-term stability and rapid osseointegration in orthopedic implants, surface modification of the implant surface is required. In this sense, the new titanium-based alloys will undergo specific heat treatments to obtain alloys with good mechanical properties intended for orthopedic applications. Novelty and Innovation of the proposed approach is the development, improvement, characterization and promotion of new Ti-based alloys obtained for different concentrations of non-toxic metals (Mo, Nb, Sn). These alloys will synergistically combine the effects of each element involved in the titanium system. The obtained biomaterials based on the studied compositions are expected to show improved functional characteristics as implant materials for health-related application. While 60% of orthopedic implants have adverse reactions, these materials developed in the project can easily replace existing materials, having mechanical properties close to those of human bone, resistance to corrosion and rapid osseointegration. Originality of the proposed approach consists in the development and characterization of Ti-based alloys containing unique combination of nontoxic alloying elements that are enhancing the Young modulus (in order to have proprieties closer to the attached/replaced tissue). The newly developed alloys will be thermally treated at different temperature levels in order to obtain optimal characteristics.		
Participating Institutions	Gheorghe Asachi Technical University Iasi, Technologies and Equipment for Materials Processing, Romania; National Institute for Research and Development in Environmental Protection, Impact of Built Environment and Nanomaterials, Romania; Fundación Universitaria San Antonio (UCAM), International Project Office (OPRI), Spain; University of Chemical Technology and Metallurgy, Inorganic and Electrochemical Productions, Bulgaria		
Project duration	36 months		
Total Costs	571 830 €	**Total Requested Funding**	571 830 €

Project acronym	**ValorWaste**
Project title	Valorisation and Integration of Extractive Waste Towards the Sustainability of Raw Materials Industry
Main topic	Topic 1: Supply of raw materials from exploration to mining
Sub-topics	Sub-Topic 1.3: Improved environmental management of mines, Sub-Topic 1.4: Efficient mineral processing and metallurgy, Sub-Topic 1.5: Mine closure, remediation and remining of tailings and waste rock, Sub-Topic 2.5: Life-cycle-analysis of raw materials, Sub-Topic 4.1: Improvement of methods or data for environmental, social and health impact assessment (ESHIA), Sub-Topic 5.1: Social acceptance and trust/public perception of the raw materials industry
Keywords	Waste management, mining waste, construction materials, circular economy, Life-Cycle assessment
Publishable abstract	The extractive industry has been considered one of Europe's most significant waste streams. Given the ambition to move towards a circular economy, extractive wastes have the potential to be altered from a substantial environmental burden to valuable resources via the recovery of valuable minerals and critical raw materials (CRM), reprocessing, and reusing in various applications. Motivated by this, ValorWaste project was conceptualized to provide a holistic view under the reprocessing of extractive waste by addressing the following challenges: i) implement a comprehensive waste materials characterisation methodology to predict suitable valorisation routes; ii) assess the potential of sustainable mineral processing and hydrometallurgy techniques to valorise residues and recover CRMs and other strategic critical elements; iii) design construction materials and chemicals that can integrate extractive waste in their composition; iv) identify the environmental impact of developed valorisation routes using life cycle assessment, hot spot analysis and risk identification; v) provide access for ML algorithms, simulation models and analytics to support process/products optimisation and promote data-driven decisions; vi) identify business opportunities and challenges for the valorisation and integration of extractive waste in the materials construction industry; vii) promote sustainable practices and circularity for the raw materials industry. The project consortium is composed of 8 partners from University/Research Centres and four industrial partners, who have been selected based on their complementary expertise in terms of detailed technical competence in waste management and characterisation (INOE, UTARTU, AWIDA), mineral processing and hydrometallurgy (CUT, FEUP, HCT), construction materials and chemicals (UGR, HCT, SECIL, LIMAK and KALE), life cycle and impact assessment (MEERI PAS, UTARTU), data management and analytics (ASE, FEUP).
Participating Institutions	Faculty of Engineering of University of Porto, Mining Engineering Department, Portugal; Bucharest University of Economic Studies, Economic Informatics and Cybernetics, Romania; National Institute of Research and Development for Optoelectronics INOE 2000, Research Institute for Analytical Instrumentation, Romania;

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	Hacettepe University, Civil Engineering Department, Turkey; Chalmers Tekniska Högskola, Chemistry and Chemical Engineering, Sweden; University of Granada, Building Construction/Architectural Construction, Spain; University of Tartu, Institute of Technology, Estonia; Kalekim Construction Chemicals, R&D, Turkey		
Project duration	36 months		
Total Costs	1 769 041 €	**Total Requested Funding**	1 412 581 €

Project acronym	**SIREN**		
Project title	Rapidly sintered re-engineered Nd-Fe-B permanent magnets based on recycled content		
Main topic	Topic 2: Strengthening the circular economy		
Sub-topics	Sub-Topic 2.1: Product design for resource efficiency, including substitution, Sub-Topic 2.5: Life-cycle-analysis of raw materials, Sub-Topic 3.1: Increase resource efficiency in resource intensive production processes		
Keywords	Circular economy, magnet recycling, CRM substitution, Nd-Fe-B magnets, microstructure reengineering		
Publishable abstract	Rare earth elements (REEs) are some of the most critical materials for Europe due to their economic significance and high supply risk. Rare-earth-based permanent magnets, notably Nd-Fe-B-type, are important engineering materials for the modern society and a major application for REEs. They are used in a variety of devices, including consumer electronics, computers, sensors, magnetic resonance imaging (MRI), and energy-conversion devices like electric motors and wind turbine generators. The contemporary environmental issues of climate change and air pollution in major cities necessitate rapid development of technologies and solutions that will facilitate the green transition and a shift towards a sustainable economy. However, owing to rapid market growth, electric vehicles are today considered a disruptive technology for the consumption of REEs. Projections indicate global shortages of Nd-Fe-B alloys amounting to almost one-third of the total market by 2035. At present, less than 1% of the world's REEs are being recycled. Recycling end-of-life (EOL) magnets by conventional, i.e., chemical and pyrometallurgical routes, is expensive, energy-intensive, and incompatible with circular economy model needs. A very promising alternative is the HPMS process (Hydrogen Processing of Magnet Scrap) which can be used to recover the precious Nd-Fe-B material from often complex magnet-containing devices. The SIREN project will build on the existing HPMS technologies, upgrading them with innovative approaches to re-engineer the microstructure of magnets and boost their magnetic performance. Through its novel, environmentally friendly recycling process, SIREN will offer 100% recycled, advanced, Nd-Fe-B magnets, for use in wind-turbine generators and traction motors. This will strengthen the circular economy for rare-earth magnets and lift the reservations regarding the still relatively new green technologies to change the public perception towards green transition initiatives.		
Participating Institutions	Jožef Stefan Institute (JSI), Department for Nanostructured Materials, Slovenia; Koç University, Koç University Surface Science and Technology Center (KUYTAM), Turkey; KU Leuven, Materials Engineering, Belgium/Flanders; IVL Swedish environmental research institute, Sweden Magneti Ljubljana d.d., R&D, Slovenia (associated partner)		
Project duration	36 months		
Total Costs	960 563 €	**Total Requested Funding**	960 563 €

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Project acronym	**SuMREE**		
Project title	Sustainable Mining of REE in Europe		
Main topic	Topic 1: Supply of raw materials from exploration to mining		
Sub-topics	Sub-Topic 1.1: Innovative exploration methods, Sub-Topic 1.2: More sustainable mining operations, Sub-Topic 1.3: Improved environmental management of mines, Sub-Topic 1.4: Efficient mineral processing and metallurgy, Sub-Topic 1.5: Mine closure, remediation and remining of tailings and waste rock		
Keywords	REE mining, REE geochemistry, efficient extraction, low environmental impact, Critical Raw Materials (CRM)		
Publishable abstract	The Critical Raw Materials Act, published on March 16th, 2023, clearly stressed the need for domestic production of Critical and Strategical Raw Materials (CRM) in Europe. Rare Earth Elements (REE) are classified as the CRM with the highest supply chain vulnerability. REE mining projects in Europe have a great opportunity to be profiled as world leading regarding sustainable mining. To reach that position, efficient extraction techniques need to be developed and the environmental standards must be high to minimizing adverse impact. In SuMREE (Sustainable mining of REE in Europe), we have gathered two of the most important stakeholders regarding REE-mining in Europe (LKAB, Sokli Oy) together with researchers holding extensive experience in REE geochemistry and mineralogy (Huelva University, Universitat de Barcelona, Luleå University of Technology, and the Czech Geological Survey). The main objectives of SuMREE are to increase the competitiveness for REE mining, reduce the environmental footprint and indirectly improve the social acceptance towards REE mining. Different geomaterials hosting REE will be studied in different climates (arctic, continental, Mediterranean), different pH-conditions (acidic to alkaline) and various redox environments (anoxic to oxic) regarding REE geochemistry. The knowledge gained will be directly applied by Sokli Oy, that aims to develop state-of-the-art mining, extraction and separation of REE from the Sokli ore in Northern Finland within the project. Furthermore, the impact of waste produced from REE mining of Fe-apatite residue in LKAB's mining process will be evaluated based on the environmental impact. Thus, the close collaboration between researchers and stakeholders in SuMREE enhance the results to be implemented already at an early stage of mining to reach responsible and sustainable mine development with high efficiency, low waste production and low environmental impact.		
Participating Institutions	Luleå University of Technology, Department of Civil, Environmental and Natural Resources Engineering, Sweden; University of Huelva, Earth Sciences, Spain; Universitat de Barcelona, Spain; Czech Geological Survey, Mineral resources research and policy, Czech Republic; The Finnish Minerals Group, Finland; LKAB, JTFK, Sweden (associated partner)		
Project duration	36 months		
Total Costs	2 155 692 €	**Total Requested Funding**	1 243 069 €

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Project acronym	**CuSlag2CRM**		
Project title	Innovative copper slag processing for raw material supply		
Main topic	Topic 1: Supply of raw materials from exploration to mining		
Sub-topics	Sub-Topic 1.5: Mine closure, remediation and remining of tailings and waste rock		
Keywords	Copper Slag, Bioleaching, Solid State Chlorination, Geopolymer, Life Cycle Assesment		
Publishable abstract	Copper slag is a by-product obtained during roasting, smelting and refining of copper. Applications are increasingly being sought for the copper slag from ongoing copper slag production. Historically, however, the slag was deposited over several centuries, creating artificial mountains of considerable size. The partners would like to investigate historical dumps in their area. These are Elyseina in Bulgaria (University of Mining and Geology St. Ivan Rilski), São Domingos mine in Spain (Universidad de Huelva) and Mansfeld, Germany (TU Freiberg, GEOS). The copper slag dumps will be analyzed with regard to their chemical and mineralogical composition. In particular, it should be examined how homogeneous the composition is or how it has changed over the time of deposition. The objective of CuSlag2RM is to recover REEs, metals and critical raw materials from copper slag by bioleaching and innovative chemical leaching methods. After leaching it is the target to generate a residue, which can be used for sustainable landfilling or as functional mineral filler for construction materials like cement or geopolymers. Building materials produced in CuSlag2RM will be analyzed for its recyclability, in order to fulfill the requirements of circular economy.		
Participating Institutions	TU Bergakademie Freiberg, Institute of technical chemistry, Germany; TU Bergakademie Freiberg, Institute of Biosciences, Germany; G.E.O.S. Ingenieurgesellschaft mbH, Engineering and biotechnology, Germany University of Mining and Geology "St.Ivan Rilski", Engineering Geoecology, Bulgaria; University of Huelva, Earth Sciences, Spain		
Project duration	36 months		
Total Costs	776 735 €	**Total Requested Funding**	709 045 €

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Project acronym	**HETMOLION**		
Project title	Processing waste battery scrap into high entropy transition metal oxides for next generation Li-ion batteries		
Main topic	Topic 2: Strengthening the circular economy		
Sub-topics	Sub-Topic 2.1: Product design for resource efficiency, including substitution, Sub-Topic 2.3: Reuse, repair, refurbishing, repurposing and remanufacturing of end-of-life products, Sub-Topic 2.4: Recovery and urban mining of raw materials from end-of-life products or other wastes, Sub-Topic 4.3: Energy-saving and climate action		
Keywords	High entropy metal oxides, Li-ion battery materials, battery recycling, circular economy, life cycle assessment		
Publishable abstract	At the core of new lithium battery technologies is the design of active electrode materials with desired properties. Depending on the prospective end-user, emphasis of these efforts may be put on specific energy, rate capability, cyclic stability, safety, cost, or a combination of the aforementioned. New materials must also always be designed with careful consideration of sustainability, understood as cost, accessibility and potential environmental impact of raw materials/precursors used for their fabrication. HETMOLION is an industry needs-driven project takes the above issues into consideration and focuses on novel materials that have the potential of being intrinsically safer, do not pose sustainability problems and thus, may be regarded as future alternative to some of the currently well-established Li-ion technologies, especially (but by no means limited to) for such applications as public electric transportation. The overall objective of the project is to strengthen circular dimension of European battery industry by developing a family of novel sustainable anode materials for next-generation of durable and safe-by-design Li-ion batteries. Those new materials will be based on a recent concept of high entropy transition metal oxides (HETMO) and will contain several metallic elements, at least 80% of which could be obtained from processed waste batteries, thus minimizing the need of using primary raw materials, instead making usage of vast urban waste depository. After optimization, the materials' usability will be demonstrated in prototype Li-ion pouch cells. The whole project idea is meant to follow the circular economy approach which will be demonstrated with the application of suitable LCA tools. Thus, overall approach can be summarized as proposing novel material concept that will be both competitive in terms of operational properties and aligned with strict sustainability and circularity requirements.		
Participating Institutions	Lukasiewicz Research Network - Institute of Non-Ferrous Metals, Centre for Electrochemical Energy Storage, Poland; INEGI - Institute of Science and Innovation in Mechanical and Industrial Engineering, Energy and Environment Unit, Portugal; University of the Witwatersrand, School of Chemistry, South Africa; National Research and Development Institute for Non - ferrous and Rare Metals, Metal Resource Valorisation Technologies, Romania; Eneris Polbatt, Poland		
Project duration	36 months		
Total Costs	983 672 €	**Total Requested Funding**	840 429 €

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Project acronym	**GENIUS**		
Project title	Greener permanent magnets without or with less critical raw materials		
Main topic	Topic 2: Strengthening the circular economy		
Sub-topics	Sub-Topic 2.1: Product design for resource efficiency, including substitution, Sub-Topic 2.3: Reuse, repair, refurbishing, repurposing and remanufacturing of end-of-life products, Sub-Topic 2.4: Recovery and urban mining of raw materials from end-of-life products or other wastes, Sub-Topic 2.5: Life-cycle-analysis of raw materials		
Keywords	REE-free magnets, recycling, design-to-recycle, scrap material		
Publishable abstract	Permanent magnets (PM) are vital components of the green transition. PMs have a central role in renewable energy and sustainable mobility, and demand for high-quality PMs is ever increasing to enable the green transition. The best-performing PMs are based on REEs, while lower-performance PMs use ferrites. Due to the high performance of REE magnets, most modern devices employ them, as they are lighter and lead to better efficiency. Unfortunately, REEs are critical raw materials owing to their supply risk and price volatility, and also their harmful environmental impacts. GENIUS seeks to address the challenges brought forward in this call's Topic 2: Strengthening the circular economy by substitution of critical materials in products and components by recycled REE-free or REE-lean magnets. To address these challenges, the magnets developed in GENIUS will be produced solely by recycling of injection moulded PM scrap material, with the recycling done in several stages, by milling, or milling followed by polymer removal and annealing to recover the magnetic properties of powders. The GENIUS project's ambition is to develop recycled REE-free/REE-lean PMs by additive manufacturing coupled with novel consolidation techniques to reduce Europe's dependency on REEs and enable the circular economy of materials and value. A primary focus is on making future PM manufacture sustainable and environmentally sound, and we are hoping long-term to reduce Europe´s import of REE by 3,800 tons/year, and have considerable economic and job growth impacts. As of 2022 only 12% of secondary materials and resources are brought back to the European economy with nearly no recycling or reuse of PMs at present. Our approach will establish innovative, functionally recyclable PM designs, circular paths, and efficient workflows scalable to industry scales leading to a future of more efficient REE-free motors.		
Participating Institutions	Jožef Stefan Institute, Department for Nanostructured Materials, Slovenia; University of Nova Gorica, Materials Research Laboratory, Slovenia; Spanish National Research Council (CSIC), Institute of Ceramics and Glass, Spain; Uppsala Universitet, Division for Electricity, Sweden; Kolektor Mobility d.o.o., R&D Magnetics, Slovenia (associated partner)		
Project duration	36 months		
Total Costs	863 450 €	**Total Requested Funding**	799 700 €

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Project acronym	**MAQSIMAL**		
Project title	Multimodal Airborne Quantum Sensor InstruMent for sustAinable expLoration		
Main topic	Topic 1: Supply of raw materials from exploration to mining		
Sub-topics	Sub-Topic 1.1: Innovative exploration methods, Sub-Topic 4.3: Energy-saving and climate action, Sub-Topic 5.1: Social acceptance and trust/public perception of the raw materials industry		
Keywords	Exploration, airborne, geophysics, FTMG, AFMAG		
Publishable abstract	To secure today a sustainable supply with critical (and strategic) raw materials (CRM and SRM), the project proposal Multimodal Airborne Quantum Sensor InstruMent for sustAinable expLoration (MAQSIMAL) envisions a unique and miniaturized demonstrator based on hybrid read out Superconducting QUantum Interference Devices (SQUIDs) which is able to simultaneously record multiple measurement modalities such as the magnetic field vector, the full tensor magnetic gradient, audio-frequency magnetics, and audio-magnetotelluric data at utmost precision, high bandwidth, and unprecedented dynamic range (>32 bit) using a modular data acquisition system on an advanced helicopter-towed platform. The demonstrator will be complemented with software tools for post-mission data processing and individual or joint inversions using all or a subset of modalities. Its performance will be evaluated over two representative targets for CRM/SRM resources in Sweden and Portugal. The data will be benchmarked against available geophysical/geological and drill-hole data and by ground-based electromagnetic measurements with the transient EM method using todays best SQUID receiver technology. An integrated 3D model of the resource will jointly be developed using all available information. In MAQSIMAL, the team will analyse the outcome of predecessor projects in the topic of mineral exploration, will undertake research addressing aspects for energy and climate change as well as social awareness and actions such as press releases, publications, and public days to evaluate the impact for shareholders. The consortium provides with the new technology a significant competitive advantage to the European mining community and geophysical service providers by improvements in resolution and greater penetration (> 500 m) and will equip the European natural resources industries with a novel tool for better defining more sustainable and carbon efficient mining techniques by advancing the knowledge to identify areas.		
Participating Institutions	supracon AG, Germany; Technical University Ilmenau, Advanced Electromagnetics Group, Germany; GRM-services Oy, Geophysics, Finland; LKAB, Prospektering | Exploration, Sweden; Laboratório Nacional de Energia e Geologia, Mineral Resources and Geophysics, Portugal		
Project duration	36 months		
Total Costs	1 686 926 €	**Total Requested Funding**	997 735 €

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

Project acronym	**CLEARNESS**		
Project title	Circular product design applied to the recovery of critical raw elements from electrolyzers and fuel cells at their end of life		
Main topic	Topic 2: Strengthening the circular economy		
Sub-topics	Sub-Topic 2.2: End-of-life products pre-processing: collection, logistics, pre-treatment, dismantling, sorting, characterisation, Sub-Topic 2.3: Reuse, repair, refurbishing, repurposing and remanufacturing of end-of-life products, Sub-Topic 2.5: Life-cycle-analysis of raw materials, Sub-Topic 2.6: New business models (implementing circular economy aspects)		
Keywords	Rare earth metals, recycling, circular economy, fuel cell, electrolysis		
Publishable abstract	The main goal of the CLEARNESS project is to develop an approach of circular product design of novel multifunctional composite materials based on metals, noble metals and rare earth metals recovered from end-of-life high temperature electrochemical cells. High temperature electrolysers and fuel cells are considered as an integral part of the future hydrogen economy. At the present state-of-art, a fuel cell/electrolysis stack is supposed to reach 40,000 h of operation time. After this, the stack is supposed to be exchanged with a new one. This project addresses the issues of optimizing the circular manufacturing process of fuel/electrolysis cell stacks by recycling used electrodes and active elements. The concept will demonstrate its potential to promote the sustainable and responsible sourcing, processing, production, consumption, and recycling of primary and secondary minerals and metals by incorporating appropriate sustainability and nontechnology factors such as environmental, social, health, and circular economy concerns.		
Participating Institutions	Warsaw University of Technology, Faculty of Power and Aeronautical Engineering, Poland; Fuel Cell Poland Ltd., Poland; Eskisehir Technical University, Turkey; University of Aveiro, CICECO - Aveiro Institute of Materials, Portugal		
Project duration	36 months		
Total Costs	489 766 €	**Total Requested Funding**	464 766 €

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4. DATA ON FUNDED PROJECTS

The following tables are public and available on the ERA-MIN3 website in the « Call Results » menu.

Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participanting countries - Funding organisations	Duration	Total Costs	Total Requested Funding
Topic 1. Supply of raw materials from exploration to mining	Sub-Topic 1.3: Improved environmental management of mines, Sub-Topic 1.4: Efficient mineral processing and metallurgy, Sub-Topic 1.5: Mine closure, remediation and remining of tailings and waste rock, Sub-Topic 2.5: Life-cycle-analysis of raw materials, Sub-Topic 4.1: Improvement of methods or data for environmental, social and health impact assessment (ESHIA), Sub-Topic 5.1: Social acceptance and trust/public perception of the raw materials industry	**ValorWaste**	Valorisation and Integration of Extractive Waste Towards the Sustainability of Raw Materials Industry	Faculty of Engineering of University of Porto, Mining Engineering Department	Portugal - FCT	36 months	1 769 041 €	1 412 581 €
				Bucharest University of Economic Studies, Economic Informatics and Cybernetics	Romania - UEFISCDI			
				National Institute of Research and Development for Optoelectronics INOE 2000, Research Institute for Analytical Instrumentation	Romania - UEFISCDI			
				Hacettepe University, Civil Engineering Department	Turkey - TUBITAK			
				Chalmers Tekniska Högskola, Chemistry and Chemical Engineering	Sweden - Vinnova			
				University of Granada, Building Construction/Architectural Construction	Spain - AEI			
				University of Tartu	Estonia - ETAG			

Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participanting countries - Funding organisations	Duration	Total Costs	Total Requested Funding
				Kalekim Construction Chemicals, R&D	Turkey - TUBITAK			
	Sub-Topic 1.1: Innovative exploration methods, Sub-Topic 1.2: More sustainable mining operations, Sub-Topic 1.3: Improved environmental management of mines, Sub-Topic 1.4: Efficient mineral processing and metallurgy, Sub-Topic 1.5: Mine closure, remediation and remining of tailings and waste rock	**SuMREE**	Sustainable Mining of REE in Europe	Luleå University of Technology, Department of Civil, Environmental and Natural Resources Engineering	Sweden - Vinnova	36 months	2 155 692 €	1 243 069 €
				University of Huelva, Earth Sciences	Spain - AEI			
				Universitat de Barcelona	Spain - AEI			
				Czech Geological Survey, Mineral resources research and policy	Czech Republic – TA CR			
				The Finnish Minerals Group	Finland – Business Finland			
				LKAB, JTFK	Sweden			
	Sub-Topic 1.5: Mine closure, remediation and remining of tailings and waste rock	**CuSlag2CRM**	Innovative copper slag processing for raw material supply	TU Bergakademie Freiberg, Institute of technical chemistry	Germany – BMBF/JULICH	36 months	776 735 €	709 046 €
				TU Bergakademie Freiberg, Institute of Biosciences	Germany – BMBD/JULICH			

Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participanting countries - Funding organisations	Duration	Total Costs	Total Requested Funding
				G.E.O.S. Ingenieurgesellschaft mbH, Engineering and biotechnology	Germany- BMBF/JULICH			
				University of Mining and Geology "St.Ivan Rilski", Engineering Geoecology	Bulgaria - BNSF			
				University of Huelva, Earth Sciences	Spain - AEI			
	Sub-Topic 1.1: Innovative exploration methods, Sub-Topic 4.3: Energy-saving and climate action, Sub-Topic 5.1: Social acceptance and trust/public perception of the raw materials industry	**MAQSIMAL**	Multimodal Airborne Quantum Sensor InstruMent for sustAinable expLoration	supracon AG	Germany – BMBF/JULICH	36 months	1 656 926 €	997 735 €
				Technical University Ilmenau, Advanced Electromagnetics Group	Germany – BMBF/JULICH			
				GRM-services Oy, Geophysics	Finland – Business Finland			
				LKAB, Prospektering | Exploration	Sweden - Vinnova			
				Laboratorio Nacional de Energia e Geologia, Mineral Resources and Geophysics	Portugal - FCT			

Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participanting countries - Funding organisations	Duration	Total Costs	Total Requested Funding
Topic 2. Strengthening the circular economy	2.1: Product design for resource efficiency, including substitution 5.2: Health and safety issues	**Cool&SmartTit**	A new generation of metallic biomatierals as health solution for a sustainable life	Gheorghe Asachi Technical University Iasi, Technologies and Equipment for Materials Processing	Romania - UEFISCDI	36 months	571 830 €	571 830 €
				National Institute for Research and Development in Environmental Protection, Impact of Built Environment and Nanomaterials	Romania - UEFISCDI			
				Fundación Universitaria San Antonio (UCAM), International Project Office (OPRI)	Spain - AEI			
				University of Chemical Technology and Metallurgy	Bulgaria - BNSF			
	Sub-Topic 2.1: Product design for resource efficiency, including substitution, Sub-Topic 2.5: Life-cycle-analysis of raw materials, Sub-Topic 3.1: Increase resource efficiency in resource intensive production processes	**SIREN**	Rapidly sintered re-engineered Nd-Fe-B permanent magnets based on recycled content	Jožef Stefan Institute (JSI), Department for Nanostructured Materials	Slovenia - MIZS	36 months	960 536 €	960 536 €
				Koç University, Koç University Surface Science and Technology Center (KUYTAM)	Turkey - TUBITAK			
				KU Leuven, Materials Engineering	Belgium/Flanders - FWO			
				IVL Swedish environmental research institute	Sweden - Vinnova			

Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participanting countries - Funding organisations	Duration	Total Costs	Total Requested Funding
				Magneti Ljubljana d.d., R&D	Slovenia			
	Sub-Topic 2.1: Product design for resource efficiency, including substitution, Sub-Topic 2.3: Reuse, repair, refurbishing, repurposing and remanufacturing of end-of-life products, Sub-Topic 2.4: Recovery and urban mining of raw materials from end-of-life products or other wastes, Sub-Topic 4.3: Energy-saving and climate action	**HETMOLION**	Processing waste battery scrap into high entropy transition metal oxides for next generation Li-ion batteries	Lukasiewicz Research Network - Institute of Non-Ferrous Metals, Centre for Electrochemical Energy Storage	Poland - NCBR	36 months	983 672 €	840 429 €
				INEGI - Institute of Science and Innovation in Mechanical and Industrial Engineering, Energy and Environment Unit	Portugal - FCT			
				University of the Witwatersrand, School of Chemistry	South Africa - DSI			
				National Research and Development Institute for Non - ferrous and Rare Metals, Metal Resource Valorisation Technologies	Romania- UEFISCDI			
				Eneris Polbatt	Poland - NCBR			
	Sub-Topic 2.1: Product design for resource efficiency, including substitution, Sub-Topic 2.3: Reuse, repair, refurbishing, repurposing and remanufacturing of end-of-life products,	**GENIUS**	Greener permanent magnets without or with less critical raw materials	Jožef Stefan Institute, Department for Nanostructured Materials	Slovenia - MIZS	36 months	863 450 €	799 700 €
				University of Nova Gorica, Materials Research Laboratory	Slovenia - MIZS			
				Spanish National Research Council (CSIC), Institute of Ceramics and Glass	Spain - AEI			

Main call topic	Sub-topic areas	Project acronym/ abstract	Project title	Coordinator (partner 1) and consortium partners	Participanting countries - Funding organisations	Duration	Total Costs	Total Requested Funding
	Sub-Topic 2.4: Recovery and urban mining of raw materials from end-of-life products or other wastes, Sub-Topic 2.5: Life-cycle-analysis of raw materials			Uppsala Universitet, Division for Electricity	Sweden - Vinnova			
				Kolektor Mobility d.o.o., R&D Magnetics	Slovenia			
	Sub-Topic 2.2: End-of-life products pre-processing: collection, logistics, pre-treatment, dismantling, sorting, characterisation, Sub-Topic 2.3: Reuse, repair, refurbishing, repurposing and remanufacturing of end-of-life products, Sub-Topic 2.5: Life-cycle-analysis of raw materials, Sub-Topic 2.6: New business models (implementing circular economy aspects)	**CLEARNESS**	Circular product design applied to the recovery of critical raw elements from electrolyzers and fuel cells at their end of life	Warsaw University of Technology, Faculty of Power and Aeronautical Engineering	Poland - NCBR	36 months	489 766 €	464 766 €
				Fuel Cell Poland Ltd.	Poland - NCBR			
				Eskisehir Technical University	Turkey - TUBITAK			
				University of Aveiro, CICECO - Aveiro Institute of Materials	Portugal - FCT			

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