Matrix of R&D investments and ESIF funds with framework conditions and financial models

D6.2 Deliverable

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Authors: *Rute Martins[1], Alexandra Ribeiro[1], José Carlos Kullberg[1], Sandra Amaro[1],*
Contributors: *Meng Chun Lee[2], Chrysa Panagiotopoulou[3], Anna Ostręga[4], Kornelia Lemmer[5], Gerfried Tiffner[5] and Kristiina Jokelainen[6]*

[1]*Faculty of Sciences and Technology of NOVA University of Lisbon (NOVA ID)*
[2]*Geokomtenzzentrum (GKZ)*
[3]*National Technical University of Athens (NTUA)*
[4]*AGH University of Science and Technology*
[5]*Styrian Iron Route (VESTE)*
[6]*Regional Council of Lapland (RCL)*

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No & name	**D6.2** Matrix of R&D investments & ESIF Funds with framework conditions and financial models				
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Author(s)	Rute Martins, Alexandra Ribeiro, José Carlos Kullberg, Sandra Amaro (NOVA ID); Meng Chun Le (GKZ); Chrysa Panagiotopoulou (NTUA); Anna Ostręga (AGH); Kornelia Lemmer, Gerfried Tiffner (VESTE); Kristiina Jokelainen (RCL).				
Description of the related task and the deliverable. Extract from DoA	**Task 6.2 Review of MIREU Regions' regional and national R&D investments & ESIF Funds related to mining and metallurgy M1-M22** In close cooperation with WP2, WP3 and WP5, a "market review" of a selected number of MIREU partner regions will be performed in order to assess and document mining and metallurgy related regional and national investments & ESIF Funds at the European, national, and regional levels. This study includes an evaluation of the European ESIF legislation and similar development programs, regional and national Smart Specialisation strategies (RIS3 or S3) as well as complementary R&I strategies at the national level. A thorough review will be made of past and present projects in the EU28 in this context, such as SCRREEN, Min-Guide, and REMIX. The data will be stored in the MIREU knowledge portal provided by WP7. **Task 6.3 Matrix of the regional and national R&D investments & ESIF Funds in conjunction with the given or envisaged framework conditions (WP3) and financial success models (WP5) M18-M27** Through the support of all partners from the Regions, information will be acquired on the administrative mechanisms used by the Management Authorities (MA) of the European, national and regional FIs, the policymaking frameworks, and data on the capitalisation of the mining and metallurgical industry's R&I. A matrix on the process of decision making is formed, elaborating how this decision making is affected by national and/or European legislation, administration and whether successful parameters can be identified for effective capitalisation and better performing financial funds.				
Participants	NOVA ID, RCL, GKZ, AGH/AGH-UST, NTUA, VESTE				
Comments					

V	Date	Authors	Description
1	01-03-2020	RM, AR, JCK, SA, MCL, CP, AO, KL, GT, KJ	V1.0
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About MIREU

The project MIREU aims to establish a network of mining and metallurgy regions across Europe with a view to ensure the sustained and sustainable supply of mineral raw materials to the EU. The network will help the regions to share knowledge and experiences when facing the challenge to establish and maintain an extractive industry. MIREU will facilitate an exchange between all interested stakeholders in the regions, namely regulatory authorities, political and administrative bodies, development agencies, mining companies, non-government organisations, as well as the general public. The project will develop a shared knowledge base, taking into account the region-specific geographic and economic features, cultural, societal and language diversity, and their historical developments. The network will also learn from experience in other regions of the World. This knowledge base will allow to understand what has been conducive and what hampering to the development of extractive and metallurgical industries. It will also provide the context for a bottom-up integration of these activities into their respective socio-economic and socio-cultural context. Development is about people and, therefore, bringing people into the decision-finding procedure in order to achieve a 'social license to operate' will be a key aspect of the project. Guidelines and recommendations for actions to be taken to foster a sustained and sustainable development of the extractive industries will be developed in close co-operation with a range of selected regions from the European Union. These regions will form a nucleus and multipliers for a more extensive network beyond the life-time of the project.

Partners

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ABBREVIATIONS

CEF	Connecting Europe Facility
CF	Cohesion Fund
COSME	Competitiveness of Enterprises and Small and Medium-sized Enterprises
CP	Cohesion Policy
EAFRD	European Agricultural Fund for Rural Development
EASME	European Agency for SME
EC	European Commission
EFSI	European Fund for Strategic Investments
EIB	European Investment Bank
EIC	European Innovation Council
EIF	European Investment Fund
EIT	European Institute of Innovation and Technology
EIT RM	European Institute of Innovation and Technology Raw Materials
EMFF	European Maritime and Fisheries Fund
ERA	European Research Area
ERDF	European Regional Development Fund
ESF	European Social Fund
ESIF	European Structural and Investment Funds (or ESI Funds)
EU	European Union
FET	Future and Emerging Technologies
FI	Financial Instruments
FP7	7th Framework Programme
FTI	Fast Track to Innovation
GDP	Gross Domestic Product
ICT	Information and Communications Technology
M&M	Mining and Metallurgy
MA	Management Authority
MFF	Multiannual Financial Framework
MS	Member state
NUTS	Nomenclature of Territorial Units for Statistics
OP	Operational programme
PA	Partnership agreement
R&D	Research and Development
R&D&I	Research and Development and Innovation
R&I	Research and Innovation
RFCS	Research Fund for Coal and Steel
RIS3	Regional Innovation Strategies for Smart Specialisation
S3	Smart Specialisation Strategies
SC5	Societal Challenge 5
SME	Small and Medium-sized Enterprise
TO	Thematic Objective
TRL	Technology Readiness Level

European Commission

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1. INTRODUCTION

The aim of the present study developed under WP6 T6.2 and 6.3 is to feed MIREU's networking regions with knowledge on the European Union (EU) funding schemes for mining and metallurgy, with focus on research and innovation in EU regions.

The report starts by introducing MIREU regions (Chapter 1), and providing information about the Multiannual Financial Framework (MFF) 2014-2020 EU funding opportunities, including information about what kind of funds are there available and how they are managed and delivered (Chapter 2). After, the report presents an overview of the Research and Innovation (R&I) investments and European Structural and Investment Funds (ESIF) in the context of MIREU regions providing data on how EU funds have been applied, mainly through grants and highlighting key funded projects under the current MFF 2014-2020 (Chapter 3). Chapter 4 displays an overview of European mining and metallurgic projects, funded through financial instruments (FI), taking place in several EU countries. The report closes with the Matrix of Research and Development (R&D) investments & ESIF with framework conditions and financial models (Chapter 5) and the main conclusion taken from the study (Chapter 6).

1.1 MIREU regions

MIREU – Mining and Metallurgy regions includes 16 mining and metallurgy regions in different European countries. Table 1 presents the list of MIREU regions, countries and their Nomenclature of Territorial Units for Statistics (NUTS) level, and Figure 1 shows their location in Europe.

Table 1 List of MIREU mining and metallurgy regions

Country	Region	EU code	NUTS Level	NUTS 2	
				Name	EU code
Austria	Styria	AT22	NUTS 2	-	-
Finland	Lapland	FI1D7	NUTS 3	Pohjois- ja Itä-Suomi	FI1D
	North Karelia	FI1D3	NUTS 3		
France	Occitania	FRJ	NUTS 1	Midi-Pyrénées	FRJ2
				Languedoc-Roussillon	FRJ1
Germany	Saxony	DED	NUTS 1	Dresden	DED2
				Chemnitz	DED4
				Leipzig	DED5
Greece	Sterea Ellada	EL64	NUTS 2	-	-
Ireland	Southern	IE05	NUTS 2	-	-
	Eastern and Midlan	IE06	NUTS 2		
	Northern and Western	IE04	NUTS 2		
Poland	Lower Silesia	PL51	NUTS 2	-	-
Portugal	Alentejo	PT18	NUTS 2	-	-
Romania	Maramures	RO114	NUTS 3	Nord-Vest	RO11
Slovakia	Kosiçe	SK042	NUTS 3	Východné Slovensko	SK04
Spain	Andalucia	ES61	NUTS 2	-	-
	Aragon	ES24	NUTS 2	-	-
	Castilla y Leon	ES41	NUTS 2	-	-
Sweden	Västerbotten	SE331	NUTS 3	Övre Norrland	SE33
United Kingdom	Cornwall	UKK3	NUTS 2	-	-

Figure 1 Location of MIREU regions (source: own work)

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MIREU regions have different levels of research and innovation (R&I) with some having better performance and higher intensity than others. Regarding innovation, European regions are ranked according to their innovation performance in the Regional Innovation Scoreboard (RIS) (Hollanders, Es-Sadki, & Merkelbach, 2019). RIS report classifies each EU region according with 15 indicators and groups them into Regional Performance Groups. MIREU regions are classified into three innovation performance groups according to Table 2.

Table 2 MIREU regions RIS classification (adapted from EC, 2019e)

Strong innovators	**Moderate innovators**	**Modest innovators**
Lapland North Karelia Västerbotten Styria Occitania Cornwall Ireland Saxony	Alentejo Andalucia Castille y Leon Aragon Sterea Ellada Lower Silesia Kosiçe	Maramures

RIS classification indicates that strong innovators regions are regions that perform better their research system and business innovation. MIREU regions are divided in three different performance groups: eight regions are strong innovators, seven regions are moderate innovators and one region is modest innovator.

Regarding intensity of Research and Development (*Eurostat regional yearbook*, 2019), which is based on gross domestic expenditure on R&D (GERD) relative to gross domestic product (GDP), MIREU regions R&D intensity are classified into five intensities, according to Table 3.

Table 3 MIREU regions R&D intensity classification

(adapted from Eurostat regional yearbook, 2019)

Highest intensity (≥4%)	**4% > Intensity > 3%**	**3% > Intensity > 2%**	**3% > Intensity > 2%**	**Lowest intensity (<1%)**
Occitania (part of) Styria	Saxony (part of)	Lapland North Karelia Occitania (part of) Saxony (part of) Västerbotten	Castilla y Leon Ireland Saxony (part of)	Alentejo Andalucia Aragon Cornwall Kosiçe Lower Silesia Maramures Sterea Ellada

The characterization presented above provides an important insight on the regional capacity to implement R&D projects. For example, Styria, Occitania and Saxony are three of the MIREU regions that may have better resources to participate in European R&I projects, while Maramures, Alentejo, Andalucia, Aragon, Cornwall, Kosiçe, Lower Silesia and Sterea Ellada present less capacity to implement R&D projects.

2. BRIEF INTRODUCTION TO THE MULTIANNUAL FINANCIAL FRAMEWORK 2014-2020

This chapter provides the context of the MFF 2014-2020 its funding instruments and deliverable modes and presents a summary on the main results of the implementation of MFF 2014-2020.

2.1 EU funding instruments

The Europe 2020 strategy the EU's agenda for growth and jobs for the current decade is being implemented trough MFF 2014-2020 by a wide range of programmes and funds, which provide financial support to hundreds of thousands of beneficiaries. The MFF2014-2020 is structure by headings and the maximum annual amounts that can be spent on them, and the instruments that allow it to respond to unforeseen events.

EU funding can be managed jointly by the European Commission and national authorities, directly by the European Commission or indirectly by other authorities inside or outside the EU, depending on the nature of the funding concerned[1]. Figure 2 shows a scheme on the relations between the EU instruments and the way they are managed.

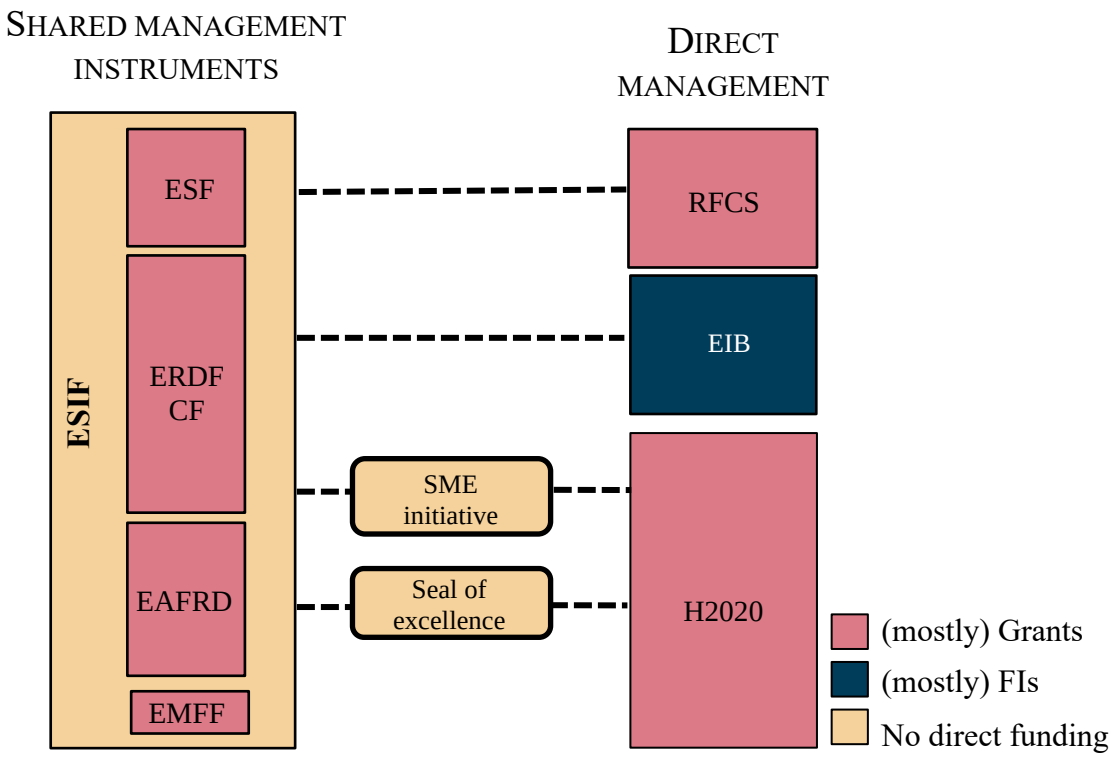

Figure 2 Relationship between ESIF and directly-managed EU instruments relevant for this study (adapted from Ferry et al., 2016).

[1] https://ec.europa.eu/info/funding-tenders/how-eu-funding-works/management-eu-funding_en#differentmanagementmodes

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Over half of EU funding is channeled through the five ESIF. They are jointly managed by the European Commission and the EU countries by means of partnership agreements and distributed according to their region's eligibility criteria and government strategy through the operational programmes[2].

As for the directly management EU instruments, Horizon 2020 is the biggest EU R&I programme helping to achieve this with its emphasis on excellent science, industrial leadership and tackling societal challenges. Research Fund for Coal and Steel (RFCS) is a fund created specifically for projects of R&I in the Coal and Steel industries and European Investment Bank (EIB) funds major mining and metallurgy EU projects through FI.

The financial delivery model between the EU instruments differs. It can be funded through grants and/or financial instruments (FI). Grants are non-repayable measures through which beneficiaries receive their monetary support. FIs are repayable measures, such as loans, guarantees and equity/venture capital (European Commission, 2014), through which beneficiaries receive their monetary support that must be repaid.

From the instruments presented in Figure 2 ESIF, Horizon 2020 and RFCS are mostly delivered through grants and EIB projects through FI.

2.2 Summary on the EU funding instruments implementation

As the main rationale for public intervention is to support activities that the market will not undertake alone or at all (ESPON, 2019). Along the period of the MFF 2014-2020 there were several reports produced by different institutes that deliver results on the funding implementation, its main constraints or blockers, best practices from different member states (MS) on the effectiveness of the funds, and recommendations for the future programing period[3].

Regarding positive impacts and value added of R&I, ESIF and FI, the implementation of the MFF 2014-2020 has produced the following results:

- Human empowerment through better jobs, better education, and better basic life conditions.
- World top quality research teams, projects, and infrastructures.
- Innovative, dynamic, and competitive businesses.
- Effectiveness and sustainability in the use of the EU funds.

As for constraints, there is a need for the support offer to be coordinated (e.g. FIs will not be attractive when grants are available for similar purposes) and a plethora of schemes causes confusion for recipients (Evans, 2013). It is possible to identify the following topics where constraints exist:

- *Human capital*: lack of human capacity from the management authority (MA), regional authorities and in SME regarding structural funds (ESIF) programming and implementation. Also, there is an ongoing need for capacity building, for example related to combining sources of funding, and combining financial instruments with grants (ESPON, 2019);
- *Red tape*: the regulation of funds and their implementation instruments are not very clear, nor the possibilities for synergies.

[2] https://cohesiondata.ec.europa.eu/programmes

[3] ESPON (2019), Corcodel (2018), European Commission (2015, 2018, 2019f), Social Platform (2018), Legaz, Vizzarri, & Grassi (2019), Fiaschi, Lavezzi, & Parenti (2018), European Parliament (2018), Veugelers & Baltensperger (2019), Smetkowaski, Gorzelak, & Rok (2018), LERU (2018), Haegeman et al. (2019)

- *Bottlenecks* for synergies between SME, regional authorities and MA, within and between MS, mainly due to human capital capabilities, knowledge of procedures, and types of instruments possible to apply in each case.

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3. MIREU REGION'S R&I INVESTMENTS & ESIF RELATED TO MINING AND METALLURGY SECTOR

This chapter will present two levels of analysis:

1. A general characterisation of national and regional funding instruments used in all MIREU regions (Chapter 3.1);
2. An analyse of specific projects on mining and metallurgy industry in seven MIREU pilot regions, focusing on the type of funds used, amount of EU contribution, type of participants involved, the Technology Readiness Level (TRL) and a show case from the study sample. This subchapter also includes the feedback from four MIREU pilot regions in the use of EU funds (Chapter 3.2).

3.1 Raw materials funding – national and regional characterisation

3.1.1 Methodology

The collection of data covered the following instruments:

1. ESIF (shared management instruments) and the application of FI
2. Horizon 2020 (direct management instruments)

The data present in this analysis was gathered between September and November of 2019.

For ESIF, the source used was ESIF Open Data Portal (European Commission, 2019c). Countries from MIREU regions were selected one by one and the data regarding EU contribution by thematic objectives (TO) was extracted from the portal. In a second stage, after having gathered the data and considering the focus on R&I of WP6, the data on the national contribution for *Research and Innovation TO* was selected to analyse. The information available in this database is at country level, meaning that in this subchapter the analysis is done by the countries where the MIREU regions are included.

For FI, the database used was the "Financial instrument data from the European Commission per country" in the fi-compass website, the platform for advisory services on financial instruments under ESIF. The indicator selected was "ESIF 14-20: FIs Implementation by MS (ESIF Committed amounts, filter by year)" with year filter "greater than 2013", in order to include all the information in the current MFF 2014-2020.

Regarding Horizon 2020, it was used the database "Data Hub" of EASME to collect information of Horizon 2020 Societal Challenge 5 data (European Commission, 2019d). At first, general information about the distribution of the money under the theme "Horizon 2020 Environment and resources" was made, and secondly, the research focused on the topic of "Raw Materials". In this second step, the approach was to first analyse at country level, due to the fact that for ESIF only data at country level was available, and then analyse at regional level, targeting only MIREU regions.

In EASME data hub, only NUTS II level regions are available for selection, and because MIREU regions are not all NUTS II, some data collected needed to be worked before the analysis, in the following way:

- for Saxony and Occitania (NUTS I), the data presented was the sum of the information from each of their respective NUTS level II regions (see Table 1);
- Ireland stands as a country;

- for MIREU NUTS level III regions (see Table 1), the only possibility was to collect data regarding their respective NUTS level II regions, as there was no other way to get the information. This means, that for these regions, the information collected may not fully represent the reality of these MIREU regions but represents their NUTS II region.

The filters used in EASME data hub served to differentiate the indicators of the type of projects, type of participants, money by region, and others.

3.1.2 ESIF

The scope of ESIF is to improve European cohesion and the national and regional performance. ESIF is allocated to priority areas, in accordance with the strategic programming documents, the Partnership Agreement and the Operational Programmes (OP), that are the result of a process of consultation between the European Commission and the EU Member States (MS). OP can be national, regional or topical (that are cross-regional)[4]. Some countries mix these options which results in complex programmes.

ESIF are allocated according to the following thematic objectives (Table 4).

Table 4 List of MFF 2014-2020 thematic objectives (TO)[5]

No.	Thematic Objective
1	Strengthening research, technological development and innovation
2	Enhancing access to, and use and quality of, ICT
3	Enhancing the competitiveness of SMEs, of the agricultural sector (for the EAFRD) and of the fishery and aquaculture sector (for the EMFF)
4	Supporting the shift towards a low-carbon economy in all sectors
5	Promoting climate change adaptation, risk prevention and management
6	Preserving and protecting the environment and promoting resource efficiency
7	Promoting sustainable transport and removing bottlenecks in key network infrastructures
8	Promoting sustainable and quality employment and supporting labour mobility
9	Promoting social inclusion, combating poverty and any discrimination
10	Investing in education, training and vocational training for skills and lifelong learning
11	Enhancing institutional capacity of public authorities and stakeholders and efficient public administration

[4] https://ec.europa.eu/regional_policy/en/atlas/programmes/

[5] https://ec.europa.eu/regional_policy/en/policy/how/priorities

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ESIF eligibility[6] varies according to the levels of development of a country. MIREU regions are characterised as follows:

- *Less developed regions*: Alentejo, Lower Silesia, Cornwall, Kosice and Maramures;
- *Regions in transition:* Andalucia and Sterea Ellada;
- *More developed regions:* Castilla y Leon, Aragon, Ireland, Västerbotter, Lapland, Northern Karelia and Styria.

Occitania and Saxony, both NUTS 1, are characterised by a mix of transition and more developed regions of NUTS level 2.

ESIF are distributed within each MS through the eleven TO where less developed countries receive higher EU contribution, as is the case of Poland and Romania. This happens in all TO presented (Figure 3).

In Figure 3, although Germany and France are considered more developed countries, they figure in several TOs as being one of the top three countries in ESIF. Spain also occupies a leading position regarding ESIF on half the TOs presented.

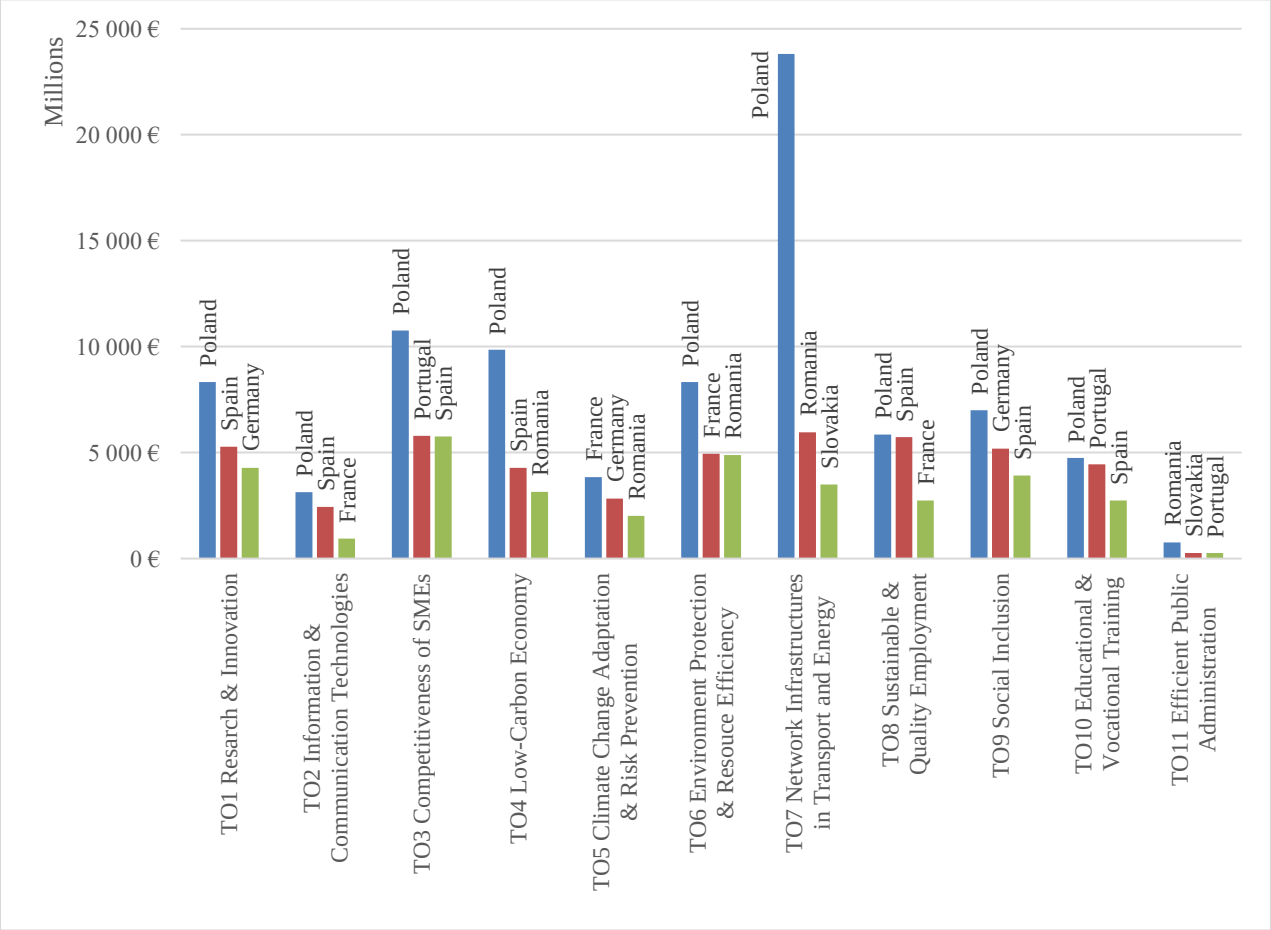

Figure 3 Top three Member States from MIREU pilot regions with more EU contribution to ESIF by TO (European Commission, 2019c)

[6] https://ec.europa.eu/regional_policy/sources/graph/poster2014/eu28.pdf

In each country the percentage of ESIF by TO is different depending on the development of each region and their national strategy. In the context of this deliverable, the study focused the TO "Research & Innovation" (Figure 4).

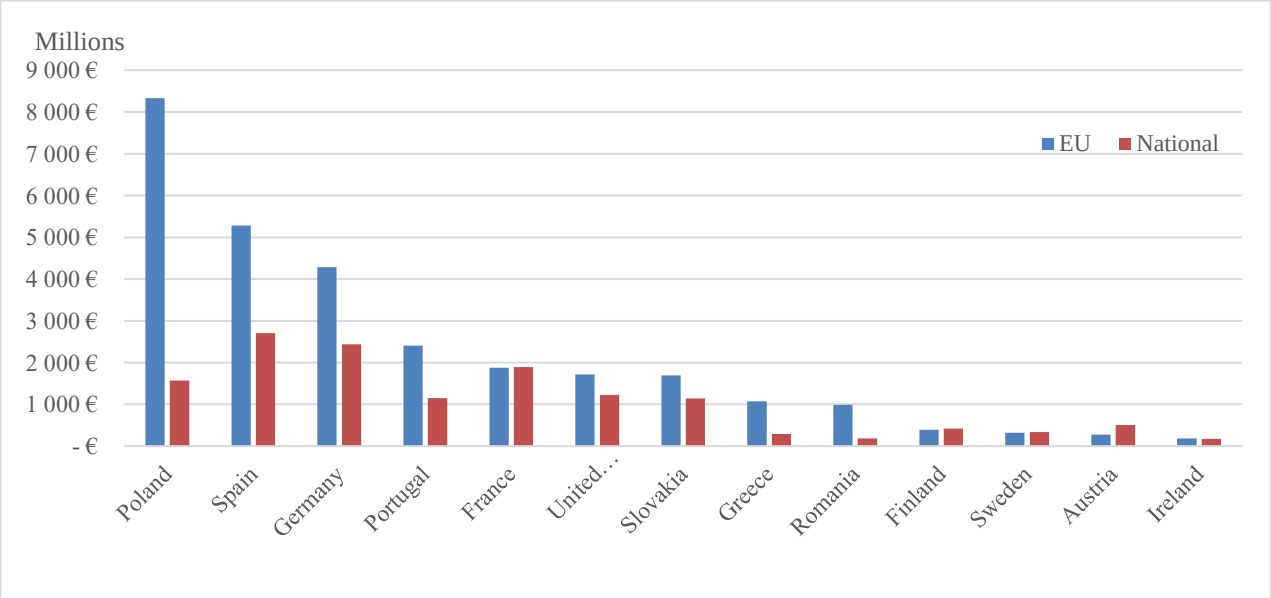

Figure 4 Total amount of ESIF allocated to TO Research & Innovation in the MIREU countries (source: ESIF – Open Data Portal)

TO Research & Innovation has an allocation of about 10% of ESI Funds, being Germany the country that attributes a higher percentage to this TO. With interest, Austria and Ireland, two of the countries considered more developed, allocate less percentage of ESIF to R&I, which could mean that the money used for R&I in these countries is provided by other sources. The same happens with Greece and Romania, two of the countries less developed, and with less investment in R&I.

In order to make the best use TO1 Research and Innovation MS and regions must indicate it in their Smart Specialisations priorities areas. The existence of a national or regional smart specialisation strategy in line to leverage private research and innovation expenditure is a prerequisite for the effective and efficient achievement of a specific objective for all investment priorities under TO1. This may also constitute a constraint in the case the priorities of a MS are not aligned with a certain industry that wishes to develop in a country or region.

Financial Instruments under ESIF

Financial instruments have a number of benefits compared to grant-based funding, mixing public and private funds to stimulate investment. Financial instruments use public money to leverage investment from the private sector by de-risking investments and offering long-term orientation, whilst the revolving nature of the instruments ensures that funds, plus interest, return to the instrument for re-investment. Since funds must be repaid, there is also an incentive for better performance of the projects than grant-based funding projects.

ESIF is generally and mostly attributed to the beneficiaries through grants, which mean non-repayable financial support. The EU has been incentivising to the use of FIs because it is a financial mechanism that creates leverage.

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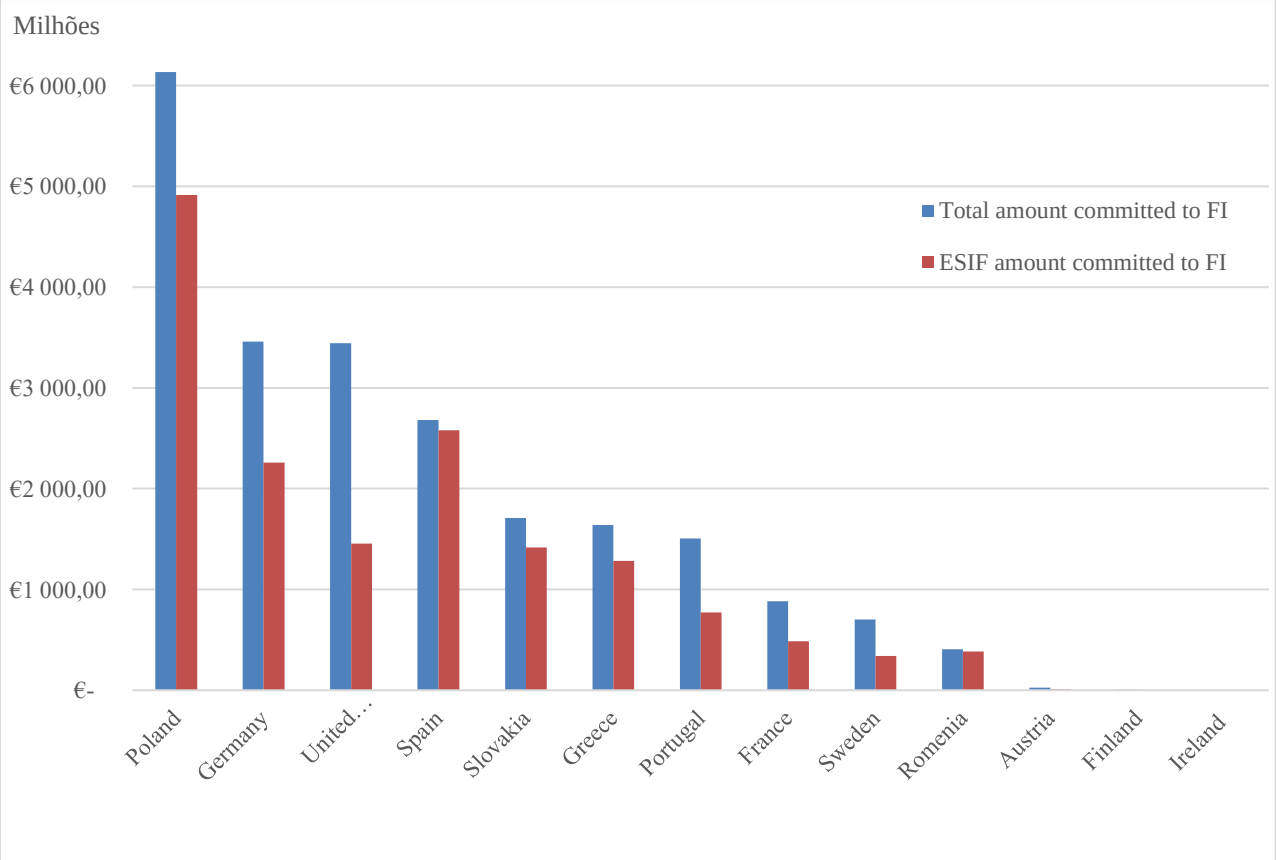

Figure 5 Total and ESIF amounts commitment by MIREU countries to financial instruments (European Commission, 2019b)

In MIREU countries, the amount of money committed to FI, in the current MFF 2014-2020, is as in Figure 5. It is possible to see that there is no correlation to ESIF eligibility and that the money committed to FI, in the majority of the countries, comes from ESIF. The difference between "Total amount committed to FI" and "ESIF amount committed to FI" implies that the country has other money sources to fund their FI. Ireland is the only MIREU country that does not have any commitment to financial instruments.

FI from ESIF in MIREU countries is very low and according to the data present in Figure 6, the highest value is around 9% from Sweden and Slovakia.

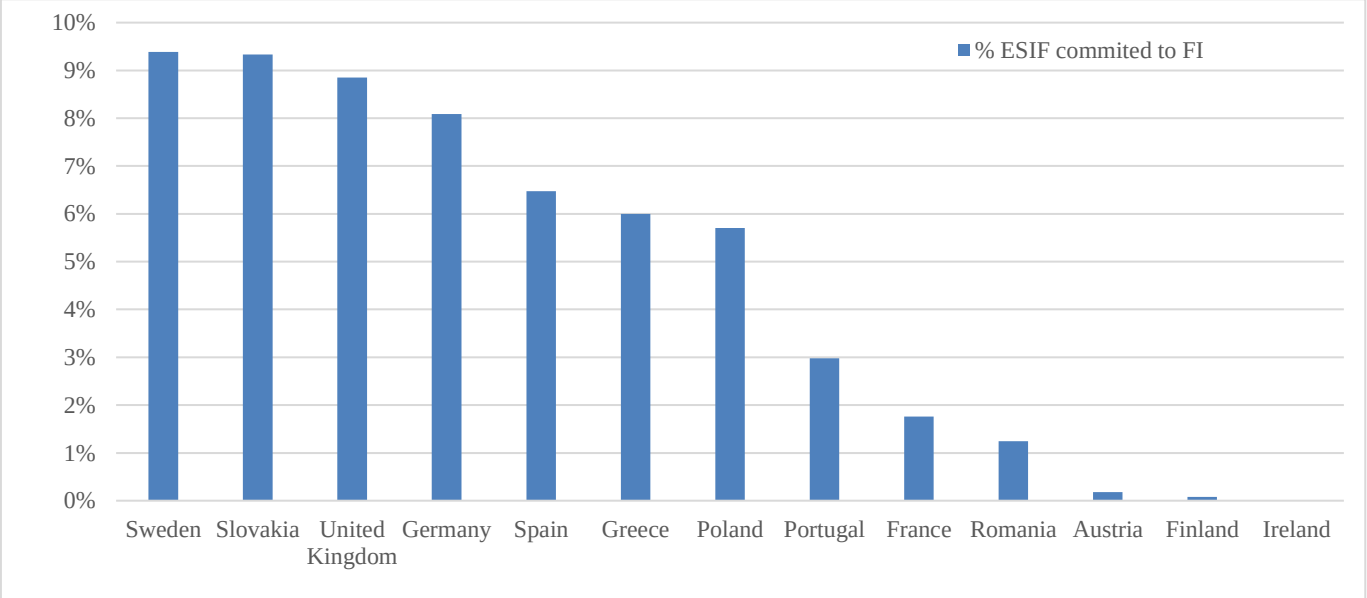

Figure 6 Percentage of ESIF committed to financial instruments by MIREU countries (European Commission, 2019b)

Taking into account Figure 5 and Figure 6 there are two cases that stand out: Sweden and Slovakia. In the case of Sweden, it is possible to see that, at the same time, the country is the one that commits more percentage of ESIF (about 9%) to their FIs and one of the countries that can arise more money from other sources to the same. In Slovakia, despite being a less developed country is the second, which uses more ESIF to their FIs (Figure 6).

3.1.3 Horizon 2020

Horizon 2020 is the financial instrument implementing research and innovation in Europe. It helps to achieve this with its emphasis on excellent science, industrial leadership and tackling societal challenges. The goal is to ensure Europe produces excellent science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation[7].

Within the Societal Challenge 5 – "Climate action, environment, resource efficiency & raw materials" there are nine topics and the money distribution is as shown in Figure 7. About 20% of the money of projects under this topic is for raw materials theme.

[7] https://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020

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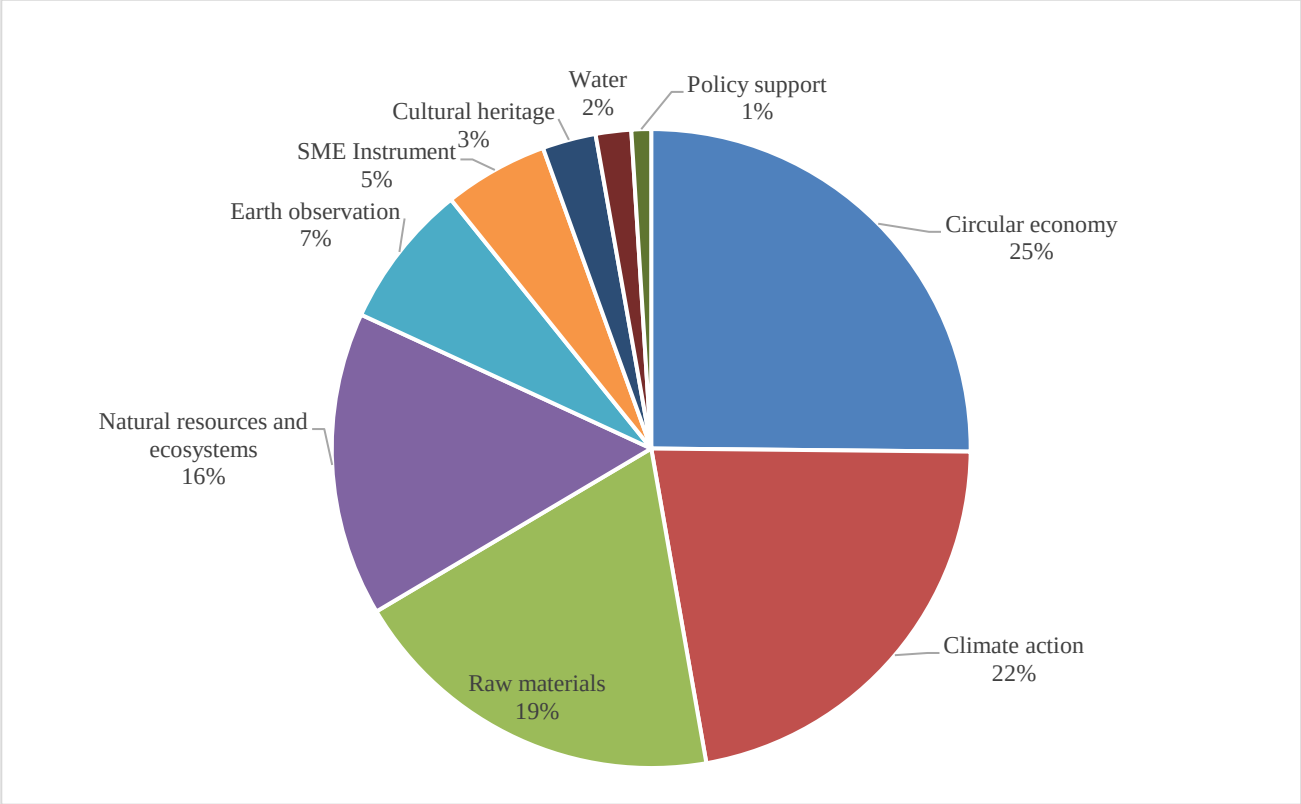

Figure 7 Distribution of the amount of money allocated per topic under H2020 – Societal Challenge: "Climate action, environment, resource efficiency & raw materials" (European Commission, 2019d)

Country analysis

Considering the raw materials theme, the money allocated to each MIREU country is shown in Figure 8. In general, more develop countries have more money (ex.: Germany) and less developed countries have less (ex.: Romania and Slovakia). Austria and Ireland are two exceptions because they are considered more developed countries, but they have a similar value as less developed countries.

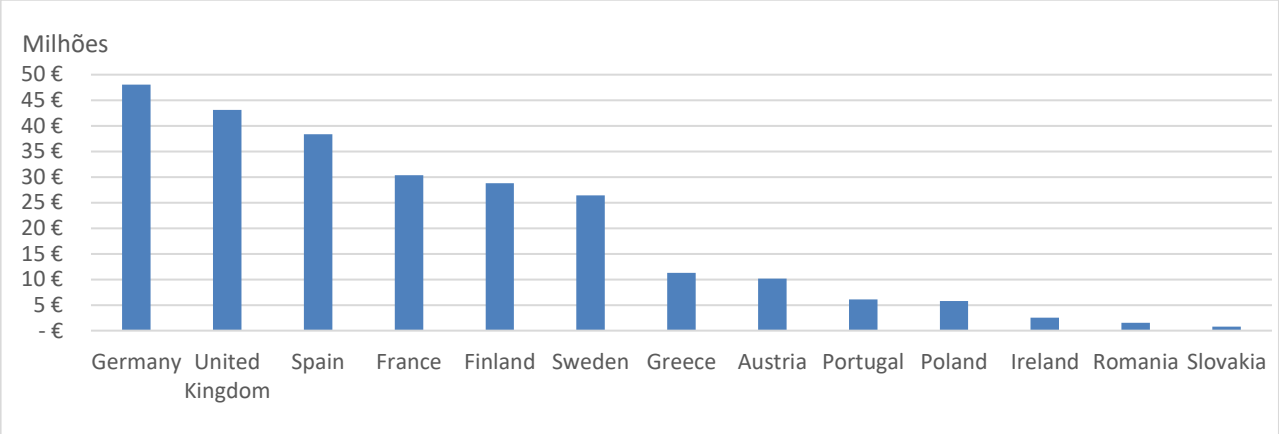

Figure 8 H2020: Raw Materials amount of money allocated per MIREU country (European Commission, 2019d)

In Figure 9 is represented the number of projects coordinated by each MIREU country, based on the nationality of the project coordinator. Spain is the leader in terms of projects coordination, despite their position in third place in Figure 8. Ireland, Romania and Slovakia do not coordinate projects of this type.

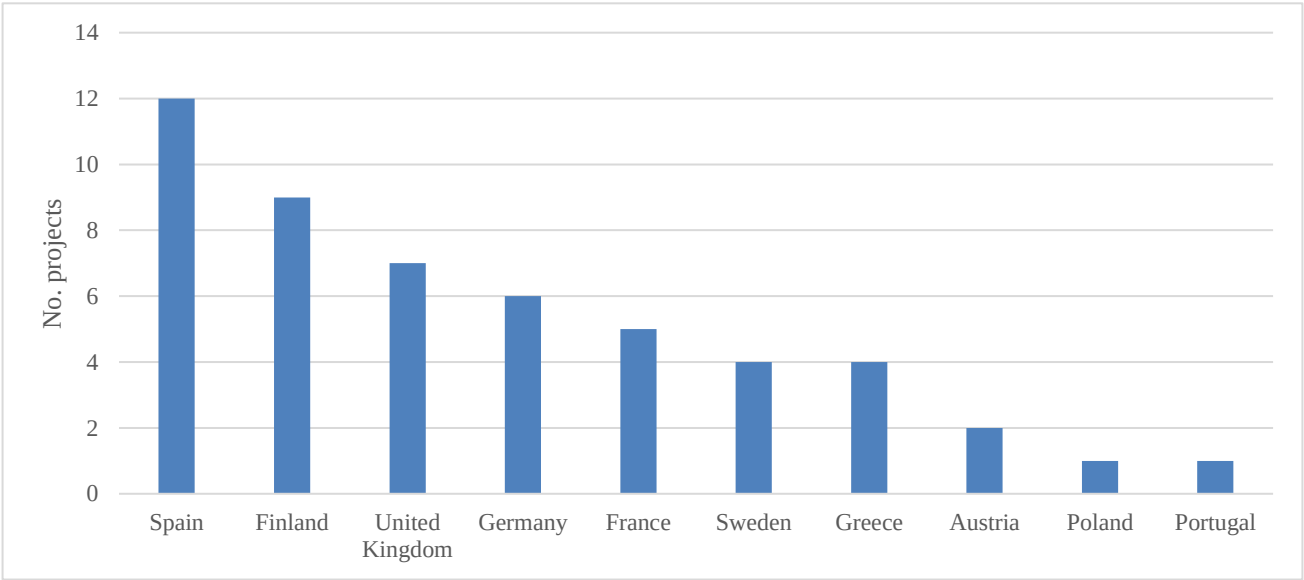

Figure 9 H2020: Number of projects coordinated by each MIREU country, based on the nationality of the project coordinator (European Commission, 2019d)

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Considering all the participants in the projects (Figure 10), Germany is the one that stands with more participants in projects regarding raw materials and, contrary to the data in Figure 9, all MIREU countries have participants in project under Horizon 2020, theme Raw Materials.

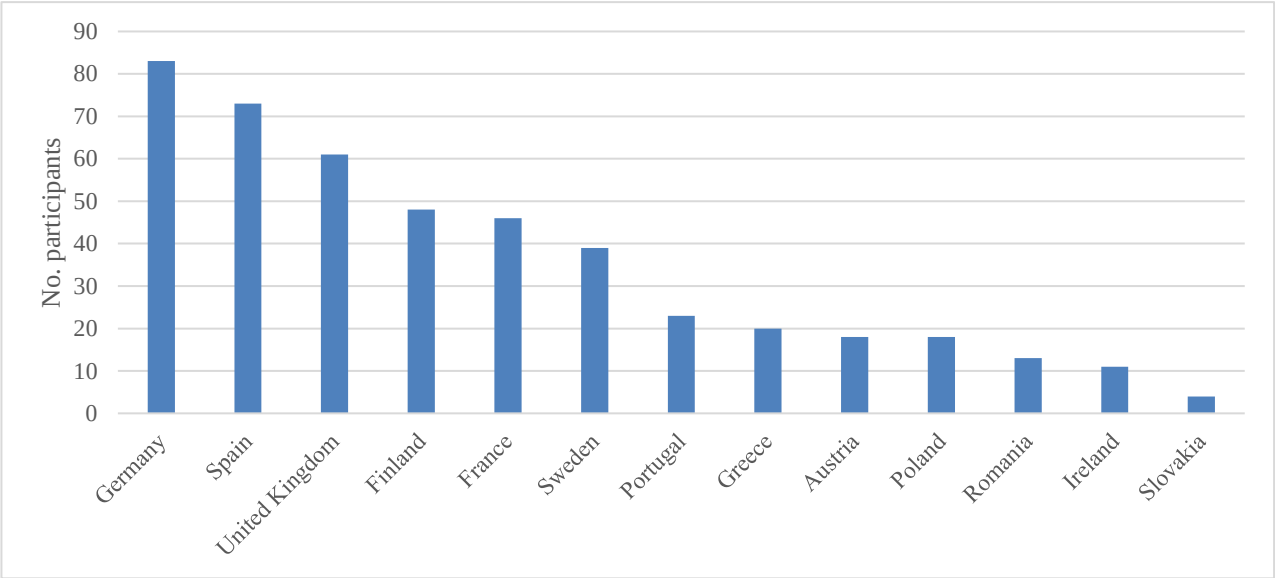

Figure 10 H2020: Number of participants per MIREU country (European Commission, 2019d)

Summing up, Germany has the highest amount of money allocated to raw materials projects and the highest number of participants, while Spain is the country that coordinates more projects in raw materials topic, followed by Finland.

Region analysis

MIREU regions have a distribution of the money from Horizon 2020 SC5 projects as Figure 11 shows. The order is similar to the country profile (Figure 8), although there are few important differences:

- Andalucia is second and Spain third, which may demonstrate that Andalucia is one of Spanish regions to be more involved in Horizon 2020 – Raw Materials projects;
- Övre Norrland, although covering a larger area than Västerbotten, puts Sweden in the third place, instead of sixth (in country analysis);
- Styria is fourth and Austria is eighth, which may be the same case as Andalucia;
- Cornwall is left to second to last, but the country (United Kingdom - UK) is the second in terms of amount of money that comes from this programme, which may mean, that Cornwall is not very involved in projects of this programme;
- Occitania and France have similar behaviour as Cornwall and UK;
- Sterea Ellada (Greece) doesn't appear in Figure 11 meaning that, under this programme, the region doesn't have any involvement in raw materials projects, despite Greece is in the middle of the chart (Figure 8).

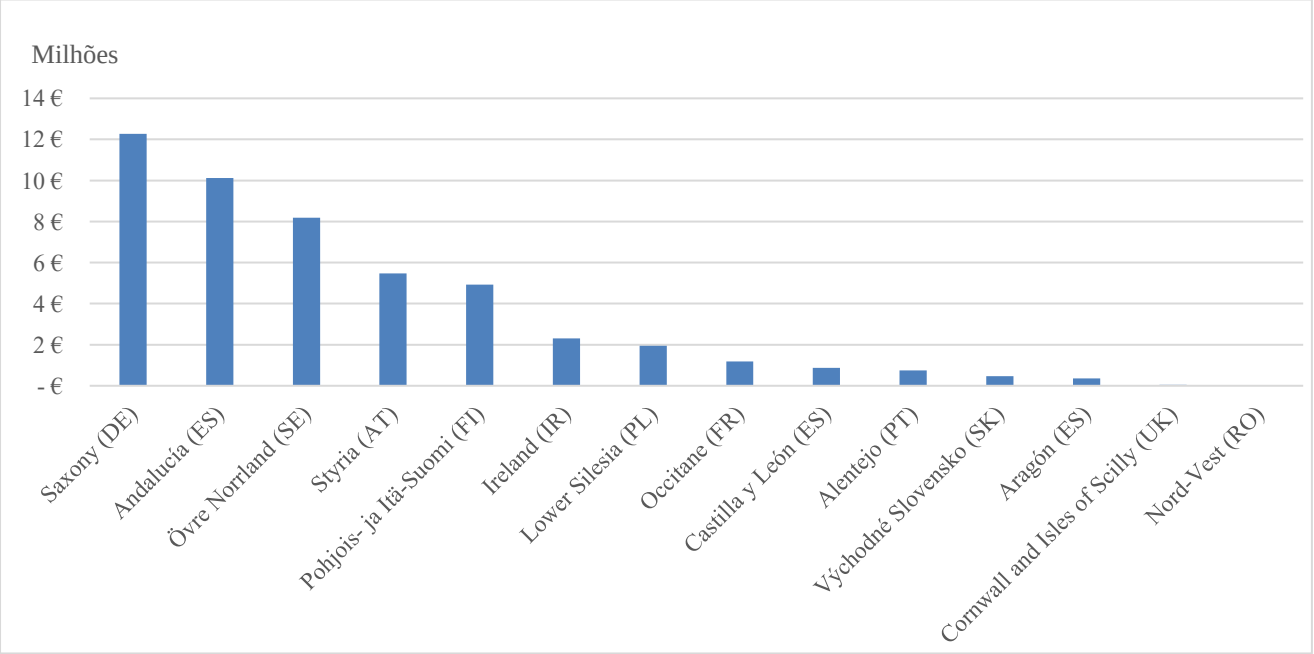

Figure 11 Raw Materials amount of money allocated per MIREU region. For correspondence of NUTS level and MIREU regions, see Table 1 (European Commission, 2019d).

The way regions are involved in the EU funded projects is also important. In this analysis there are three main type of actions, Research and Innovation Actions (RIA), Coordination and Support Actions (CSA) and Innovation Actions (IA).

Figure 12 shows the type of action per region. RIA are the ones that bring more money to regions, being the only type of action of Alentejo and Východné Slovensko.

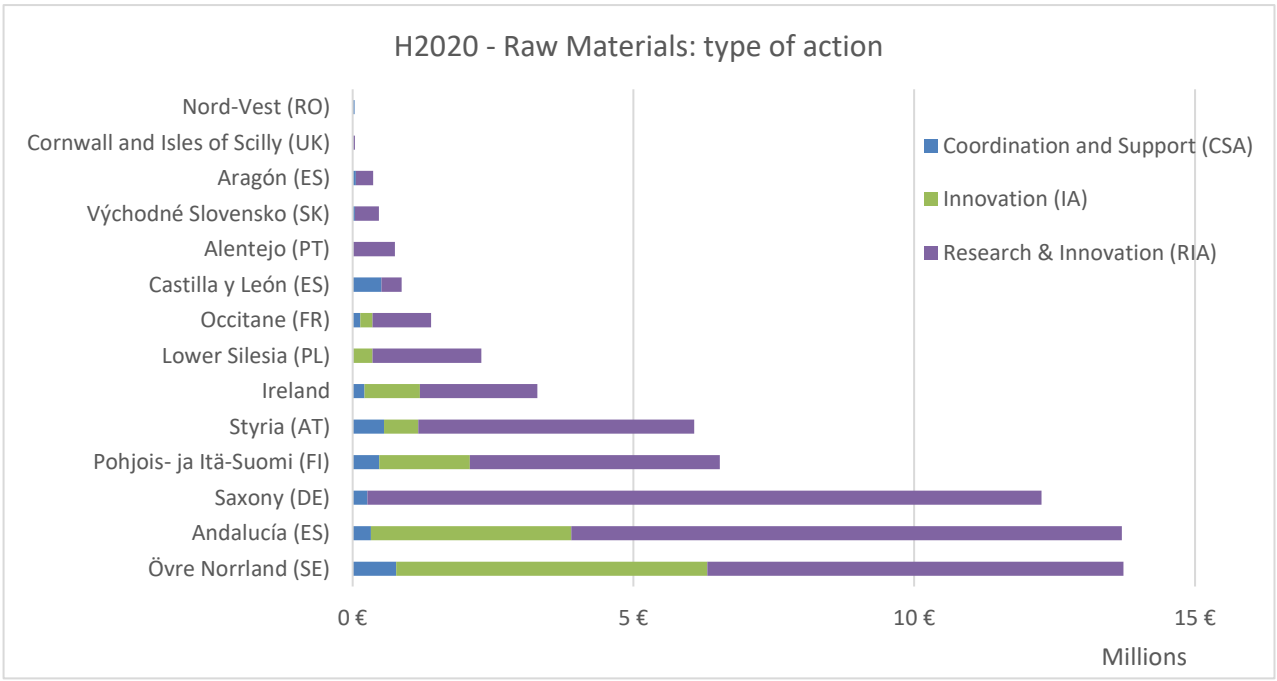

Figure 12 Amount of money per type of action in MIREU regions (European Commission, 2019d)

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Övre Norrland is the region that benefits of more money from CSA and IA projects, followed by Styria and Castilla y Leon in CSA, and Andalucia and Pohjois- ja Itä-Suomi in IA. The leader in RIA type of action is Saxony, followed by Andalucia and Övre Norrland.

CSA actions regard mainly networking and knowledge transfer, IA actions are more tailored for projects that cover TRL above 6 and RIA actions may include basic research (TRL 1-2). For example, Andalucia have projects for basic research, TRL above 6, and networking and knowledge transfer.

The type of action gives the idea of how much diversified is R&I in MIREU regions, but the type of participants give the idea of how the region is involved in R&I for mining and metallurgy. In Figure 13 is represented the type of participants in each MIREU region.

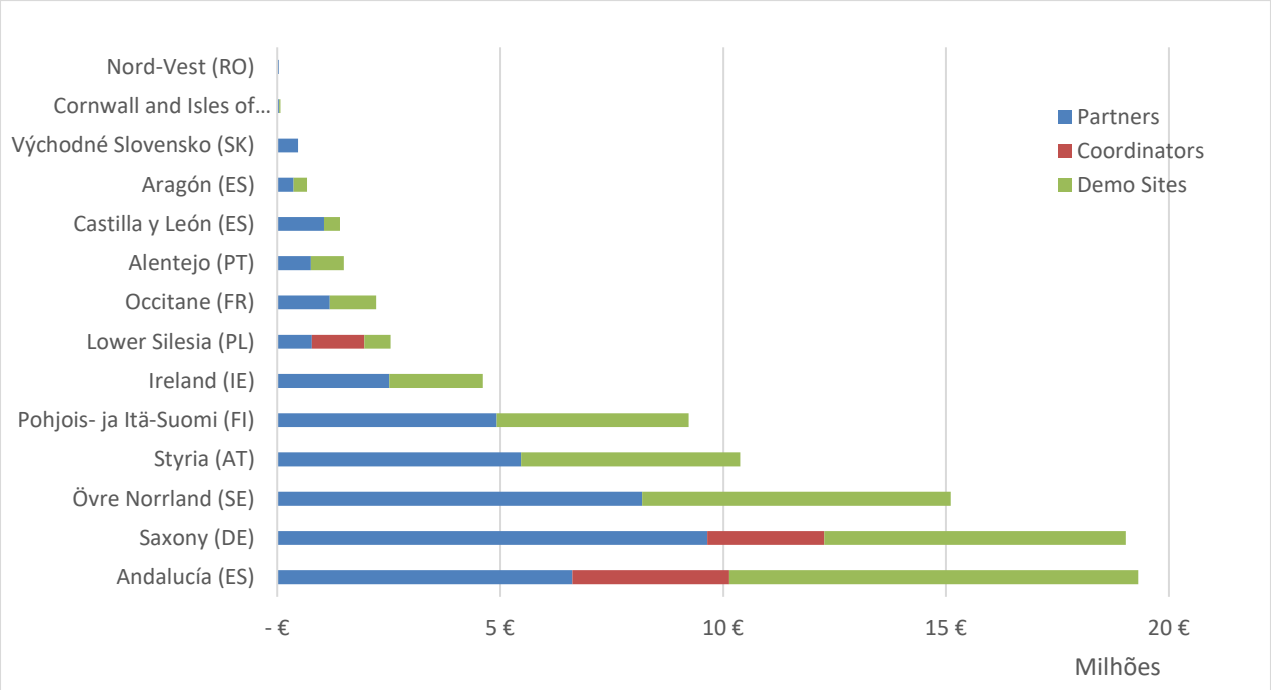

Figure 13 Amount of money per type of participants in MIREU regions (European Commission, 2019d)

All the regions have participants of the type "Partners" and the majority of money in each region comes from projects with this type of participants, except for Andalucia and Lower Silesia.

Andalucia is the leader in terms of money coming from projects which type of participants are demo sites, meaning that they are very active in using their own sites to serve as case studies in Horizon 2020 – Raw Materials projects.

Andalucia, Saxony and Lower Silesia are the MIREU regions that coordinate projects, being Andalucia the leader. Lower Silesia, in previous figures didn't stand out much, but despite not being one of the regions that receives more money from this programme, it is one of the few that coordinates them.

Východné Slovensko and Nord-Vest are regions that participate in Horizon2020 – Raw Materials topic only as "partners".

3.1.4 Synthesis

ESIF national level data

- The EU contribution from ESIF allocated to the regions and countries is directly related to the countries strategies and their level of development;
- The amount of money from national and European contributions is similar in more developed countries, firstly because they allocate less ESIF money than less developed countries, and secondly, because they are better suited to finance themselves TOs as R&I due to their stronger economic structure;
- ESIF to Research & Innovation is prevalent in more developed countries than in less developed countries;
- Less developed countries apply ESIF mostly in Network Infrastructure in Transport and Energy, as they still have several social basic challenges to overcome;
- According to the collected data, the main highlight of ESIF allocation to R&I TO in the MIREU countries are as follows:
    - Germany is the country that attributes higher percentage of ESIF allocated to TO of Research & Innovation;
    - Austria and Ireland, two of the countries considered more developed, allocate less percentage of ESIF to R&I.
- Although there has been an effort from the EU to encourage a more extensive use of financial instruments, ESIF have been delivered mostly through grants in the regions and countries analysed;
- Concerning the financial models and the total amount committed to FI from MIREU countries, the more developed countries apply more money to FI than less developed countries;

H2020 national level data

- In SC5 "Climate action, environment, resource efficiency & raw materials" in H2020, the Raw Materials topic, linked with mining and metallurgy industry, is the third topic that delivers more money to projects;
- In general, more developed countries have more money, coordinate more projects and involve more partners, than less developed countries, under this topic;
- Spain is the country coordinating more projects which may mean that it is making efforts to innovate the mining and metallurgy industry in the country;
- Ireland includes all type of actions showing interest in having diversity on the type of projects related to mining and metallurgy.

H2020 regional level data

- MIREU regions present a great diversity of projects and participants:
    - ✓ three MIREU regions, Andalucia, Saxony and Lower Silesia, coordinate projects from the programme H2020, topic Raw Materials;
    - ✓ all regions have RIA type of actions projects and is from where the majority of the money comes from, but for some of the regions this is the only type of action;
    - ✓ Ireland is the only region with projects covering all type of actions from H2020 – Raw materials topic;
    - ✓ Andalucia is the only region which the majority of participant type are Demo Sites;

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- Nord-Vest (RO), Cornwall (UK) and Aragon (ES) are the MIREU regions with less money coming from Horizon 2020 – Raw materials topic, which may represent the low involvement of the regions' participants in mining and metallurgy industry or the low capacity of the regional stakeholders to get involved in EU programmes;
- Sterea Ellada is not at all involved in projects from the database used, under the topic of Raw Materials, although Greece is involved;

As shown above national and regional data are not aligned, as MIREU regions do not follow the tendency of their countries, and this can be caused by the following aspects:

- ✓ Some regions, in term of its development, do not correspond to the majority of their country's regions;
- ✓ The mining tradition in a certain region influence the access to R&I funding;
- ✓ The data for some regions covers different NUTS level than the one covered by MIREU region.

3.2 Sample of projects

3.2.1 Methodology

An analysis of EU funded projects targeting mining and metallurgy, in MIREU regions, allows for a deeper understanding of how EU funding instruments are being applied in these regions.

For this analysis a template was prepared and shared with the partners responsible for collecting the data regarding the regions. The template included collecting data on the main characteristics of each of the funded project running in the region during the current MFF 2014-2020: aim, type of partners involved, total amount of EU contribution, the amount attributed to regional partners and part of the value chain addressed (Annex 8.1). In addition, it was asked to the partners their perception on the use of EU funds in the regions, their relevance regarding the regional strategy (RIS3) and the potential to use other EU funds in the future. The specific questions were the following:

1. Do EC funded projects filled the gaps existing in the region on M&M?
2. How do ongoing EC funded projects match the priority axis for M&M in RIS3?
3. Is there a potential for the use of other financial instruments in M&M in the region?

The study was opened to all MIREU regions that wish to collaborate and provide the information required. From the 16 EU regions, seven contributed to this study (Table 5).

Table 5 MIREU pilot regions

MIREU pilot regions	Country	Questions answered
Alentejo	Portugal (PT)	Yes
Andalucia	Spain (ES)	No
Lapland	Finland (FI)	Yes
Lower Silesia	Poland (PL)	Yes
Saxony	Germany (DE)	Yes
Sterea Ellada	Greece (EL)	No
Styria	Austria (AT)	Yes

The present analysis occurred during 2019 and, as described previously, besides the data sent by partners, it was gathered complementary data from two of the main EU projects database, CORDIS, for Horizon 2020 funded projects, and KEEP.EU, for Interreg funded projects. Note that, because of language barriers, ESIF projects from the regions from which partners did not provide information were not included.

In CORDIS (European Commission, 2019a), the research was conducted according to the following steps:

1. Selection of the sub-programme “H2020-EU.3.5.3. - Ensuring the sustainable supply of non-energy and non-agricultural raw materials” and at this stage it was possible to narrow the search specifically to mining and metallurgy related projects.
2. Selection of projects started in the period of MFF 2014-2020. From this selection, were included in the sample projects with partners located in MIREU pilot regions. The location was also the criterion to the amount of money to each region.

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In KEEP.EU database (Interact, 2019) MIREU pilot regions were selected, and from the projects shown those that target mining and metallurgy activities were added to the sample.

Note that, for both databases, when available, the data provided by the regions was confirmed against the data provided by the European commission's database. Due to some divergences, between the data given by the regions and the data included in the databases, several corrections were made. However, it must be noted that some inconsistencies may prevail.

A sample of 109 projects (Annex 8.2) from three EU funding programmes (Horizon 2020, RFCS and ESIF) and from seven MIREU pilot regions were analysed. The sample does not intent to be an exhaustive study on EU funded projects in these MIREU pilot regions but instead aims to provide an overview of the practical application of the EU funds in mining and metallurgy investments.

3.2.2 Analysis

The sample of 109 projects from seven MIREU pilot regions, funded by EU instruments, will be analysed in this sub-chapter.

Number of projects and starting date

The number of projects on which MIREU pilot regions are involved is shown in Figure 14. The region that provided more mining and metallurgy projects for the present analysis was Saxony, with 36 projects while Sterea Ellada is the region with less projects in the sample (10 projects). It is possible to observe that there are four groups, according to the number of projects in each region:

- Saxony with more than 30 projects;
- Andalucia, Lapland and Styria with 20-25 projects;
- Lower Silesia and Alentejo with 15-20 projects;
- Sterea Ellada with 10 projects.

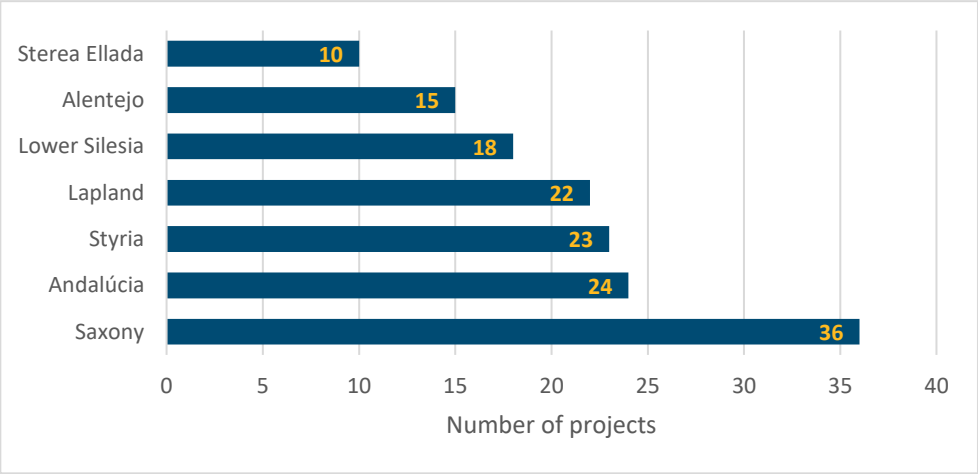

Figure 14 Number of projects in which MIREU pilot regions are involved (source: own work).

Figure 14 includes more than 109 projects as MIREU pilot regions have common projects. About 24% of the sample includes more than one MIREU pilot region. This aspect points out the relevance of Horizon 2020 and Interreg programmes for the creation of partnerships.

One of the criterion for the research was that the project must have had started within the current MFF. According to the starting date of the projects in the sample analysed there are two projects that started in the first year of the MFF 2014-2020 (Figure 15), which are the Horizon 2020 project "OptimeOre" from Saxony and ESIF project "ELLA" from Lapland. The majority of the projects started in and after 2016.

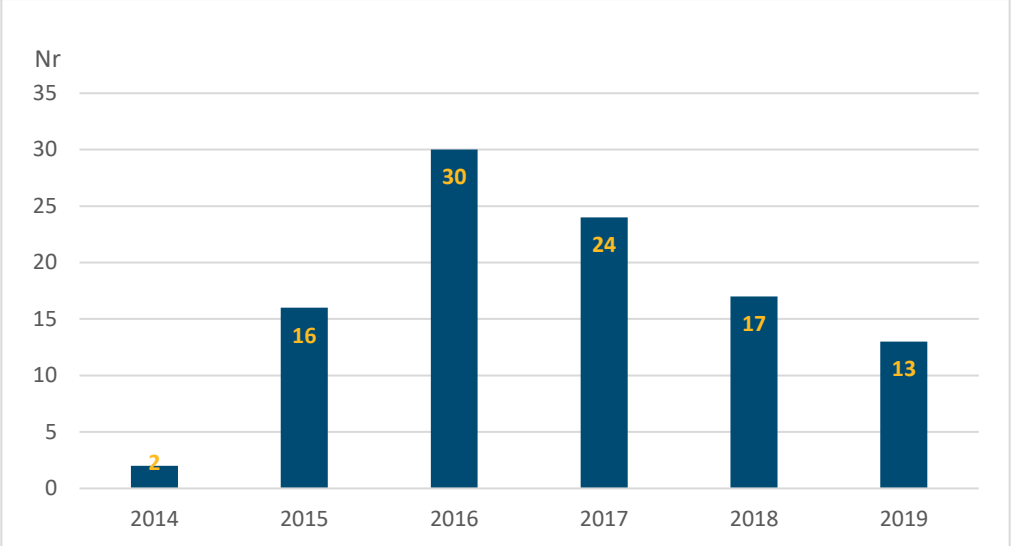

Figure 15 Starting date of sampled projects (source: own work[8]).

Participant type

Projects have different type of participants that include project partners and project coordinators. Regarding project partners, the majority are research organisations and higher or secondary education establishments, representing more than 50% of the type of partners. They are followed by public bodies and private for-profit partners. Other type of partners are less represented in the sample (about 4%).

The type of coordinator of each project gives an idea of which kind of participants are more capable of coordinate an EU project. In Horizon 2020 projects, the most common coordinators are research organisations and higher or secondary education establishments, representing more than 40% of the sampled projects (Figure 16).

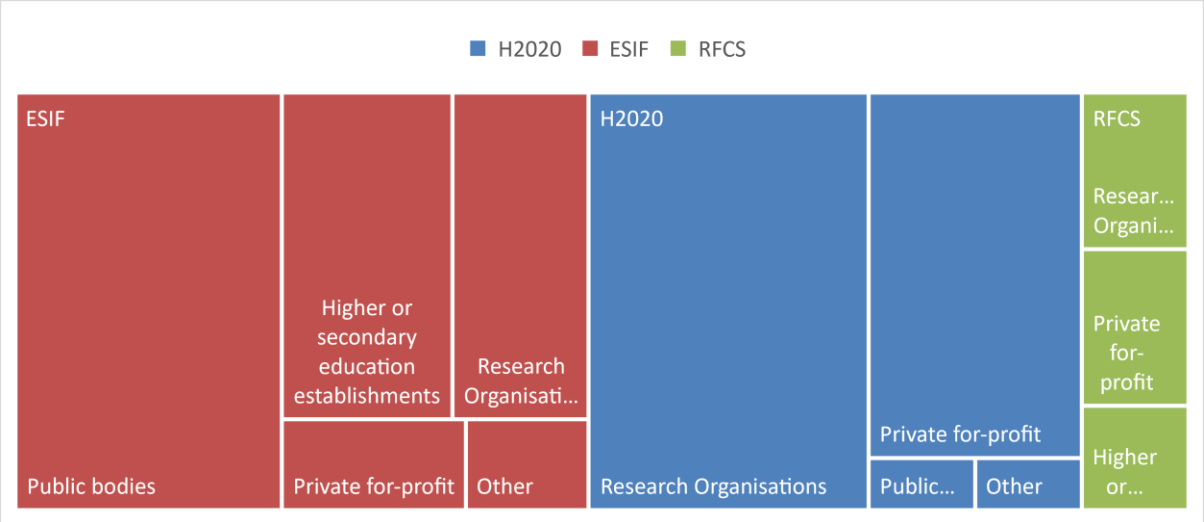

Figure 16 Distribution of the type of coordinators by programme (source: own work)

[8] Four projects are missing from the graphic due to lack of data

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For ESIF projects, the main type of coordinator are public bodies (about 21%), followed by higher or secondary education establishments. Other type of coordinators are the minority, regardless the EU instrument. In RFCS projects there are three types of coordinators in similar proportions: private for profit, higher or secondary education establishments and research organisations.

In the projects analysed it was observed that MIREU pilot regions have common projects. Table 6 shows the regions that share projects, on which MIREU project was not considered. All regions have collaborations with all other MIREU pilot regions, with the exception of Sterea Ellada, which shares projects with Andalucia, Lapland and Styria.

Table 6 MIREU pilot regions collaborating (yellow cells) (source: own work).

	Alentejo	**Andalucia**	**Lapland**	**Lower Silesia**	**Saxony**	**Sterea Ellada**	**Styria**
Alentejo							
Andalucia							
Lapland							
Lower Silesia							
Saxony							
Sterea Ellada							
Styria							

Note that the partnership relation shown in Table 6 does not take into account any particular regional stakeholder, which means that the partnership regards only the region, not the stakeholder itself.

MFF 2014-2020 money distribution

From the overall of the projects, 52% are projects from Horizon 2020 which absorb 77% of the total EU contribution; as for ESIF projects, they correspond to slightly less, around 41% of the projects and absorb about 20% of EU contribution; and RFCS has only 7% of the projects and their EU contribution correspond to 3% of the overall EU contribution to the sampled projects (Figure 17).

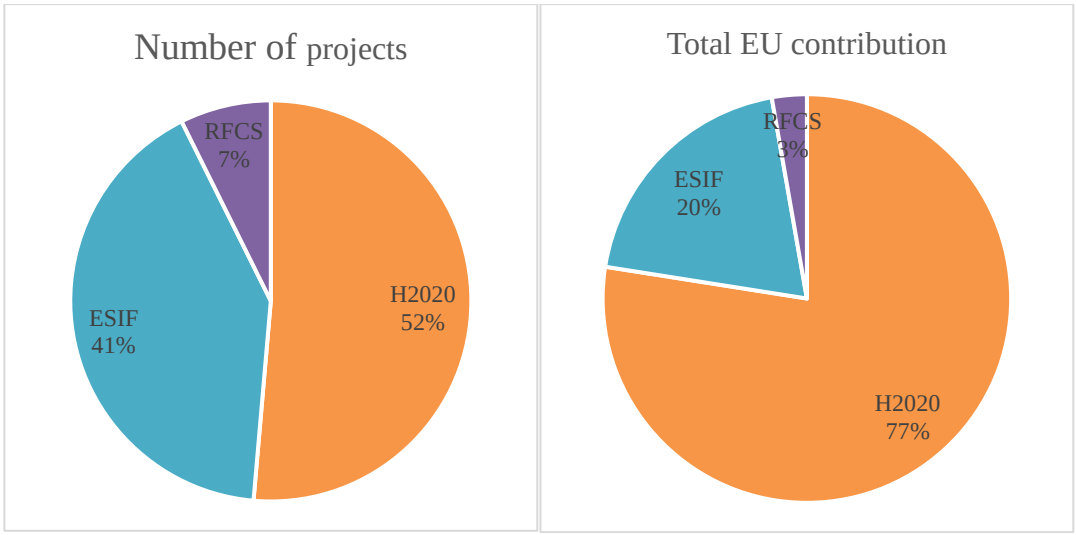

Figure 17 Distribution of the sample projects through their respective main EU funding programme regarding the number of projects and the total EU contribution to the projects (source: own work).

ESIF and Horizon 2020 have several specific funds or type of actions in which the projects were created and are included (Figure 18).

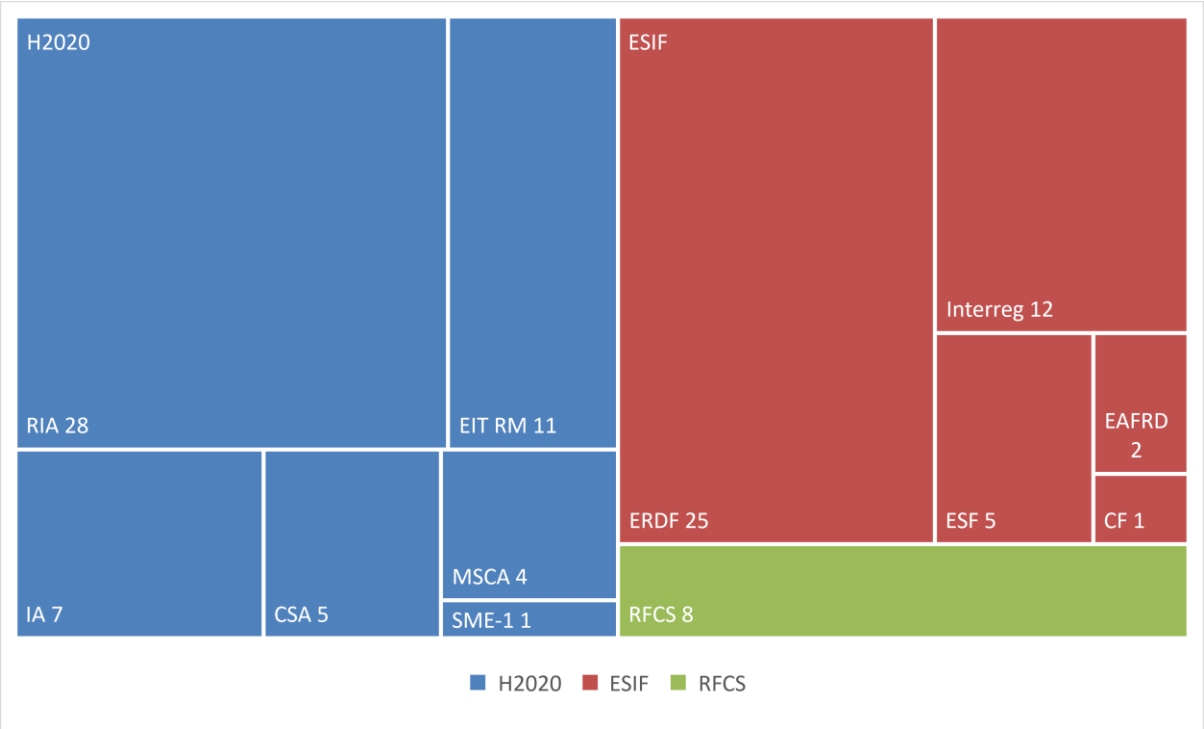

Figure 18 Number of projects by specific fund or type of action (source: own work).

From the 56 projects of Horizon 2020, there are projects covering several type of actions, namely, Innovation Actions (IA), Research and Innovation Actions (RIA), Coordination and Support Actions (CSA), Marie Skłodowska-Curie actions (MSCA), SME Instrument (phase 1) and also projects through EIT RawMaterials (EIT RM). The majority of the sampled projects, from H2020, correspond to RIA funded projects (28 projects) and only one project is from SME Instrument – Phase 1, which is METALLICA project from one Private for-Profit Styria's partner.

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From the five different ESIF funds 33 of the sampled projects are from ESF, CF, EAFRD and ERDF. Additionally 12 are funded by Interreg programme, which although not directly linked to ESIF, it makes usage of ERDF. From these funds and programme, ERDF funds 25 sampled projects, followed by Interreg programme with 12 of the sampled projects. The less represented in the sample are ESF, EAFRD and CF. Most of the ESF funded projects are from Saxony, EAFRD projects from Styria and CF project from Alentejo that corresponds to the rehabilitation of São Domingos' Mine.

RFCS has eight projects in this sample, but its presence means that there are more opportunities for mining and metallurgy investments that reinforcing the whole mining value chain.

Figure 19 shows the distribution of money among the different types of funds and actions. RIA and IA are the main sources of funding for mining and metallurgy projects in MIREU pilot regions, and ERDF is in third place.

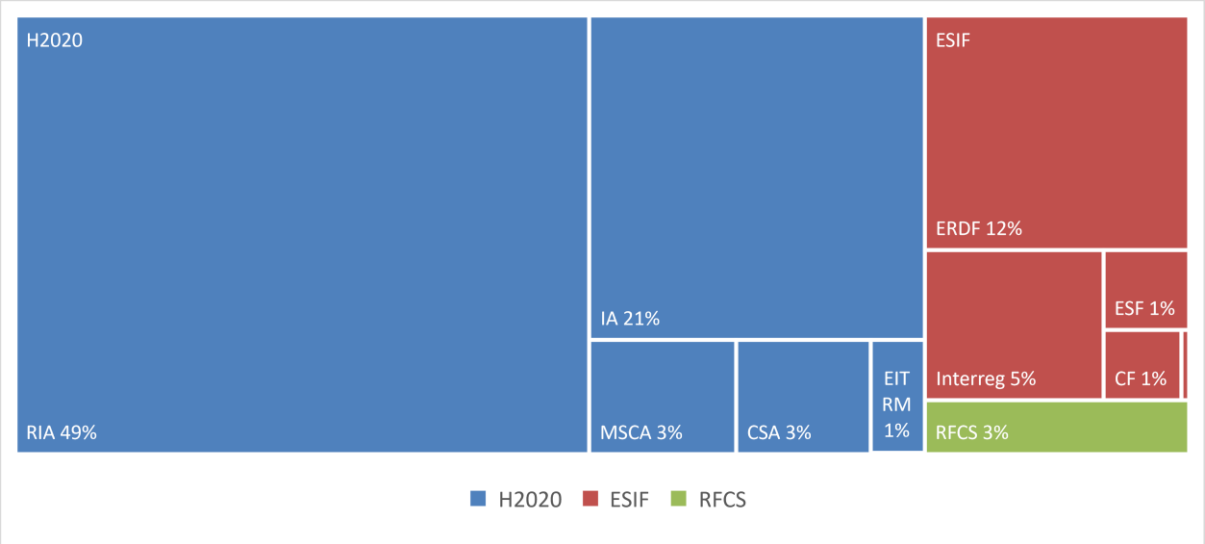

Figure 19 Distribution of total EU contribution through specific fund or type of action (source: own work).

Comparing the number of projects (Figure 18) and the distribution of total EU (Figure 19), RIA has the higher number of projects and the higher amount of money allocated the projects. As for IA projects, although the sample only includes seven of these type of projects, they are in second place in terms of total EU contribution. The second in terms of number of projects is ERDF which represent about 12% of the total EU contribution.

The most notorious cases are Interreg and EIT RawMaterials programmes. Interreg is one of the instruments that has more quantity of projects but represents 5% of the total EU contribution, and EIT RawMaterials programme, has almost the same number of projects as Interreg and represents 1% of the total EU contribution. In this regard it must be noted that the data on the total EU contribution of four projects from EIT RawMaterials was not available and this can be an aspect that is influencing the data.

The total amount of money involved in all projects is over 353 million €. In the next topics a more detailed analysis regarding MIREU pilot regions and ESIF, Horizon 2020 and RFCS will be performed.

ESIF

In analysed sample, ESIF projects (excluding Interreg) get fund from ERDF, EAFRD, ESF and CF and the overall amount of money from ESIF projects is over 50 million € with Andalucia and Lapland being the ones that receive more money. The MIREU pilot regions involved are five, namely Andalucia, Lapland, Alentejo, Saxony and Styria (Figure 20) and the summary of the type of projects is as follows:

- Andalucia is the MIREU pilot region with more budget attributed to ERDF mostly in rehabilitation projects;
- Lapland ERDF projects are diverse with the focus in the development of the SME capacity and support environment including the innovation infrastructure, business practices in the field of industrial circular economy – aiming at sustainable supply chains in mining and metallurgy;
- Alentejo has its ESIF target at supporting the mineral cluster and a new research centre in the region to foster mining R&I with the use of ERDF and rehabilitation projects using CF to Mine closure & rehabilitation ("São Domingos' Mine rehabilitation");
- Styria has two projects funded by EAFRD target at employment & community benefits. They are "Abenteuer Erzberg", a touristic project in the active mine of Erzberg which beneficiary is a private for-profit partner, and "Wir sind Unesco Erbe", related to miners and steelworkers' Unesco Heritage in schools;
- Saxony has several projects funded by ESF that target to education in the different parts of the mining and metallurgy, from upstream operations to downstream, and they are all related to education, because they were created within a higher or secondary education or a research organisation to involve students.

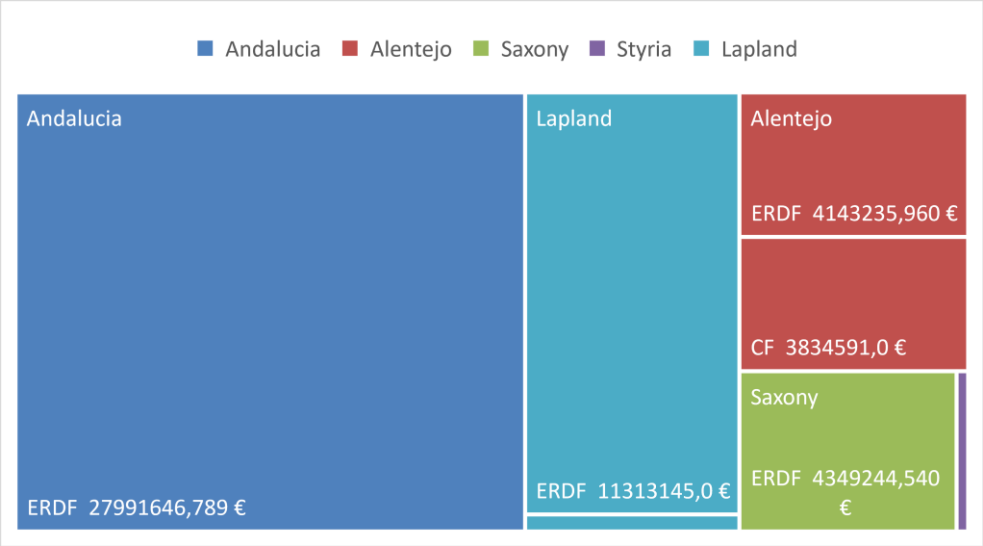

Figure 20 ESIF money distribution through the MIREU pilot regions (source: own work).

ESIF projects are tailored to help at the regional level, thus, except the case of Interreg projects, the EU funds are 100% allocated to the region where the project belongs. Interreg projects budget was not included in this a is because in these projects wasn't possible to see how much money was going to regions, since in KEEP.EU database the amount of EU contribution regards only the overall project.

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Horizon 2020

The overall amount of money of Horizon 2020 projects (except from EIT RawMaterials projects) is around 275 million € and about 14% is for MIREU pilot regions' partners (Figure 21). The reason to exclude EIT RawMaterials projects is that it was not possible to determine how much money is allocated to regional partners.

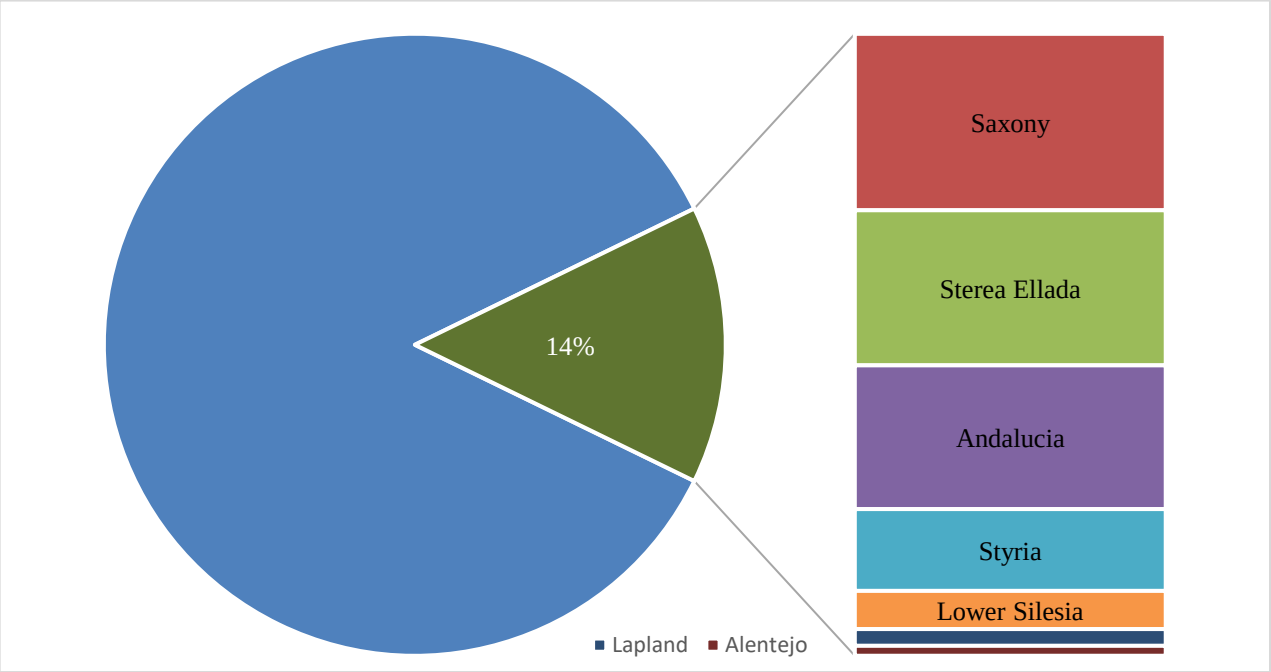

Figure 21 EU total contribution to Horizon 2020 sampled projects and the distribution through MIREU pilot regions' partners (source: own work).

In average, about 20% of the EU contribution from one project goes to MIREU pilot regions. Two Horizon 2020 projects have 100% attributed to regional partners, namely "GaLIophore" from Saxony (MSCA type of action) and "METALLICA" from Styria (the only SME Instrument Phase 1 project). These two projects have one regional participant.

Still in Figure 21, it is possible to observe that Saxony, Sterea Ellada and Andalucia are the regions which have more have more money from Horizon 2020 sampled projects allocated to regional partners, each of them representing about 25% of the Horizon 2020 money contribution. Alentejo and Lapland are the regions with less money coming from Horizon 2020 projects.

All regions have RIA and CSA type of action projects, being RIA the type of action that involves more money in almost all regions, except in Lapland where CSA projects is the action that gives more money to the region. IA type of action projects also exists in almost all regions.

The region with more diversity on the type of action is Styria that has all type of actions (CSA, IA, RIA, MSCA and SME-Instrument phase 1). Regarding SME-Instrument phase 1, Styria is the only region with that type of action and only on project with one private for-profit partner involved. As for MSCA type of action projects, Saxony and Alentejo also have projects of this type of action, respectively three and one (Styria has also one MSCA project).

RFCS

Regarding RFCS focused in R&I in the steel industry, the projects sampled are eight and the partners involved are from Saxony and Styria regions. It was not possible to analyse the distribution of the EU money contribution through the partners because the data was not available.

Value chain and R&I

An important aspect to analyse is the type of categories of the value chain in mining and metallurgy activities that projects target. In this sample, many projects cover more than one category indicating a broad approach of the projects. The categories most covered are extraction and production, considered as upstream phases of mining and metallurgy activities, and also environment and circular economy, considered as crosscutting phases (Figure 22). Projects covering issues related to policy and network and the business part (sale and export) are less represented in the sample.

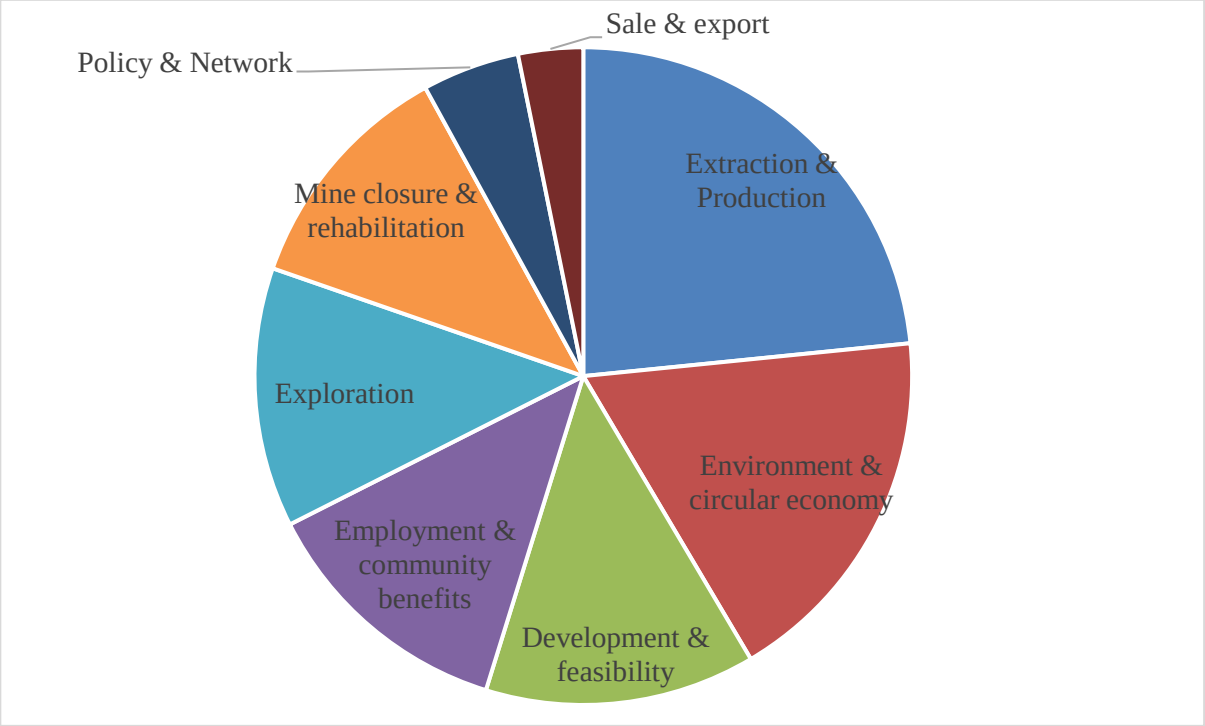

Figure 22 Value chain categories covered by the projects in this sample (source: own work).

Along the value chain categories there are projects whose main purpose is to enhance R&I (Figure 23). The category for which there are more R&I projects is extraction & production followed by environment & circular economy. In opposition, the downstream of the value chain represented by the mine closure & rehabilitation and also employment & community benefits, include mostly operational projects and implementation of actions. Policy & Networking is the category with less R&I projects. Projects that cover Sale & export category within this sample are not focused in R&I for mining and metallurgy activities.

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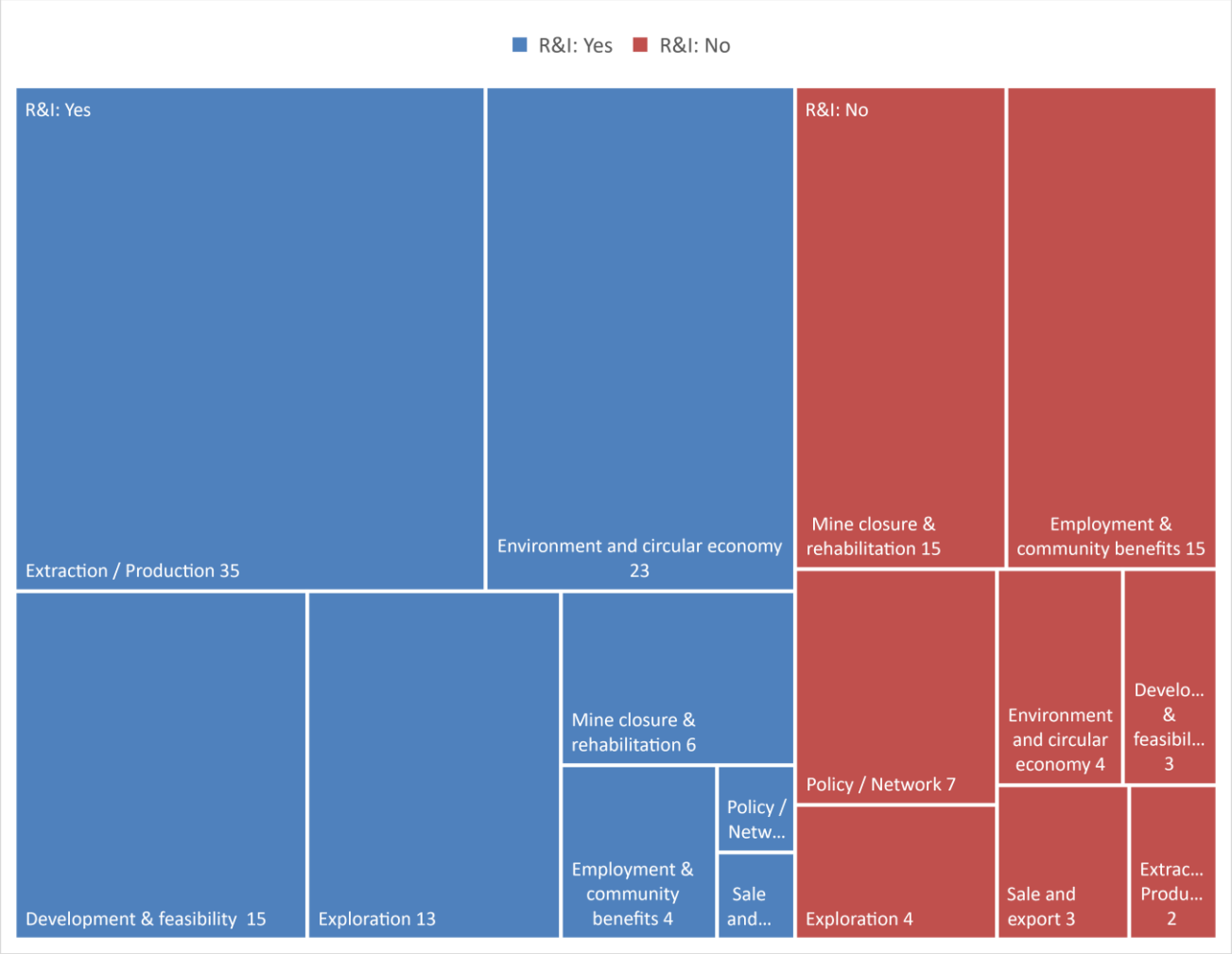

Figure 23 Research and innovation enhancing regarding the value chain categories (source: own work).

Analysing the projects focused in the enhancement of R&I in comparison with the EU main funding programmes it is visible that, there are about 55% of the projects enhance R&I for mining and metallurgy industry. Also, Horizon 2020 is the one with more R&I enhancing projects (about 45% of the projects) as this is the main objective of this EU fund. All of the eight RFCS projects from the sample enhance R&I. At last, although ESIF projects are not so tailored to enhance R&I, some of them contribute to R&I enhancement in mining and metallurgy.

3.2.3 Relation of programmes with TRL

A different type of analysis is the relation between EU instrument and TRLs[9], linking the EU programme to level of technology development that a project aims to achieve.

From the study conducted, is was possible to make the relation as Figure 24 shows and three more EU funding instruments were added, namely FTI and EIC Pathfinder and Accelerator pilots, that are tailored for specific purposes[10]. In this type of analysis, it was not possible to include ESIF or other national programmes because there is no relation between this funding schemes and TRL.

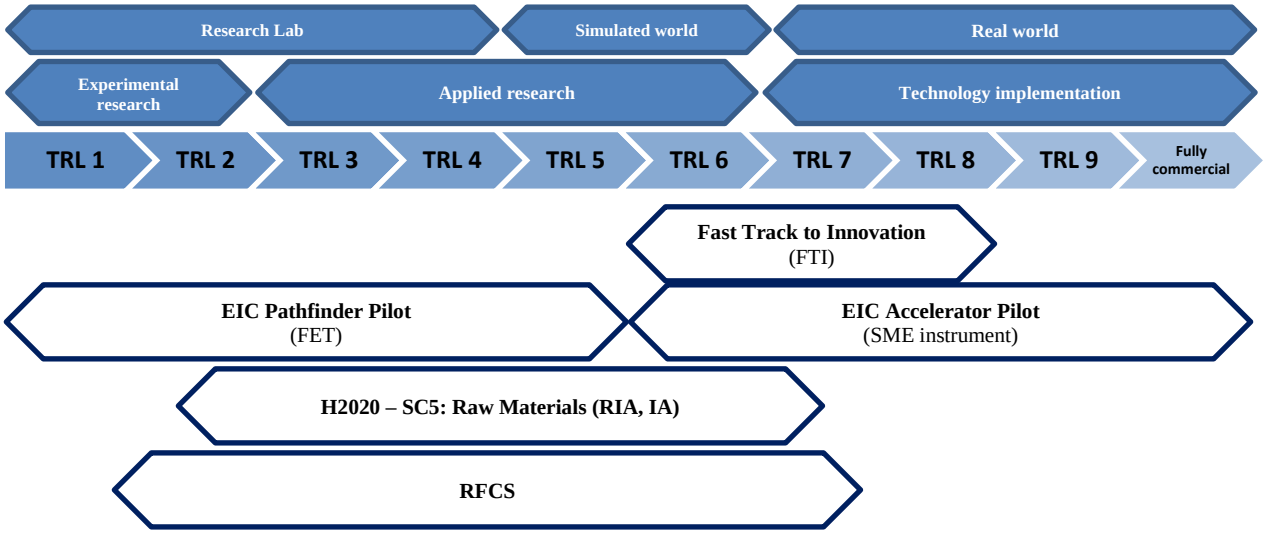

Figure 24 Relation between EU programmes and TRL (source: own work).

The EIC Pathfinder pilot is the successor of FET-Open and FET-Proactive, and EIC Accelerator pilot is the successor of SME Instrument Phase II.

[9] https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

[10] https://ec.europa.eu/research/eic/index.cfm?pg=funding

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3.2.4 Project show case from the study sample

This subchapter includes a showcase of some of the sampled projects in order to demonstrate the possibilities for funding for mining and metallurgy and some thematic areas possible to be covered (Table 7).

Table 7 Examples of projects from the study that cover a wide range of mining and metallurgy themes and possibilities for fund (source: own work).

EU Instrument		**Theme**	**Project name**	**MIREU pilot region**
ESIF	EAFRD	Heritage	Wir sind Unesco Erbe	Styria
	ESF	Education	ARIDuA	Saxony
	ERDF	Circular economy	Biopeitto	Lapland
	CF	Mining rehabilitation	São Domingos' rehabilitation	Alentejo
Horizon 2020	RIA	SLO and community benefits	Virtual Mine	Lower Silesia
	IA	Innovation and technology	Al sical	Sterea Ellada
	CSA	Circular economy	Nemo	Andalucia
	MSCA	Policy	GaLIophore	Saxony
	SME Inst 1	Circular economy	METALLICA	Styria
	EIT RM	Innovation and technology	MAMMA	Lower Silesia
RFCS		Innovation and technology	I3UPGRADE	Styria

3.2.5 MIREU regions' feedback in EU funding

An important aspect to be considered is the feedback of each MIREU partner regarding the use of EU funds in their region, considering the questions made (see sub-chapter 3.2.1). There were four regions that gave their insights as follows:

Alentejo

- Although major universities involved in the projects are mostly concentrated out of the region, there are important ongoing EC funded R&I projects in the region with major companies and research centres- The regional university has been more active in this type of projects recently;
- Although the scope of projects in Alentejo match RIS3 priority, there is reduce interaction between regional partner within the projects, and reduce number of regional and local authorities participating on the projects sampled;
- In the region, all value chain categories are covered, yet there is still potential in the use of other EU funds, especially in categories as employment & community benefits, policy & network and sale & export. For this, stakeholders must be properly informed and capacitated.

Lapland

- RDI environment and education support through ERDF and ESF has been successful;
- Due to the Finnish state aid rules the collaboration with the industry is not possible to be that deep as needed;
- Interreg projects from different strands have been good tools enabling further collaboration regionally and interregional;
- In Lapland the regional strategies were developed in parallel with the smart specialization development. The term RIS3 is not used anymore but S3. In Lapland S3 highlights Arctic Circular Economy and development of the refining of the natural resources as priority industries to develop. S3 was develop to fulfil the gap between the national OP and regional needs – S3 acts as an intermediary;
- Due the considerable large structural funding the regional stakeholders have not taken advantages of the available EU funding as they should have done;
- Particularly Erasmus+ for developing knowledge alliance and education, Cosme to strengthen industry collaboration, clusters and interregional match-making and Life programme to develop environmental solutions.

Lower Silesia:

- The feeling is that EU funded projects do not cover the entire value chain and the majority of projects relate to extraction, missing projects covering metallurgy and the environment.
- EU funded projects match the priority of RIS3 "Natural and secondary raw materials", especially in the field of "Natural resources – extracting, advanced processing and use";
- The region sees that there is potential for the use of EU funds and that it will promote exchange experience in the international teams, but there is still lack of information on the usefulness of project results for improving mining operations.

Saxony

- EU funded projects are being implement in most of mining and metallurgy research fields with a particular emphasis on resource efficiency, although it seems that is missing funding opportunities, or their application in the region, regarding the following:
    - value chain/industry exceeding TRL 6-7 and market entry (above TRL 8);
    - implementation of R&D results by companies;

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    - developing digital processes in M&M (industry 4.0);
    - supporting mining and metallurgy education and awareness.
- The current Saxon RIS 3 does not include mining and metallurgy industry, but in the next revision it will be covered, mainly on the sustainability (green mining), reduction of losses in the whole raw material value chain, digitalisation and substitutions of raw materials. The ongoing EC funded projects covers a large part of the RIS3 M&M focus except rehabilitation and digitalisation.
- Saxony has been implementing project focused more in resource efficiency and circular economy than in securing reliable raw materials sources since the state and federal policy is addressing securing raw materials supply as a responsibility of the industry. This and the lack of funding opportunities for projects above TRL level 6-7 and 8 evidence that need for more funding mining and metallurgy projects.

Styria

- Regional stakeholders are involved in EU funding programmes, helping them to stay competitive on the world market, especially the mining and metallurgy companies, although many SME and some large companies are still nor involved in EU funding programmes. The region is involved in several EU funding instruments, including CSA and Interreg, which allows it to have important knowledge transfer and help the region to fill gaps.
- Although mining is not much in the focus of Styrian RIS3, the themes that will allow the industry to stay competitive are focus or pillar in the regional strategy. For example, "Growth through innovation" is the focus of Styrian RIS3, Green tech is a major pillar in regional strategy through training and support of innovative companies, as also close connection to the scientific environment and R&D, sufficiently qualified employees and efficient usage of resources are stated in the strategy. The Styrian RIS3 strategy also emphasizes the promotion of regional initiatives.
- For Styria the potential use of EU funds could be canalized more to training and education in order to have "skilled workforce" in the future, not only for mining but mostly for metallurgic topics. Another field that have potential for the application of EU funds is identity building & branding and the promotion/image-building for a mining and metallurgic region. This is also directly connected to SLO and the acceptance of mining & industry, as dedicated earmarked EU funding can play an important role for establishing a broad social acceptance of Europe´s mining and metallurgy strategy on a local/regional scale.

3.2.6 Synthesis

Number of projects and starting date

- From the pilot MIREU regions included in the sample, Saxony, Andalucia, Lapland and Styria are developed regions and are the leaders in terms of number of projects;
- The majority of the projects started in and after 2016 and only two have started in 2014.

Participant type

- In the sampled projects, participants can be partners and/or projects coordinators;
- The majority of the partners are research organisations and higher or secondary education establishments;
- The type of coordinators in mining and metallurgy are as follows:
    - In H2020 and RFCS, the majority of the projects are coordinated by research organisations and higher or secondary establishments, although some coordinators may not belong to MIREU pilot regions;
    - In ESIF the majority of the projects are coordinated by public bodies, although some coordinators may not belong to MIREU pilot regions, as in the case of Interreg projects;
- In terms of partnerships, all regions have common projects with one or more other MIREU pilot regions.

MFF 2014-2020 Money distribution

- Regarding the programmes money allocation, H2020 projects involve more money from EU than ESIF. As for RFCS the sample includes fewer projects from this fund which is reflected also on the reduce amount of money allocated to RFCS in the sample;
- Regarding the EU money contribution delivered to MIREU pilot regions participants:

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- From ESIF projects the regions that stand out are Andalucia, Lapland, Alentejo and Saxony;
- The level of regional development does not condition the access funding for R&D (ex.: Lower Silesia);
- From Horizon2020, the regions that receive more money are Saxony, Sterea Ellada and Andalucia;
- RFCS: Both Saxony and Styria have available projects in this EU instruments.

Value chain and R&I and TRL relation

- The majority of R&I projects are funded by Horizon 2020, namely in extraction & production taking in account the environment & circular economy;
- ESIF projects are more tailored for the operational necessities of mining and metallurgy projects namely mine closure & rehabilitation and employment & community benefits;
- Considering the TRL for projects involving the development of a technology, it is possible to arise fund for any TRL stage in EU programmes. Yet, projects with high levels of TRL are just a few in the sample analysed.

MIREU regions' feedback in EU funding

From Saxony and Styria, the feedback, in general, EU funded projects fill existing gaps in mining and metallurgy industry, are aligned to regional RIS3 strategy and there is still great potential for the use of EU funding instruments, mainly in specific mining and metallurgy topics. In addition, these regions are focused on the market side of R&D meaning that there is a special concern related to the operationalization of the R&I results into business operations.

In Lower Silesia, the implementation of EU funds is not so well achieved, but there is potential and the sector is included in RIS3 strategy.

In Alentejo, important ongoing EC projects that match RIS3 priorities with major regional stakeholders and for the use of other EU funding programmes there is the need to engage other stakeholders in order to diversify the access to funds and increase regional collaboration.

These feedbacks are in line with what the sampled projects of these regions indicate, that is in all pilot regions it is visible that there has been an effort to improve mining and metallurgy investments through EU funding instruments.

4. MINING PROJECTS FUNDED THROUGH FI (EIB)

The deliverable mode of the projects presented in Chapter 3.2 is only through grants, meaning that there was no example of mining and metallurgy projects using FI. Due to the lack of this type of information, and the relevance of it, a search for major European project was conducted in EIB database, related to mining and metallurgy activities, and eight projects were found (Annex 8.3).

These projects occur in eight European countries: Belgium, Bulgaria, Denmark, Finland, France, Germany, Poland and Sweden. The one implemented in Poland is from a MIREU region: Lower Silesia ("Walbrzych Urban Revitalisation"). The type of promoter is mostly by "Private for-profit" companies. Yet, from the EIB projects, there is a case, the Lower Silesia project that is promoted by a "Public bodies".

The distribution of the amount of money through the countries is shown in Figure 25, where Poland is the major beneficiary. The total amount of money of these eight projects are over 1 500 million €, a value much higher than the total of the 109 sampled projects (353 million €). Figure 25 does not include Denmark because the total amount of money, comparing with the amount of money that other countries receive, is very close to 0% (see Annex 8.3).

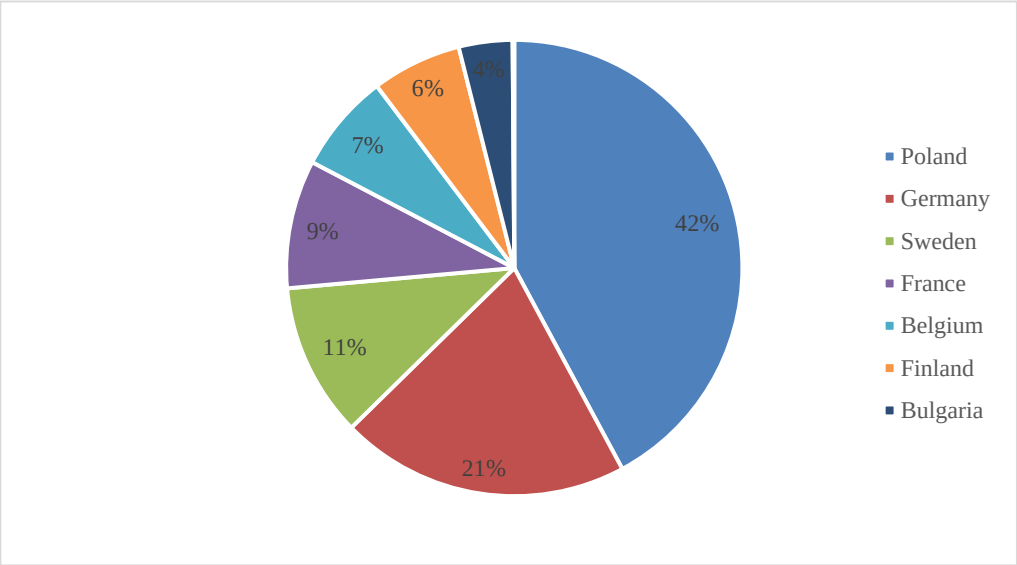

Figure 25 Amount of money distribution of the EIB projects related to mining and metallurgy in European countries.

The value chain categories covered by these eight EIB projects are mainly Extraction & Production. There are no EIB projects for Exploration or Policy & Network (Figure 26). It must be noted that, similarly with the sample in Chapter 3.2, one project may cover more than one value chain category.

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Figure 26 Dominance of the value chain categories within the twelve EIB projects.

Within the eight EIB projects there are two projects that enhance R&I related to Extraction & Production. All the other six projects do not enhance R&I.

This brief EIB project analysis allows to see that mining and metallurgy projects can be fund through FI., even in categories that do not regard technology development, as Mine closure & Rehabilitation or Employment & community benefits.

5. MATRIX OF R&D INVESTMENTS & ESI FUNDS WITH FRAMEWORK CONDITIONS AND FINANCIAL MODELS

From all the research conducted in this study and the analysis of the reports *Research and Innovation Roadmap 2050* (VERAM, 2018), *Raw Materials Scoreboard 2018* (Beatriz et al., 2018) and Euromines (2019), the challenges and needs[11] for mining and metallurgy sector for the near future were cluster in several categories and are presented together with the matrix of R&I investments.

Table 8 Matrix of R&I investments (source: own work)

EU funding programme		Deliverable mode		Industry 4.0	Environment	Business & Financing	Employment & Education	SLO & Community benefits	Policy & Networking	Circular economy	Technical Assistance
		FI[12]	Grants								
ESIF	ERDF		x	x	x	x			x	x	National and regional managing authorities ESIF's FI Fi-compass
	ESF		x	x			x		x		
	EAFRD		x			x	x				
	CF		x		x						
	Interreg		x	x	x			x	x		
H2020 Call SC5	EIT RM		x	x			x	x	x		National Contact Points (NCP)
	CSA		x				x		x	x	
	IA		x	x						x	
	RIA		x	x	x		x			x	
	MSCA		x		x					x	
	SME-Inst 1		x		x						
RFCS			x	x	x						RFCS contacts
EIB		x		x	x	x	x	x		x	EIB

[11] For details regarding the information clustered within each category, please see Annex 8.4.

[12] In the sample there was no data regarding the application of FI in ESIF or H2020, but from the research conducted it was possible to verify there is potential for the use of FI in mining and metallurgy projects.

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6. CONCLUSIONS

The available funds represent a great opportunity for Mining and Metallurgy EU Regions, but as shown trough, the data gathered the regions present different contexts, namely its ESIF eligibility and research and innovation levels and intensity which strongly influences the way that regions perform.

From the analysis carried out mining and metallurgy projects are funded mainly by ESIF or Horizon 2020 and cover all value chain categories. Although both, financial instruments and grants deliverable modes are available, ESIF and Horizon 2020 are mostly attributed to the beneficiaries through grants, thus, investment through FI in MIREU countries are few. Given that the EC wants to promote the use of FI, the study included examples out of MIREU regions that show that for mining and metallurgy investments are also been delivered by FI and this could be achieved by other countries and regions. This example show that the use of FI are drivers to increase R&I.

As briefly summarized in Chapter 2.2 the diversity in the type of funding and deliverable mode received by the countries and regions is constraint or potentiate by several determinants such as human capital capabilities and knowledge of procedures. This, together the red tape associated to the regulation of funds and the implementation of the instruments influence the fully exploitation of EU funds for mining and metallurgy industry investments.

Also, to potential increase the absorption capacity of EU funds MS and regions must align their Smart Specialisations priorities areas with the MFF framework.

The main message taken from this study is that is possible to get fund for mining and metallurgy projects in several EU instruments and for the entire value chain from exploration to sale and export and mainly to 1-6 TRL stages.

7. STUDY'S CONSTRAINTS

Throughout the study, several constraints occurred for a proper analysis, according to the following:

- Lack of unified type of information available in KEEP.EU and CORDIS databases (e.g. in CORDIS it is possible to know the money volume attributed to each participant while KEEP.EU does not have this information available);
- In ESIF, the information is only available in native language and it is available on the national authorities website. This fact was an obstacle for collecting data from this type of funding and this data could only be provided by the partners in the regions;
- The difference in the NUTS level of MIREU regions led to constraints in the analysis performed in Chapter 3.1;
- The projects that Sterea Ellada provided to the sample do not have participants located in the region. This could mean that, although the participants do not belong to the region, they produce work for the region. In this case, it is possible that a similar situation occurs in other regions and thus influencing data.

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8. ANNEX

8.1 Template of the information asked to regions

EC funded projects (Name)	
EU total contribution (€)	
EU contribution to the region (€)	
Programme	
Fund/Type of action	
Type of coordinator	
Type of partners involved in the region	Research organisation
	Higher or Secondary Education establishments
	Private for-profit entities
	Public bodies
	Others
Value chain categories	Exploration
	Development & feasibility
	Extraction & Production
	Environment and circular economy
	Sale and export
	Employment and community benefits
	Mine closure & rehabilitation
	Policy & Networking
Enhance R&I	
Start date	
End date	
Partnerships of MIREU pilot regions in other EU projects	
Aim of the project	

8.2 List of projects considered in the sample

EC funded projects (Name)	EU total money contribution	Programme	Fund/Type of action	Type of Coordinator	Research organizations	Higher or Secondary Education establishments	Private for-profit entities	Public bodies	Others	Regions involved
Abenteuer Erzberg	195,000.00 €	ESIF	EAFRD	Private for-profit			x			Styria
ALCIRC	1,381,628.00 €	RFCS	RFCS	Research Organisations			x			Styria
AlSiCal	12,977,445.62 €	H2020	RIA	Research Organisations		x				Sterea Ellada
AMIC	559,710.00 €	ESIF	ERDF	Research Organisations	x	x	x	x		Lapland
Arctic Smartens projects	4,000,000.00 €	ESIF	ERDF	Public bodies	x	x	x	x		Lapland
ARIDuA	1,380,824.43 €	ESIF	ESF	Higher or secondary education establishments		x				Saxony
Arktinen geoinnovaatiokeskus	826,208.00 €	ESIF	ERDF	Research Organisations	x	x	x	x		Lapland
BioMOre	8,564,961.75 €	H2020	RIA	Private for-profit	x	x	x		x	Saxony Lower Silesia Andalucia
BIORECOVER	6,337,278.00 €	H2020	RIA	Other	x	x	x			Sterea Ellada
Biopeitto	739,168 €	ESIF	ERDF	Research Organisations	x	x				Lapland
BSUIN	3,425,609.14 €	ESIF	Interreg	Higher or secondary education establishments	x	x				Lower Silesia
BuSK	1,192,744.19 €	ESIF	Interreg	Research Organisations	x	x		x		Lapland
CABRISS	7,844,564.54 €	H2020	IA	Research Organisations			x			Saxony
CEGMA 2.0	807,627.30 €	ESIF	ERDF	Research Organisations	x					Alentejo
CHROMIC	4,869,687.50 €	H2020	RIA	Research Organisations	x					Saxony
CROCODILE	11,625,289.01 €	H2020	IA	Research Organisations	x		x			Styria Andalucia Sterea Ellada

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EC funded projects (Name)	EU total money contribution	Programme	Fund/Type of action	Type of Coordinator	Research organizations	Higher or Secondary Education establishments	Private for-profit entities	Public bodies	Others	Regions involved
Depósito de lodos Aquisgrana. La Carolina. Jaén	3,257,006.45 €	ESIF	ERDF	Public bodies				x		Andalucia
DISIRE	5,998,343.75 €	H2020	RIA	Higher or secondary education establishments	x	x				Lower Silesia
Eisen, Zinn und Handwerkskunst in Schwarzenberg und Abertamy – Zeitzeugen der montanen Kulturlandschaft Erzgebirge/Krušnohoří	2,328,446.32 €	ESIF	Interreg	Public bodies				x		Saxony
ELLA	91,050 €	ESIF	ERDF	Private for-profit		x				Lapland
EXPLORA	548,306.00 €	ESIF	ERDF	Public bodies	x	x	x			Alentejo
FAME	5,000,000.00 €	H2020	RIA	Private for-profit		x	x			Saxony
FASTLOROLL	802,680 €	RFCS	RFCS	Private for-profit		x				Saxony
FineFuture	6,195,022.50 €	H2020	RIA	Research Organisations	x	x				Saxony Lower Silesia
FINES2EAF	974,994.00 €	RFCS	RFCS	Higher or secondary education establishments	x					Styria
Flintstone2020	4,996,180.00 €	H2020	RIA	Higher or secondary education establishments		x				Saxony
GaLIophore	171,460.80 €	H2020	MSCA	Research Organisations	x	x				Saxony
Geo-FPI	867,052.80 €	ESIF	Interreg	Public bodies				x		Alentejo Andalucia
GeoMAP	832,647.83 €	ESIF	Interreg	Public bodies				x		Saxony
GEOSax	1,500,000.00 €	ESIF	ESF	Higher or secondary education establishments		x				Saxony
HybArkt	415,451 €	ESIF	ERDF	Higher or secondary education establishments	x	x				Lapland

EC funded projects (Name)	EU total money contribution	Programme	Fund/Type of action	Type of Coordinator	Research organizations	Higher or Secondary Education establishments	Private for-profit entities	Public bodies	Others	Regions involved
HYDROCOAL PLUS	1,227,791 €	RFCS	RFCS	Research Organisations		x				Saxony
I3UPGRADE	1,991,844.00 €	RFCS	RFCS	Higher or secondary education establishments	x		x			Styria
IN2TRACK	2,799,993.00 €	H2020	RIA	Public bodies	x		x			Styria Andalucia
Indika	413,680 €	ESIF	ERDF	Research Organisations	x	x	x			Lapland
InduCult2.0	2,448,581.64 €	ESIF	Interreg	Public bodies	x	x		x	x	Styria
INFACT	5,624,029.59 €	H2020	RIA	Research Organisations	x	x				Lapland Saxony Andalucia
i2MON	1,353,206 €	RFCS	RFCS	Private for-profit		x				Saxony
InnoCrush	1,350,920.11 €	ESIF	ESF	Higher or secondary education establishments		x				Saxony
Innovationsmanager Ressourcentechnologie	117,500.00 €	ESIF	ESF	Research Organisations	x	x				Saxony
INTERMIN	1,266,021.25 €	H2020	CSA	Research Organisations	x					Styria
INTMET	7,834,976.25 €	H2020	RIA	Private for-profit			x			Lower Silesia Alentejo Andalucia
INVENTARIO AMBIENTAL	1,591,486.32 €	ESIF	ERDF	Public bodies				x		Andalucia
ION4RAW	5,684,450.00 €	H2020	RIA	Private for-profit	x	x				Saxony Andalucia
ITERAMS	7,915,364.25 €	H2020	RIA	Research Organisations	x		x			Styria Lapland Alentejo
JaMit - Modeling oil spreading with CFD connected to oil and low metal (Ni, Hg) measurements in mines and harbors.	324,528 €	ESIF	ERDF	Research Organisations	x					Lapland
KaiVi	943,350 €	ESIF	ERDF	Higher or secondary education establishments		x	x			Lapland

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EC funded projects (Name)	EU total money contribution	Programme	Fund/Type of action	Type of Coordinator	Research organizations	Higher or Secondary Education establishments	Private for-profit entities	Public bodies	Others	Regions involved
MAMMA	403,425.00 €	H2020	EIT RM	Private for-profit	x					Lower Silesia
Management and dynamization of the actions of the Cluster of Mineral Resources	69,288.24 €	ESIF	ERDF	Other					x	Alentejo
MEMAN	5,998,686.00 €	H2020	RIA	Private for-profit			x			Styria
METALLICA	50,000.00 €	H2020	SME-1	Private for-profit			x			Styria
METGROW+	7,911,462.50 €	H2020	RIA	Research Organisations			x			Andalucia
MiGaEL	450 002 €	ESIF	ESF							Lapland
MILDROLLING	1,048,711 €	RFCS	RFCS	Private for-profit		x				Saxony
MIND	4,160,234.50 €	H2020	RIA	Private for-profit	x	x				Saxony
Mine Life	591,736.25 €	ESIF	Interreg	Public bodies				x		Saxony Lower Silesia
MINEPLAT	656,982.42 €	ESIF	ERDF	Higher or secondary education establishments		X				Alentejo
MIN-GUIDE	1,999,625.00 €	H2020	CSA	Higher or secondary education establishments	x					Styria Sterea Ellada
Minland	1,498,691.25 €	H2020	CSA	Research Organisations	x					Styria Lapland Sterea Ellada
MIREU	2,999,725.00 €	H2020	CSA	Research Organisations	x			x		All
Need survey of automation and measurement technology in mining and primary crushing operations	117962 €	ESIF	ESIF	Research Organisations	x	x	x			Lapland
NEMO	12,407,294.63 €	H2020	IA	Research Organisations			x			Andalucia
NetFlot	5 000,00 €[13]	H2020	EIT RM	Research Organisations	x	x				Saxony

[13] https://www.port.org.pl/en/projekt/netflot-2/

EC funded projects (Name)	EU total money contribution	Programme	Fund/Type of action	Type of Coordinator	Research organizations	Higher or Secondary Education establishments	Private for-profit entities	Public bodies	Others	Regions involved
NEW-MINE	3,836,165.55 €	H2020	MSCA	Higher or secondary education establishments	x					Styria
NEXT	6,901,276.25 €	H2020	RIA	Research Organisations			x			Lapland Saxony Andalucia
OpenYourMine	942,887.00 €	H2020	EIT RM	Higher or secondary education establishments	x	x				Lower Silesia
OptimOre	5,084,468.75 €	H2020	RIA	Higher or secondary education establishments	x	x				Saxony
PreFlex	360,594 €[14]	H2020	EIT RM	Research Organisations	x	x				Saxony
PREVENTSECDUST	1,201,556.00 €	RFCS	RFCS	Research Organisations	x		x			Styria
Proyecto de Clausura de la Balsa de estériles y su integración en el medio natural. (Huelva)	9,307,001.42 €	ESIF	ERDF	Public bodies				x		Andalucia
Proyecto de clausura y restauración del depósito de procesos de tratamiento de industrias extractivas abandonado, Llanos de Caparidán, Fuentenueva y El Segundo. T.M.Laujar de Andarax y Berja	4,511,047.81 €	ESIF	ERDF	Public bodies				x		Andalucia

[14] https://www.rwth-aachen.de/go/id/ddigb?lidx=1

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EC funded projects (Name)	EU total money contribution	Programme	Fund/Type of action	Type of Coordinator	Research organizations	Higher or Secondary Education establishments	Private for-profit entities	Public bodies	Others	Regions involved
Proyecto de Clausura y restauración del depósito de procesos de tratamiento de industrias extractivas abandonado, Pago de Las Cabras T.M. de Almócita	2,489,681.78 €	ESIF	ERDF	Public bodies				x		Andalucia
Proyecto de recuperación de suelos degradados por actividad minera en el entorno del Muelle de Tharsis (T.M. de Aljaraque. Huelva)	1,600,000.00 €	ESIF	ERDF	Public bodies				x		Andalucia
Proyecto de restauración de espacios afectados por la minería en el Parque Matural Sierra de Baza. TTMM de Baza y Gor (Granada)	1,151,851.74 €	ESIF	ERDF	Public bodies				x		Andalucia
Proyecto de restauración del espacio degradado por minería metálica "Cementación Las Viñas". Sotiel Coronada. T.M. de Calañas. (Huelva)	4,083,571.28 €	ESIF	ERDF	Public bodies				x		Andalucia
PureNano	4,246,490.00 €	H2020	RIA	Higher or secondary education establishments	x		x			Andalucia
Re-Activate	374,816.00 €	H2020	EIT RM	Private for-profit	x					Lower Silesia
Real-Time-Mining	5,629,199.75 €	H2020	RIA	Higher or secondary education establishments		x	x			Saxony Alentejo
REMIX	1,683,900.95 €	ESIF	Interreg	Public bodies	x		x			Styria Lapland Saxony Lower Silesia
Removal	11,481,599.13 €	H2020	IA	Private for-profit	x	x	x			Sterea Ellada

EC funded projects (Name)	EU total money contribution	Programme	Fund/Type of action	Type of Coordinator	Research organizations	Higher or Secondary Education establishments	Private for-profit entities	Public bodies	Others	Regions involved
RMProSchool		H2020	EIT RM	Higher or secondary education establishments	x	x				Saxony
ROBOMINERS	7,445,900.00 €	H2020	RIA	Higher or secondary education establishments	x					Styria
Rock Vader	1,544,347.00 €	H2020	EIT RM	Private for-profit	x					Lower Silesia
SafeDeepMining	339,995.00 €	H2020	EIT RM	Higher or secondary education establishments	x	x				Lower Silesia
São Domingos Mine Rehabilitation	3,834,591.00 €	ESIF	CF	Public bodies				x		Alentejo
SCALE	7,000,000.00 €	H2020	RIA	Private for-profit	x	x	x			Sterea Ellada
Schutz und Erhalt von durch Bergbau und landwirtschaftliche Nutzung entstandenen Fels-, Gesteins- und Rohbodenbiotopen im Erzgebirge	439,576.72 €	ESIF	Interreg	Higher or secondary education establishments		x				Saxony
SCRREEN	2,999,500.00 €	H2020	CSA	Research Organisations		x	x			Lapland Andalucia Sterea Ellada
SESAME	5,200,000.00 €	H2020	RIA	Research Organisations	x	x				Saxony
Sifucel - Worldwide innovative product	1,388,250.00 €	ESIF	ERDF	Private for-profit			x			Alentejo
SIMS	12,709,745.00 €	H2020	IA	Private for-profit	x		x			Lapland Lower Silesia
SLIM	6,979,200.00 €	H2020	RIA	Higher or secondary education establishments	x		x			Styria Andalucia
Smart Exploration	5,217,843.75 €	H2020	RIA	Higher or secondary education establishments	x	x	x			Saxony Alentejo

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EC funded projects (Name)	EU total money contribution	Programme	Fund/Type of action	Type of Coordinator	Research organizations	Higher or Secondary Education establishments	Private for-profit entities	Public bodies	Others	Regions involved
SMART-Plant	7,536,300.02 €	H2020	IA	Higher or secondary education establishments	x	x	x			Andalucia Sterea Ellada
SOCRATES	3,858,940.08 €	H2020	MSCA	Higher or secondary education establishments		x				Saxony Alentejo
SUGA		H2020	EIT RM	Research Organisations	x	x				Saxony
SULTAN	3,910,958.64 €	H2020	MSCA	Higher or secondary education establishments			x			Saxony Alentejo
SUSMAGPRO	12,977,445.62 €	H2020	IA	Higher or secondary education establishments		x				Styria
SusMinNor	143,368.00 €	ESIF	Interreg	Public bodies				x		Lapland
TARANTULA	6,946,607.50 €	H2020	RIA	Research Organisations	x		x			Andalucia
THE CIRCULAR AND BIOECONOMY CENTRE	3,000,000.00 €	ESIF	ERDF	Other	x	x	x	x	x	Lapland
THING	4,071,685.00 €	H2020	RIA	Higher or secondary education establishments			x			Lower Silesia
tRAILs	1,859,290.26 €	ESIF	Interreg	Higher or secondary education establishments	x			x		Styria
Vamos	9,200,000.00 €	H2020	RIA	Private for-profit	x					Styria

EC funded projects (Name)	EU total money contribution	Programme	Fund/Type of action	Type of Coordinator	Research organizations	Higher or Secondary Education establishments	Private for-profit entities	Public bodies	Others	Regions involved
VirtualMine	315,025.00 €	H2020	EIT RM	Research Organisations	x					Lower Silesia
VISUAL3D	382,437.00 €	H2020	EIT RM	Higher or secondary education establishments	x					Lower Silesia
Vita-Min	3,033,657.72 €	ESIF	Interreg	Public bodies				x		Saxony
Wir sind Unesco Erbe	195,000.00 €	ESIF	EAFRD	Public bodies		x		x	x	Styria
ZOM - 3D	672,782.00 €	ESIF	ERDF	Higher or secondary education establishments	x	x	x			Alentejo

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8.3 List of EIB projects

Project Name	EIB financing volume	Type of Promotor	Development & feasibility	Extraction & Production	Environment & circular economy	Sale & export	Employment & community benefits	Mine closure & rehabilitation	R&I	Country
ATLAS COPCO RDI III	300,000,000 €	Private for-profit		x		x			Y	Sweden Belgium Germany
BRAUNKOHLESANIERUNG LAUSITZ II	150,000,000 €	Private for-profit						x	N	Germany
KCM LEAD ZINC CAPACITY EXPANSION	65,000,000 €	Private for-profit		x	x		x		N	Bulgaria
KELIBER BATTERY GRADE LITHIUM PRODUCTION	80,000,000 €	Private for-profit	x	x		x			N	Finland
MODERNISATION PROGRAMME I and II	691,719,843 €	Private for-profit		x	x		x		N	Poland
METSO RDI	40,000,000 €	Private for-profit	x	x	x				Y	Sweden Germany Finland Denmark France
REHABILITATION LOGEMENT SOCIAL BASSIN MINIER	153,000,000 €	Private for-profit						x	N	France
WALBRZYCH URBAN REVITALIZATION	28,000,000 €	Public body					x	x	N	Poland

8.4 Mining and Metallurgy challenges and needs clustered in categories

Industry 4.0

- Improve geochemistry and geophysics exploration methods and integrate 3D/4D modelling
- Improve systems to collect and predict ore-body and rock information
- Improve facilities architecture
- Enhance digitisation, automation and optimization of processes
- Improve efficiency in all value chain
- Develop the concept of biomining, biometallurgy and microbiological stability
- Create synergies with eco-design concept and on-demand customization
- Innovate operations management
- Intelligent feedback monitoring systems and robotic technology (ex.: big data management)
- Creation of a database for available by-products, residues, etc. and traceability of raw material from source to end-use
- Improve machinery (ex.: fuel mixes)

Environment

- Improve beneficiation technologies to increase yields from old mine waste disposal sites
- Improve closed systems for water and waste
- Minimizing environmental impacts, CO_2 emissions and energy and water consumption
- Mining requalification / heritage

Business and Financing

- Develop new materials for new products and design
- Create new business models associated with a materials revolution leading to independence from critical raw materials in the EU
- Analyse better ways to get financing to the sector

Employment and Education

- Improve working conditions using robotics for unsafety tasks
- Creation of mining related green jobs
- Better alignment of skills with market needs, including representatives of administration bodies involved in permitting procedures
- Develop new education and awareness tools to increase collection rates

SLO and Community benefits

- Social issues analysis and effective communication to educate society about raw materials, mining and metallurgy
- Develop knowledge on societal influence and social acceptance of different mining and exploration activities
- Conduct social, economic and/or market research on the impact of public policy on material sciences, raw materials and material design

Policy and Networking

- Land-use planning
- Examine the role of fiscal incentives or other types of incentives
- Adequate legislation at national and EU level
- Create dedicated networks to knowledge share and transfer.
- Integration between academia and business

Circular economy

- Explore new technologies and synergies between sectors (ex.: the end-product and its metallurgical process to improve the its recyclability)
- Monitoring framework for the entire cycle of the raw materials usage
- Research the consequences of disruptive technologies and their impact on products' EOL phase

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