Roadmap compiling best practices and conclusions of an inter-regional plan for integration of funds policy, framework, policies and regional strategies

D5.3

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Description of the related task and the deliverable. Extract from DoA	**Task 5.5 EU mirroring strategy M20-M30** A "mirroring strategy" successfully used in previous EU projects (i.e. MSP-REFRAM, SCRREEN) will be set up between those MIREU regions deemed to have a high degree of similarity (mirror regions) in terms of RIS3, economic activity, and societal challenges (per Task 5.3). A pilot plan of actions, implemented in a mirror-core group of regions, will be carried out under the umbrella of ERRIN and EURADA. This will constitute the proof-of-concept for a possible future large-scale demonstrator and the creation of a common EU roadmap for EU mining and metallurgy regions.				
Participants	ICAMCyL, MUL, DGEyM, NOVA ID, ERRIN				
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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

Acronyms and abbreviations

AMBP	Advanced Materials for Batteries Partnership
EU	European Union
EBA	European Battery Alliance
TRL	Technology Readiness Level
CoMMER	Council of Mining and Metallurgy European Regions
M&M	Mining and Metallurgy
NUTS	Nomenclature des Unités Territoriales Statistiques
RDI	Research, Development and Innovation
RIS3	Regional Innovation Strategy for Smart Specialisation
RM	Raw Materials
WP	Work Package
MB	Management Board
S3P	Industrial Modernisation Platforms

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1 INTRODUCTION

1.1 Purpose

The purpose of deliverable is to define a roadmap of actions targeting the creation of new business opportunities and economic growth and linking this with the EU's Strategy on Raw Materials. This is aligned with MIREU **Objective 4: Promoting regional synergies for economic growth:**

• Reviewing the Smart Specialisation strategies of the regions.

• Carry out a "regional mirroring" strategy across MIREU regions with the aim of informing public authority decision makers and regional strategic plans.

This deliverable contributes to KPI 4: Roadmap of actions targeting the creation of new business opportunities and economic growth and linking this with the Raw Materials Strategy of EU.

1.2 Contributions of partners

ICAMCyL has been in charge of designing and elaborating the task T5.5 called "Identification of societal challenges such as demographic change and geographic location", and this Deliverable 5.3. The five MIREU partners participating in this task, named: MUL, DGEyM, NOVA ID and ERRIN, have helped with the revision of the present document, contrasting, improving and validating the information contained.

1.3 Baseline

One of the basis for this work has been Task 5.5 as well as previous MIREU deliverables in WP5, such as D5.1 that study the Regional Innovation Strategy (RIS3) of the MIREU regions. We have also used RIS3 from other non-MIREU regions and databases of the European Commission's to study past and ongoing funded projects. Information has been gathered regarding the different clusters associations across EU using public information available to the entities that manage these infrastructures.

1.4 Relations to other activities

This work is closely related all works done to date under MIREU WP5 and also some relevant task from WP6. It is closely linked to Task 5.5 UE mirroring strategies and T5.1: Review of MIREU Regions' RIS3 strategies related to their assets in economic aid programmes and measures knowledge identification, which is included in deliverable D5.1, and the task T5.3: Identification of societal challenges such as demographic change and geographic location.
We have also benefit from the information gathered under MIREU Event: "Governance and Policy within Mining and Metallurgy EU regions", hosted by ICAMCYL on the 15th January 2019.

2 EXECUTIVE SUMMARY

The purpose of this work is providing a roadmap to develop a better integration of policies, funding and regional strategies compiling best practices and conclusions of an inter-regional plan for integration of funds policy, framework, policies and regional strategies. The document reflects best practices for inter-regional integration, cooperation schemes and a range of strategies for regions and policy development that could maximize raw materials sectors and circular economy.

The mining and metallurgy industries are key drivers of European sustainable development and an integral part of our smart specialisation strategies. Raw materials are essential to meet basic societal needs, as they are key enablers of many critical sectors of the economy and, more importantly, they will be crucial in the development of the technologies that will lead the transition to a low-carbon, energy-efficient and circular economy.

In the identification of societal challenges such as demographic change and geographic location, we have considered it necessary to carry out an overview of how covid-19 crisis is affecting the M&M sector, its impact and the measures that have already begun to be taken to alleviate its effects. Other social challenges addressed that greatly affect the M&M sector are ageing and depopulation. It have great importance of creating educational and employment opportunities to mitigate its effects.

From an economic development point of view, the strengthening of mining clusters is of great importance, they will be essential for the implementation of measures to improve the operational environment for mining-related activities.

One of the objectives of MIREU project is the connection of EU regions with the production of raw materials and with their common priorities in the S3 regional strategies. To this end, the implementation of regional development policies and programs that support investment in innovation in areas of smart specialization will be improved. Mining and metallurgy are essential industries in which regional priority strategies are primarily to develop sustainable resource exploitation.

One of the important aspects of the whole process is the transmission of knowledge and awareness about the balance of the economic needs of the region and companies, with the environmental considerations and cultural traditions of the people who live in mining areas. In this sense, strategies must be established for the development of more constructive relationships between the extractive industry and the affected communities based on respect, commitment and mutual benefit.

Analyzes carried out in MIREU project, concluded that the involvement of all social partners in the mining and metallurgical industry is one of the fields in which there is still a long way to go. Mining with 100% reusable resources could be considered, which would minimize the impact on the environment in which it operates, and that would promote the development of the societies that host it. Integrating not only the sector itself, but also its intermediate and final users and the society that integrates both.

Analysing funding opportunities for R&I in the metallurgy and mining sectors within the Multiannual Financial Framework 2014-2020 in the EU shows an interesting view of how MIREU regions perform in terms of research and innovation. A thorough study was already carried out in D6.2 and we extract in this document the main conclusions of the report in this aspect. As will be observed, MIREU regions perform quite differently, having some of them higher levels of R&I than others. Interestingly, national and regional outputs do not necessarily align with each other. In addition, most of the institutions involved in funding activities are

research centres, being industry less represented. TRLs of R&I projects are usually low and grants dominates the landscape over financial instruments.

The present work summarizes potential mirror strategies between MIREU regions that are considered to have a high degree of similarity (mirror regions) in terms of RIS3, economic activity and social challenges. The study raised similarities among regions that can easily develop mirroring actions, copying best practices from leading regions. In order to assess this, the present work provides an overview of different parameters or factors from different sources to study the potential similarities, these are based on review of RIS3 of MIREU and other EU regions, industrial clusters and associations, and research projects funded by different programs. The remarking conclusions of the study have been used to create a map of the 10 most similar active regions in EU M&M. The remarked regions contain important hubs regarding the raw materials industry and great mirroring possibilities.

Concluding remarks provides main barriers and concerns hindering the development of a thriving mining and metallurgy industry in Europe have been identified. Suggestions for the roadmap for most pertinent solutions to address these issues are summarized with the aim to fulfil the targets set by the EC and support EU level policy change towards more sustainable raw materials value chains in terms of social acceptance, environmental soundness and economic viability.

3 ACTUAL KEY SOCIAL CHALLENGES FACED BY THE REGIONS TODAY

The last published RIS3 of each region was used as a reference to determine the temporal scope of the analysis, which in most MIREU regions corresponds to the period 2014-2018, except the covid-19 pandemic analysis which corresponds to 2020.

	Opportunities (selected)	Challenges (selected)
Demographic changes	• **Migrants** may enhance labour supply. • **Lifelong learning** for old workforce to keep adding-value.	• **Shortage of labour** from local demographic decline. • **Reduction of social, economic and cultural activities** from youth out-migration • Higher **pressure to local finances**.
Climate change and environmental pressures	• **Competitive advantage** from high environmental standards in mining • **New jobs** from the development of environmentally friendly technologies. • **Increased need for minerals and metals** in the production of renewable energy	• **Pressures** to reduce **environmental footprint** throughout the value chain • **Increased public scepticism towards mine** explorations and opening
Technological innovation	• **Compensate for shortage of labour**. • **Enhance attractiveness** of mining regions (e-services). • **Raise productivity** with environmentally friendly processes • Greater **labour opportunities for young and women** (Prepare workforce for the future)	• **Automation of jobs** in the mining sector. • **Impact competitiveness** if technological innovation is produced outside the region. • **Reduce the need for certain minerals** from laboratory products or recycling processes

Source: OECD (forthcoming) OECD Mining Regions Case Study: Västerbotten And Norrbotten, Sweden

Figure 1: Megatrends impacting mining regions and cities

3.1 Covid-19 crisis

The mining sector, which is highly dependent on commodity markets, is especially vulnerable to the effects of external shocks, in terms of jobs, income levels and living standards.

Mining regions and cities are exposed to the shock effects of **COVID 19** on both the supply and the demand side. On the production side, lockdown measures have influenced working conditions and input supply chains, potentially affecting production levels. On the demand side, the global drop of manufacturing and construction activity can reduce the demand for minerals and metals, which may lead to disruptions in the value chain. These combined effects can influence productions levels and eventually jobs, income and well-being in mining regions and cities.

At the beginning of May 2020, the current situation of the covid-19 pandemic and its influence on the m&m sector was addressed in a general way due to lack of information. It was observed that each country/region MIREU has applied its own health security measures to prevent contagion and the spread of the disease and the times of application of the measures have also been different in each country/region therefore the effects are/will be also different, but as a conclusion it is important to emphasize that the effects on the mining and metallurgical projects affect a significant decrease in the turnover and benefits as well as internal labour adaptation measures, but above all to emphasize that the effects will be negative to a greater or lesser extent depending on the duration of the pandemic.

Following this first analysis, a specific webinar was held on 23 June 2020 to analyse this issue in greater depth. Under the title "OECD & MIREU: covid-19 on mining regions and cities", issues such as preparing mining regions and cities for the future – measures to improve resilience and the impacts of covid-19 in mining regions and responses. This virtual discussion served as a platform to share experiences and best practices by OECD and MIREU mining regions and cities in the context of the covid-19 crisis.

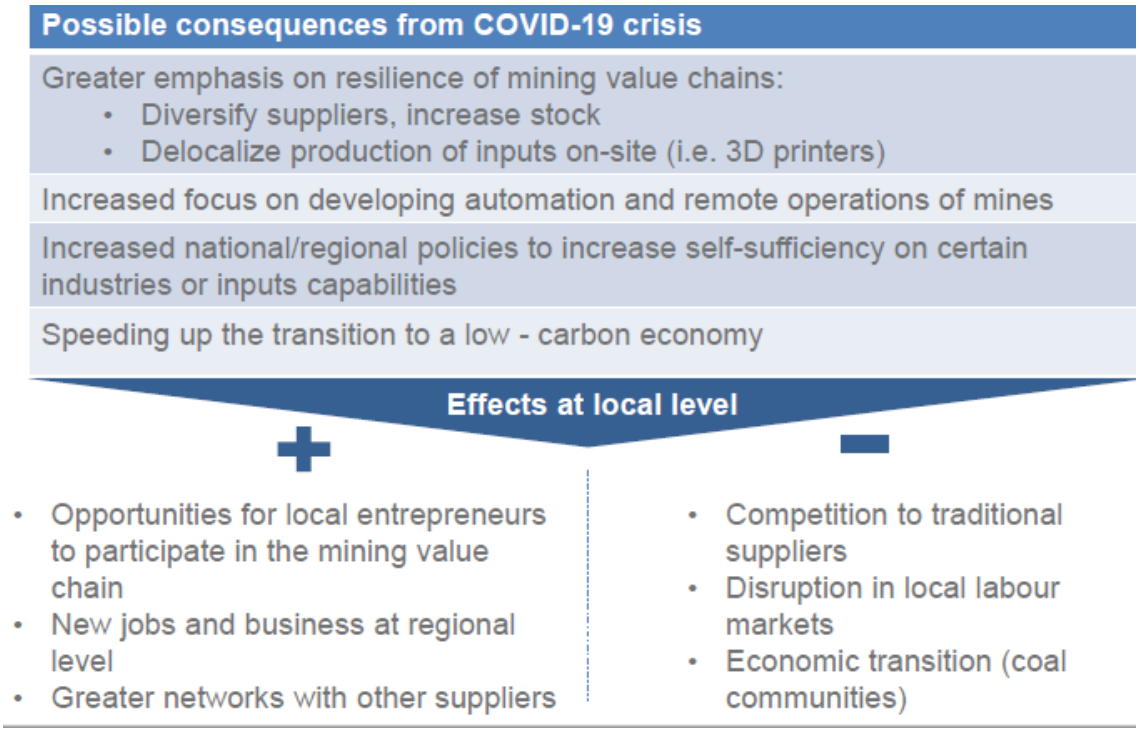


Figure 2: Possible changes in industry and policy decisions because of the COVID-19 crisis

The covid-19 impact's analysis on the M&M sectors of the MIREU regions, determines the following:

- Not yet significant impact on mining. Mining companies have performed quite well, manufacturing facilities continue producing and promoting remote working where possible.
- Mining companies invest in their current mining activities, instead of expanding.
- Growing impact on metallurgy and manufacturing, exploration and for the technology and service companies.
- Posing significant challenges to an increasing number of companies.
- One difficult scenario is the simultaneous infection of workers.
- Shifts have been organized or reduced to decrease exposure times and contact between colleagues.
- Requests for tenders and demand is decreasing.
- New orders and demand have decreased in metallurgy and mining related manufacturing but not in mining.
- Exceptions can be found, e.g. Metso declares increase in new orders.
- Difficulties to get payments due to customers financial issues.
- Postponement or total withdrawal of agreed orders.
- Unable to conduct work due to restrictions travelling, cancellations of visits, etc.
- Reduction in the presence of contractor companies whose services are not urgent or a priority right now.
- In mining impacts are mainly on new investments and expansion projects.

Several examples can be found in Ireland, Spain and Poland.
a) As a result of the lockdown both of Ireland's two operating mines went into care and maintenance:

- Boliden Tara Mines DAC zinc mine in Navan,Co Meath made the decision to reopen.
- Essential service due to the fact that they are a part of international value chains for raw material needed in a variety of industries, including the medical industry.

b) The Spanish mining industry is considered essential (e.g. Asturias, Castilla y León or Andalucía), as it is a supplier of raw materials irreplaceable for our society, even for making medical or sanitary devices. Therefore, the mines are producing at normal rate.

The process industries in Spain, aluminium, steel, chemicals, etc., are also essential and they kept activity, sometimes reduced but enough to not stop, of course having extra and full H&S measures to avoid COVID spreading.

c) In Lower Silesia (Poland), in rock raw materials and aggregates there is no influence, some mines have even hired new employees. In the company KGHM Polska Miedź S.A. the coronavirus pandemic has not yet had a significant impact on the group's production results. NITROERG, Capital Group of KGHM and producer of explosives, has started production of Nitrosept liquid for disinfection for the needs of the KGHM Group Mining Plants, other mining plants and for general use for sale.

On the other hand, the economic measures adopted by Europe to alleviate the crisis of the covid-19 are generalist:

- European Commission recovery plan: Next Generation EU: €750 billion as well as targeted reinforcements to the long term EU budget for 2021 2027 will bring the total financial support of the EU budget to €1.85 trillion.
- EIT Raw Materials Booster Call for businesses affected by the COVID 19 crisis to support the future recovery up to 200 000 € in funding per application.

The funds offered by European governments and regional authorities do not convince most small exploration and mining companies for the inadequacy and slowness of the process.

This immediate response supports the repair of the sector in the next 2 - 3 years but its recovery will be in the long term.

An example of financial support to the M&M sector is that of the Finnish government because GDP is projected to decrease by 5.5% in 2020, based on the assumption that restrictive measures will last for three months however, the uncertainty is much higher than normal. Finnish government amending budget proposal of additional 4.0 billion € in June 2020 includes a package of measures to support the economic recovery from the coronavirus situation, for example:

- 970 million € to support all business sectors.
- 300 million € to be used for the development of the battery cluster Suomen Malmijalostus Oy.
- 150 million € to strengthen the balance sheet of Suomen Malmijalostus Oy (state ownership in mining companies has been centralized in this company).
- 2 million € to the Geological Survey of Finland for use in the development of the GTK Mintec pilot plant complex.

However, European mining is essential for increasing the security of supply of many metals and minerals. One example is the Spanish mining industry, with the implementation of three measures that are essential for its recovery:

- Streamlining of permits and procedures for pending projects, taking into account the strategic essential nature of mining activity.
- Reduction of fiscal charges (local taxes, fees, etc.); creation of aid to support measures against the pandemic that the sector is already implementing and increasing the added value of the mining industry.
- Promotion of the use of metals produced in regions, like copper, considering its properties, such as antimicrobial, and promoting activities that consume copper: electric batteries, energy renewable, sanitary uses.

Regional Mining Authority in Andalucia -SGIEM has already initiated several processes to modify the regulations with an impact on mining. A new Decree has been approved to simplify the land use permitting process for mining industry.

Covid 19 pandemia is proven how fragile production chains are it offers good opportunity to show how essential the European mineral raw materials are for the society.

3.2 Ageing of the population and depopulation

Another social challenge in the MIREU regions is **ageing of the population**. Following a demographic study analysing parameters such as size, structure and demographic trends, population ageing can be confirmed in all MIREU regions except Västerbotten, where there is a decline in the overall average age of the population. Interestingly, the Saxony region has the oldest average age of the population, which will be 50,9 years in 2019. However, the other extreme is found in Ireland which has the youngest average population of the MIREU regions with an age of 37,6 years.

The confirmation of population ageing highlights the importance of being considered by governments as a priority to help reduce another related problem, namely **depopulation**. A steady decline in population is observed in nine MIREU regions, according to data extracted from Eurostat: Alentejo, Aragon, Castilla y León, Lapland, Lower Silesia, Maramures, North Karelia, Saxony and Sterea Ellada. However, an increase in population is observed in the other six MIREU regions: Andalusia, Cornwall, Ireland, Kosice, Styria and Västerbotten. In the case of Styria it is necessary to make the following assessment because although the increase in overall Styria is mostly due to its capital, Graz (automotive and other industries etc.), the districts of Northern Styria where most mining takes place, there are a decline of the population.

To tackle both problems, measures are recommended such as develop a strategy to involve the older working-age population in the economic development of the municipalities. Such a strategy should be aligned with the regional priorities and the work of institutions that aim to create new economic opportunities for the older population.

3.3 Education level

At **educational level**, the analysis carried out is limited to knowing the level of studies by age group at a given time, starting with tertiary education and ending with a doctorate. It is observed that only in one MIREU region is the number of students studying both tertiary education vocational/professional and bachelor, Master and Doctorate increased, which is the case of Ireland. However, in 5 MIREU regions there is a decrease in the number of students at the four levels of study mentioned: Kosice, Lower Silesia, North-West Romania, Northern and Eastern of Finland. The cause is not investigated but the population decline is a determining factor, not in

the case of Kosice. The increase in the number of Master's students at Sterea Ellada is noteworthy, in 2014 they had no students and in 2017 they reached 448.

This analysis has not been further developed in order not to repeat the information contained in the section "Educational and research capacity" developed for MIREU regions of the deliverable D2.2 "SWOT analysis of regions and valuation of mining heritage".

4 REGIONAL INFRASTRUCTURE AND ECONOMIC DEVELOPMENT OF MINING AND METALLURGICAL PROJECTS IN THE REGIONS

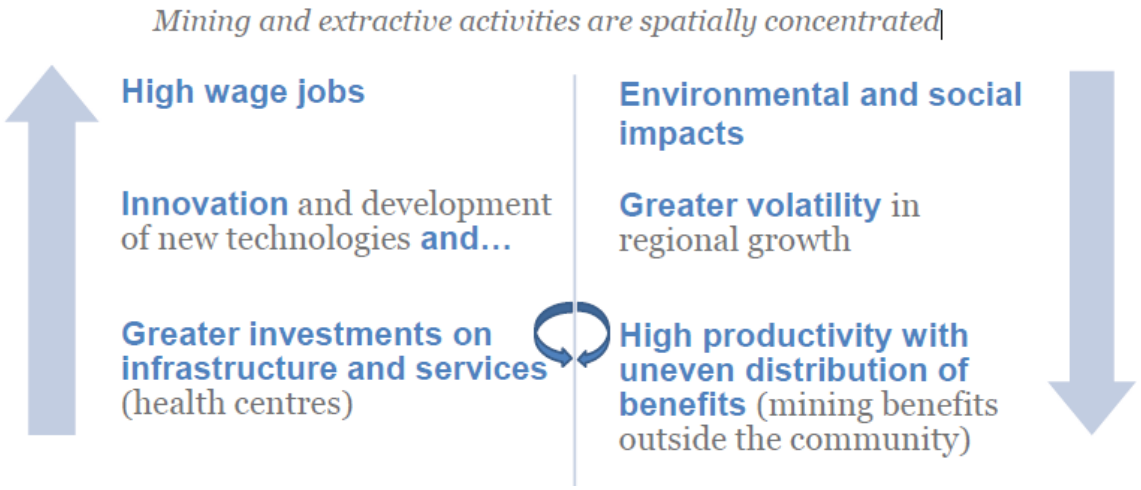


Figure 3: Relevance of mining for regional development

Given the importance of the M&M sector, the strengthening of mining clusters is essential for the implementation of measures to improve the operational environment for mining-related activities.

4.1 Economic data and labour market

In the analysis of the **economic data** of the MIREU regions an overview of the economic situation of each region is given to give way to regional economic aspects such as where the total GVA - all NACE activities, GVA Industry (without construction) and GDP are also detailed. An overall increase in all three parameters is observed in the MIREU regions during the years 2014 - 2018. However, the only region that shows constant annual variations and final decline in 2017 (latest available data) in GVA Industry is North Karelia.

The example is in North Karelia (Finland) through Business Joensuu. Strengthen programmes to boost small- and medium-sized enterprises (SMEs) and entrepreneurial culture. Actions for this are:

- Improve the link of entrepreneurs and SMEs in small rural municipalities to regional business development programmes. This involves enhancing local and international networks for SMEs to transition toward related higher-value economic activities connected with the green economy (Business Joensuu).
- Develop a strategy to strengthen an entrepreneurial culture by enhancing education programmes, improving information and mentoring and reducing the negative social consequences of business failure

We have also been studying the **labour market** where we analyse employment and unemployment levels from 15 to 74 years of age disaggregated by gender, but regardless of the measures that each government applies to promote employment in each region, it is important to highlight the importance of the installation of mining and metallurgy projects for employment, increasing the volume of hiring of the local and regional population and promoting the economic development of the area of intervention.

Measures for such employment projects can be to embrace a comprehensive strategy to attract and integrate high-skilled migrants in order to fill gaps in the labour force demand and boost local business and improve programmes and regional co-ordination to enhance vocational, language and information technology (IT) training to increase workforce suitability with the current and future needs of the m&m sector.

4.2 Economic aid

Reference is made to **economic aid** to the mining-metallurgical sector but without going into detail because this point has already been analysed in deliverables D5.1 and D6.2. of MIREU. Enhance interregional co-operation on smart specialisation and green mining technologies by promoting joint projects on research and innovation with other regions and supporting the internationalisation of local businesses is a measure that helps to attract economic aid to the regions. On the other hand, the European Commission has adjusted its Work Programme for 2020 to propel Europe's recovery and resilience. To ensure the recovery is sustainable, even, inclusive and fair for all Member States, the European Commission is proposing to create a new recovery instrument, Next Generation EU. Next Generation EU of €750 billion as well as targeted reinforcements to the long-term EU budget for 2021-2027 will bring the total financial firepower of the EU budget to €1.85 trillion. The money raised for Next Generation EU will be invested across three pillars:

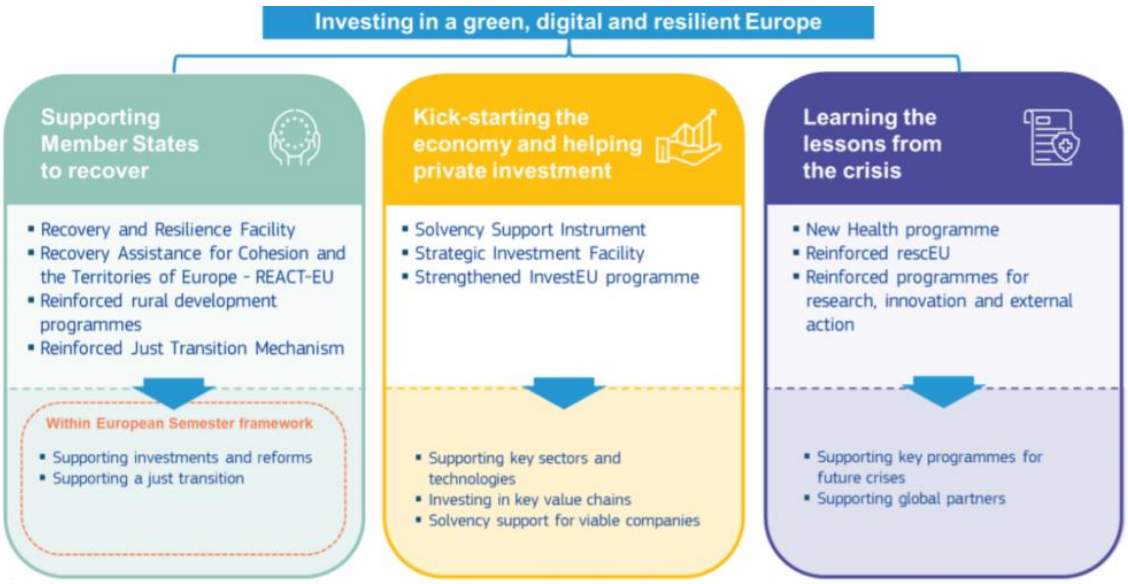


Figure 4: Three pillars of the Next Generation EU[1]

More info linked to this topic is discussed in section 6.

4.3 Influence of geographic location

Another important aspect is referred to the **influence of geographic location** of M&M projects on regional infrastructure, where aspects such as their geographic location have been observed: environmental factors (climate), logistics or transport infrastructure, proximity to aquatic areas such as rivers, lakes and/or seas, proximity to environmentally protected areas, proximity to urban

[1] Source: https://watereurope.eu/ec-unveils-e750-billion-recovery-plan-next-generation-eu/

centres, proximity to border areas, proximity to centres consuming these raw materials. These aspects have been put in relation to the infrastructure of the most relevant entities of the M&M sector in MIREU regions, which have been compiled from the deliverable D5.1. named "Strategic analysis of EU regions and mining potential and opportunities within their RIS3".

In general, all these aspects have an impact on the M&M projects, which are usually located in areas close to rural centres where they have access to the necessary infrastructure for their installation and development after having carried out the relevant explorations, having the viability of the projects and the operating licences. In addition, as the development of the projects progresses, investments are observed for the extension of their own infrastructures and environmental restoration. This leads the governments of the area and/or regions to also develop a greater number of infrastructures for the area, above all to favour the logistic aspect, to promote entrepreneurship by favouring the creation of auxiliary and/or indirect companies and in certain cases also to promote tourism (visits to closed mining operations, holding of musical and sporting events) since all this has repercussions on the greater economic development of the region. In the case of tourism, a recommendation would be to enhance partnerships with stakeholders involved in mining tourism and expand the offer of thematic events.

4.4 Customers and markets

The last aspect dealt with was that of **customers and markets**, where each of the most relevant entities of the M&M sector in MIREU regions was studied: the type of raw materials and metals extracted, resources and reserves, products, type of customers and markets of destination (sectors), market share and the volume of exports, where we can see the important capital that these companies move and that directly affects the area/region of intervention thanks to the employment generated, the infrastructures created, the attraction of tourism, the creation of auxiliary companies and in short the economic development of the region.

Measures to enhance it can be to conduct a flagship project for mining activities (e.g. testing of tailings for mines in cold temperatures) to align and spur commercial partnerships among established industries. In the case of Finland, this should involve an active role from the Geological Survey of Finland (GTK), local firms and the University of Applied Sciences in Joensuu (Outokumpu Municipality and Business Joensuu). Also develop a clear mining brand for the region and a strategy to promote it internationally.

However, all this contrasts with the opposition to the M&M sector due to the risks involved, which include the loss of the ecosystem, air and water pollution or health risks, especially in the case of open-cast mining operations, which due to this change in the production model that destroys the agricultural and livestock fabric, accelerates the depopulation of the affected territories.

It will be necessary for the existing legal frameworks to be respected by all actors and for legal certainty to be guaranteed for all parties so that mining projects are implemented in accordance with these frameworks from the exploration stage to the final restoration of the land in order to obtain greater protection of the environment and of the people who could be affected by these mining projects and support the regional mining strategy by building a network of experts to support innovation and higher-value-added activities in the sector.

Dimension	Policy objective	Action areas (examples)
Competitiveness and diversification	**Producing more value in extractive industries**	Long-term planning for regional infrastructure networks, moving up in GVC.
	Diversifying into other economic activities	Upscaling suppliers/SMEs, supporting clusters, green technologies and services
	Preparing workforce for technological change	Life-long learning for workforce, matching curriculum with future industry needs
Quality of life and attractiveness	**Enhancing local quality of life**	Improving broadband quality and accessibility, quality of services, land-use coordination, environmental impacts
	Making growth more inclusive	Entrepreneurship support for women, young and Indigenous peoples Integrating elderly population in local economy.
Regional governance and public investment	**Making the most out of fiscal transfers and benefit-sharing mechanisms**	Linking planning and budgeting (multi-year planning), developing framework for monetary and non-monetary benefit-sharing
	Developing collaborative institutions for development	Developing a common vision and priorities for regional innovation
	Integrating planning and community engagement	Strengthening mechanisms of dialogue and consultation, transparency and urban-rural linkages

Figure 5: Integrating mining with regional development for a resilient future of communities and environment[2]

[2] Source: OECD (2016) Mining regions and their cities: scooping paper http://www.oecd.org/regional/regional-policy/Scoping-paper.pdf

5 BEST PRACTICES REGARDING RIS3

A series of very interesting conclusions have been reached for the Project considering the benchmarking table in which the majority of the MIREU regions are potential candidates for the promotion of intersectoral interaction and comparing each of the regions of the ***D.5.1. Deliverable Strategic analysis of EU regions and mining potential and opportunities within their RIS 3***. Below is a summary of how these regions include mining and metallurgy within their strategic priorities and what are the main activities that should be improved in each of them.

Västerbotten (Sweden)

Mining and metallurgy are part of the Västerbotten RIS3 priority "Technology and service development for industry. Mining and metallurgy is one of the areas in which technologies and services have to be developed. In addition, the exploration phase should be included in it RIS3 priorities.

Andalusia (Spain)

Mining is part of the RIS3 priority, endogenous territorial-based resources "Natural resources management" priority. In addition, Andalusia has published two regional policies concerning mining and metallurgy sectors, the Andalusia Mining Strategy 2020 and the Andalusia Industrial Strategy 2020. In the case of Andalusia, there is a gap within its priorities regarding the administrative and legal issue and its relationship with access to mineral resources. Its priorities deal mainly with the exploitation phase and policies to reinforce the transformation and treatment of raw materials could be favoured.

Castilla y León (Spain)

In the case of Castilla y León, mining appears in its thematic priority 4: "Natural Heritage, Cultural Heritage and the Spanish Language, and endogenous resources as basis of the sustainability of the territory" in the Action Area "Mineral raw materials". As in the case of Andalusia, Castilla y León, the exploration phase does not complete, neither does the administrative or social issue. Furthermore, there is no specific plan in the Community for mining and metallurgy.

Lapland (Finland)

Mining is part of the latest Lapland RIS3 2018-2022 strategy: "Lapland: and Artic and international highflier. The Strategic Priorities for International Smart Specialisation 2018-2022. The current thematic priorities are: TP1. Advanced Artic business – foundation for the growth., TP2. Artic expertise, renewal and innovations strengthening the growth and international business activities., TP3. Regional ecosystem as the base for internationalisation. Within these priorities, the exploration and exploitation phases are not addressed. No mention is made of metallurgy or mining heritage. Finally, administrative / legal issues are not addressed when accessing resources, nor are social issues.

Lower Silesia (Poland)

Mining and metallurgy are part of the Lower Silesia RIS3 priority "Raw materials and recyclable raw materials/Natural resources and recyclable materials". In this case, the creation of companies in the mineral processing / treatment sector can be favoured since most of the companies in this region belong to the extractive sector. There are no facilities in the scientific field of smart specialization. A priority could be included to provide greater promotion of the region's mining sector. Administrative procedures are tough and there is great legal instability. Transport

infrastructures must improve considerably. Poor intellectual protection. Improve the application of national and regional policies according to the market.

North Karelia (Finland)

Mining is part of the S3 priority in North Karelia. It is covered by the S3 priority: Technologies and Materials. The mining exploration stage is not covered, nor is anything on the topic of mining heritage.

Alentejo (Portugal)

Mining is part of the priority of the Alentejo RIS3, "Mineral, Natural and Environmental Resources". Further implementation of the regional monitoring and consolidation of the RIS3 governance system is necessary. Establish environmental management strategies to recover mining legacy. More emphasis could be placed on processing and treatment techniques to optimize these processes. Mining heritage is also missing and should be included.

Saxony (Germany)

Mining and metallurgy have the potential to be part of the Saxony RIS3 priority (technical support priority) "Advanced production technologies". Greater inter-ministerial coordination of strategies and implementation programs. Include a timeline or roadmap or budget. Consider more strongly the existing local strength in the raw materials sector throughout the value chain and promote research in resource efficiency and circular economy.

Sterea Ellada (Greece)

Mining and metallurgy can be seen in the S3 priorities: Metals and materials and Metals and their industrial processing. In this case there is a great environmental problem since the city is tourist, there is no social acceptance, there are severe environmental problems that are attributed to metal processing activities. Lack of public awareness of the need to use and exploit mineral resources to meet energy demand.

Aragón (Spain)

Mining and metallurgy are not part of the Aragón RIS3 but they have the potential to link to the S3 priority: Resources efficiency. Lack of public awareness of the need to use and exploit mineral resources to meet energy demand. Current policies focus exclusively on renewable energy, leaving the mining industry aside. Positive education for mining. There are no regional public funds to address the lack of mining activity.

Košice (Slovakia)

In the Slovakia national RIS3, metallurgy is included in the chapter of "Areas of economic specialisation" based on traditional sectors, due to its contribution to increasing domestic value-added products through improving production process. The strategy should include metallurgy as it is recognized as one of the main factors of industrial development in the region. Include companies / clusters in the sector. It does not say anything about the exploration part that is the base of the mining life cycle. Nor on the social issue.

As general conclusions, the following can be highlighted:

- ✓ There are four regions that do not include mining and metallurgy in their RIS3.
  - Cornwall and Isles of Scilly
  - Ireland
  - Styria
  - North-West (Maramures)

- ✓ Regarding these regions, in Cornwall and Isles of Scilly there is currently no mining and metallurgy relevant policy/strategy/plan at the national level, only legislations, and in Styria raw materials sector is also not mentioned in the regional development strategies.
- ✓ The aspects that should be taken into account for future regional actions and strategies are:
    - Social involvement of all social agents in mining and metallurgy.
    - Establish a clear legal and administrative framework in each of the stages of mining and metallurgy.
    - Include optimization strategies and good practices in processing and treatment activities.
    - Establish action policies in the exploration stage, including specific areas regarding mining research methodology, mining exploration techniques and tools.

6 R&D INVESTMENTS AND ESIF FUNDS ROADMAP

Deliverable 6.2 of MIREU project was oriented to feed MIREU's networking regions with a thorough knowledge of the funding schemes for mining and metallurgy industries, with a focus on research and innovation funds. To this end, the report provided information about the Multiannual Financial Framework (MFF) 2014-2020 European Union (EU) funding opportunities, including information about what kind of funds are available and how they are managed and delivered.

This study revealed that the MIREU regions have different levels of research and innovation (R&I) with some having better performance and higher intensity than others. The following conclusions were drawn:

Regarding ESIF national level data

- The EU contribution from ESIF allocated to the regions and countries is directly related to the country's 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.

Regarding 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.

Regarding 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 most 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 most of the participant type are Demo Sites.
- 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.

6.1 Analysis of EU funded projects targeting mining and metallurgy

D6.2 report also analysed EU funded projects targeting mining and metallurgy in MIREU regions, allowing for a deeper understanding on how EU funding instruments are being applied in these regions. The main conclusions in this regard were the following:

Regarding the number of projects and starting dates:

- 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.
- Most of the projects started in and after 2016 and only two have started in 2014.

Regarding the participant type:

- In the sampled projects, participants can be partners and/or projects coordinators.
- Most 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, most of the projects are coordinated by research organisations and higher or secondary education establishments, although some coordinators may not belong to MIREU pilot regions.
  - In ESIF most 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.

Regarding MFF 2014-2020 Money distribution:

- Regarding the programme's 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:
    - 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.

Regarding value chain and R&I and TRL relationship:

- Most 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.

Regarding 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, despite important ongoing EC projects that match RIS3 priorities with major regional stakeholders, the knowledge is not located in the region and for the use of other EU funding programmes there is the need to capacitate the stakeholders.

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.

6.2 Mining projects funded through FI (EIB)

A search for major European projects using FI was conducted in EIB database, related to mining and metallurgy activities. Eight projects were found occurring 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 "Public bodies". The value chain categories covered by these eight EIB projects are mainly Extraction & Production. There are no EIB projects for Exploration or Policy & Network. 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.

6.3 Conclusions

The available funds represent a great opportunity for Mining and Metallurgy EU Regions, but as shown in D6.2, 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 is small. 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 shows that the use of FI are drivers to increase R&I.

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 with 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. In addition, to 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 it is possible to get funds for mining and metallurgy projects in several EU instruments and for the entire value chain from exploration to sale and export and mainly in 1-6 TRL stages.

Mining and Metallurgy challenges and needs clustered in categories

The following list accounts for the main challenges in mining and metallurgy found in D6.2 report and clustered in thematic categories. These results aligned well with the high-level workshop report included also in this deliverable.

Industry 4.0

- Improve geochemistry and geophysics exploration methods and integrate 3D/4D modelling
- Improve systems to collect and predict orebody and rock information
- Improve facilities architecture
- Enhance digitisation, automation and optimization of processes
- Improve efficiency in all value chain
- Develop the concept of biomining, bio metallurgy 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 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

7 THE ROLE OF CLUSTERS AS DRIVERS OF INNOVATION IN REGIONAL ECOSYSTEMS

The effect of clustering and networking among SMEs have been proved fundamental to boost SMEs' competitiveness. SMEs usually face two main challenges when dealing with the global landscape: how to evolve and increase their individual competitiveness and, due to their limited size, how to take advantage of synergy effects by entering into cooperative relations with other SMEs and related partner institutions. Clusters are instrumental to overcome these two challenges.

That is why many EU countries and regions have promoted the development of industrial clusters where companies can develop competences and competitive advantage against global competitors by sharing resources, innovative capabilities and knowledge. In this context, the role of clusters consists on removing obstacles, lowering constraints and ameliorate inefficiencies. If cluster-based economic development is properly implemented, it can provide the grounds for sustainable economic growth and prosperity.

Most of the benefits of clustering derives from its ability to concentrate economic activity in a particular location[3]. At the end of the day, **geographical concentration of certain economic activities** is key for regional development, as they bring together suppliers, buyers and exporters, government institutions, business associations and providers of business services and agencies that support clustered enterprises in fields such as product development, technology, marketing information and production process improvement.

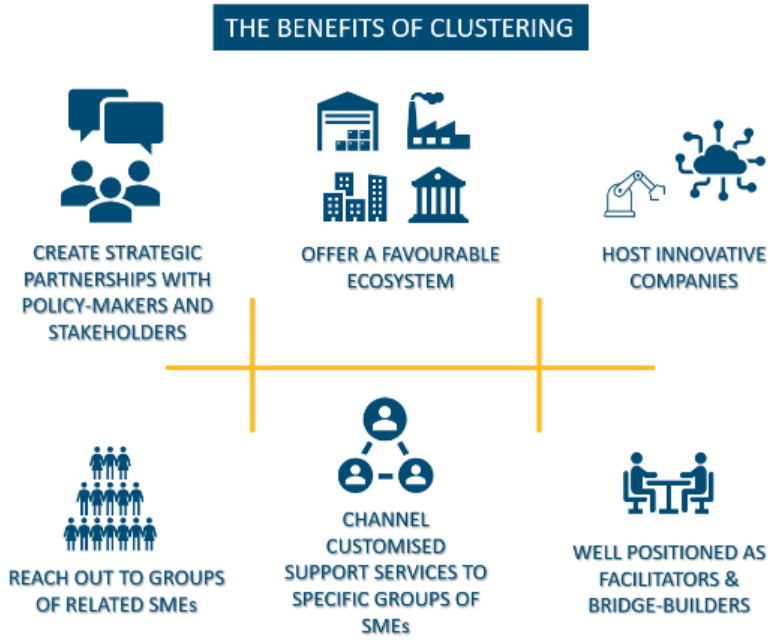


Figure 6: Benefits of clustering and networking in regional ecosystems.

SMEs are regarded as one of the main driving forces of economic development, stimulating private ownership and entrepreneurial skills. They are also crucial for sustained, long-term growth, dynamism and employment. They generally employ the largest percentage of the workforce and are responsible for income generation opportunities. In many EU regions, the SME

[3] C. Mason, T. Castleman and C. Parker, "Communities of enterprise: developing regional SMEs in the knowledge economy", Journal of Enterprise Information Management, vol. 21(6), pp. 571-584, 2008.

sector can be a strong pillar of support for regional and economic development since it provides a means for the mobilization of a region's resources.

This is especially true in the **EU raw materials and mining sector**, where domestic extraction of construction and industrial minerals has steadily decreased since 2008 economic crisis, partly due to large mining companies concentrating their production in countries with low levels of governance and partly due to lack of access to financing of junior mining companies unable to increase their productivity and go beyond exploration phases without further investments. This is particularly severe in an industry, the EU mining and quarrying, where 18.952 out of 19.237 (98,5%) enterprises are SMEs accounting for 35,5% of the people employed in the sector[4].

The contribution to innovation of SMEs should not be underestimated. SMEs have considerable comparative advantages over large enterprises, which enable them to respond more quickly and effectively to changing environments and global trends. Most SMEs have simple systems and procedures, which allows flexibility, immediate feedback, short decision-making chains, better understanding and quicker response to customer needs than larger organizations.

However, **scarcity of resources continues to be one of the main problems and typical characteristic of SMEs**. Individual SMEs are often unable to capture market opportunities that require large production quantities, homogeneous standards, and regular supply. Also, they have difficulties in achieving economies of scale in the purchase of inputs, such as equipment, raw materials, finance, consulting services, etc. Moreover, small size also constitutes a significant hindrance to the internalisation of functions such as training, market intelligence logistics and technology innovation. It can also prevent the achievement of specialised and effective internal division of labour, which fosters cumulative improvements in productive capabilities and innovation. Finally, because of their low profit margins, small-scale entrepreneurs are often locked in their routine and unable to introduce innovative improvements to their products and processes, or to look beyond the boundaries of their firms to capture new market opportunities.

This is the main reason why **SMEs can benefit greatly from being linked into national, regional and global networks** of companies and value chains, as this can help them to overcome the inherent limitations with regard to economies of scale and scope imposed by their size and frequent isolation.

In this context, **clustering is one of the most useful strategies for SME development**, as it means geographic concentration of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions in a particular field that compete but also cooperate. We understand clusters here as a geographically bounded concentration of similar, related or complementary businesses, with active channels for business transactions, communications and dialogue that share specialised infrastructure, labour markets and services, and that are faced with common opportunities and threats.

The following table analyses some of the most remarkable benefits from clustering and their rationale:

BENEFIT OF CLUSTERING	RATIONALE
ACCESS TO KNOWLEDGE AND INFORMATION RESOURCES; GENERATION OF KNOWLEDGE	Due to geographical proximity, communication between cluster members is strengthened and exchange of knowledge and dissemination of new knowledge is intensified
ENHANCE COMPETENCES AND GENERATION OF COMPETITIVE ADVANTAGES	Encouraging learning and innovation leads to the development of sustainable competitive advantages

[4] Eurostat, key size class indicators, mining and quarrying (NACE Section B), EU-28, 2016.

CREATE SYNERGIES	The sum of the components is of greater value than each individual company or institution
LOWER PRODUCTION COSTS	Cluster members are able to reduce costs and improve the level of service to their customers
ENHANCING ORGANIZATIONAL PERFORMANCE AND INNOVATION	The differentiation that evolves within firms in the cluster is likely to increase variety, which has been shown to enhance profitability, learning, and innovation.
REGIONAL AND NATIONAL ECONOMIC DEVELOPMENT	Cluster approach upgrades capabilities leading to the development of sustainable competitive advantages and to the stimulation of regional economic development
A POOL OF SUPPLIERS OF RAW MATERIAL, EQUIPMENT AND SPECIALIZED SERVICES	With clustering, firms achieve the economies of scale in the purchase of inputs, such as equipment, raw materials, finance, consulting services, etc.
A POOL OF SPECIALISED LABOR	Agglomeration of enterprises engaged in similar or related activities brings advantages such as a pool of specialised workers and easy access to suppliers of specialised inputs and services.
LOW-TRANSACTION COSTS	Inter-organizational trust is likely to enhance collective learning when it encourages the sharing and disclosure of organizational information and knowledge and reduces transaction costs.
FORMATION OF LOCAL SUPPORTING INSTITUTIONS	The existence of a cluster also stimulates formation of local supporting institutions oriented towards satisfying specific needs of the cluster participants.
ESTABLISH CO-OPERATIVE LINKAGES BETWEEN COMPANIES	Proximity helps to establish co-operative linkages between companies through enhancing mutual learning and knowledge creation
HIGHER SPECIALISATION	High concentrations of SMEs, both from the supply and demand sides as well as cluster support institutions, can contribute to high levels of specialisation.

Table 1. Most important benefits from clustering. Adapted from M. Zeinalnezhad (2010).

Industrial clusters have become privileged innovation systems due to their potential for collective learning local knowledge. More importantly, they have a key role also in cross-sectoral and cross-regional collaboration, as they:

- Bring different competences and business cultures together
- Enable flexibility in labour, production and demand
- Offer opportunities for multidisciplinary discoveries and innovation
- Shape new products, value chains and industries
- Diversify specialisation patterns that are more likely to boost economic prosperity

At the moment, a variety of platforms and institutions represent the interests of industrial clusters and promote their development and interaction. One of the most remarkable platforms is the European Cluster Collaboration Platform[5] (ECCP), which is a service facility aiming to provide cluster organisations with modern tools and aloe them to:

- Make efficient use of networking instruments, such as search/find potential partners and business opportunities.
- Develop transnational collaboration (within Europe) and abroad (beyond Europe).
- Support the emergence of new value chains through cross-sectorial cooperation.

[5] https://www.clustercollaboration.eu/

- Access the latest quality information on cluster development.
- Improve their performance and increase their – as well as their members' - competitiveness.

ECCP services include a dynamic mapping of over 1000 profiled cluster organisations worldwide (as depicted in the image below); the largest information hub for clusters offering latest news/events/open calls to a broad community; matchmaking events supporting the development of cooperation between clusters in Europe and beyond; a unique database on regional, national, international and sectoral cluster networks; detailed information on the European Strategic Cluster Partnerships and many more.

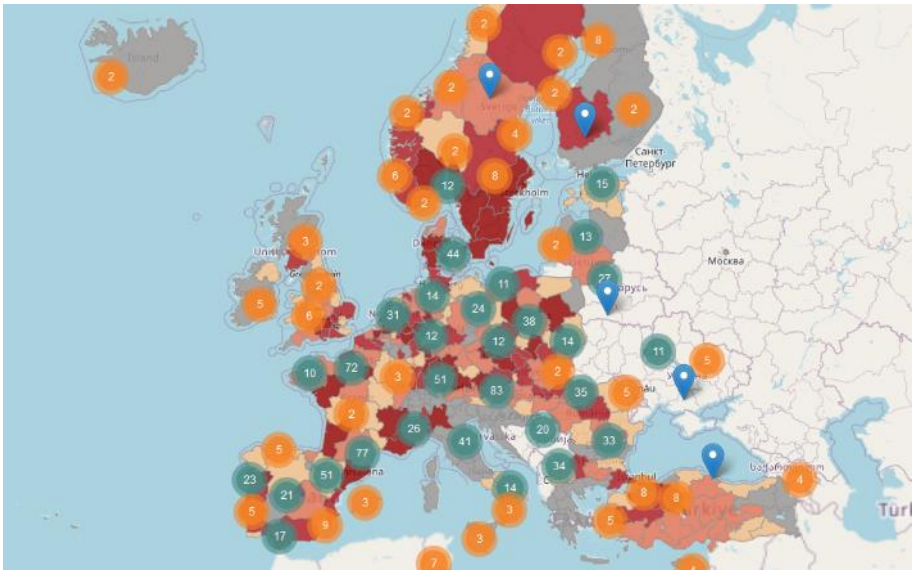


Figure 7. Map of EU clusters from different sectors and regions. Source: ECCP.

In the following section, we will make use of the ECCP's database of European clusters to identify key industrial ecosystems in the MIREU regions, accounting for more than 20 different industrial sectors and more than 130 cluster organizations.

7.1 Identifying key clusters and regional innovation hubs in MIREU regions

In this section, a thorough analysis of the relevant industrial ecosystems in the MIREU regions is developed. It has been largely demonstrated that innovation is most likely to happen at the frontier between industries and disciplines. Innovation ecosystems grow in symbiosis, not in isolation. Thus, in order to ensure that European mining improves its productivity and meets the huge demand of raw materials in the coming years, partnering between mining companies and technology providers must be promoted, and mining companies must look beyond the boundaries of the mining industry to seek inspiration from other sectors.

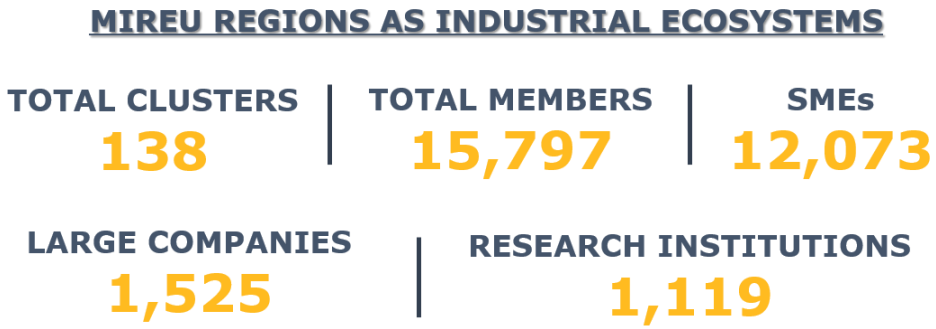
Only by interlinking companies of different sectors, new and reconfigured value chains will be created, acting as a source of competitive advantage for all the actors involved. Clusters play a major role in creating these informal exchanges and organised interactions across value chains and industries. The wide range of industries and activities covered by MIREU regions ensure a knowledge sharing environment, enabling SMEs and other stakeholders' cooperation to exploit the above-mentioned business opportunities in order to create value in the mining industry.

Through joint actions, clusters can drive innovation and contribute to stimulate regional economic development.

The formal industrial clusters of the 15 MIREU regions and their immediate neighbouring areas were studied, including technology fields, smart specialisations, sectors of interest and emerging industries. In addition, an account for the number of entities (including total members, SMEs, large companies and research centres) has been carried out for all the regions involved, highlighting the most representative clustering industrial sectors in each region.

This work is to build a dense network of expertise with the potential to create and/or reinforce industrial value chains from the very beginning, by cross-linking technology providers and adopters in the benefit of both sides, the raw materials and mining sectors on one hand and on the other hand, ICT, biotechnology, advanced manufacturing, advanced materials, e-health, agrofood, maritime, automotive, aeronautics…

As a result, a set of 138 clusters have been listed, accounting for 15,797 members, 12,073 SMEs, 1,525 large companies, 1,119 research centres and 20 sectors of specialisation, as depicted in the figure below:



20 INDUSTRIAL SECTORS PRESENT IN MIREU REGIONS

SECTORIAL CAPABILITIES OF MIREU & NEIBOURING REGIONS

Using the information gathered above regarding the industrial ecosystems present in the MIREU and neighbouring regions, a series of sectoral maps have been created accounting for the technological capabilities available in the different regions than can enrich cross-sectoral, cross-regional cooperation among clusters. The following pictures show MIREU and neighbouring regions capabilities according to the main sectoral clusters present:

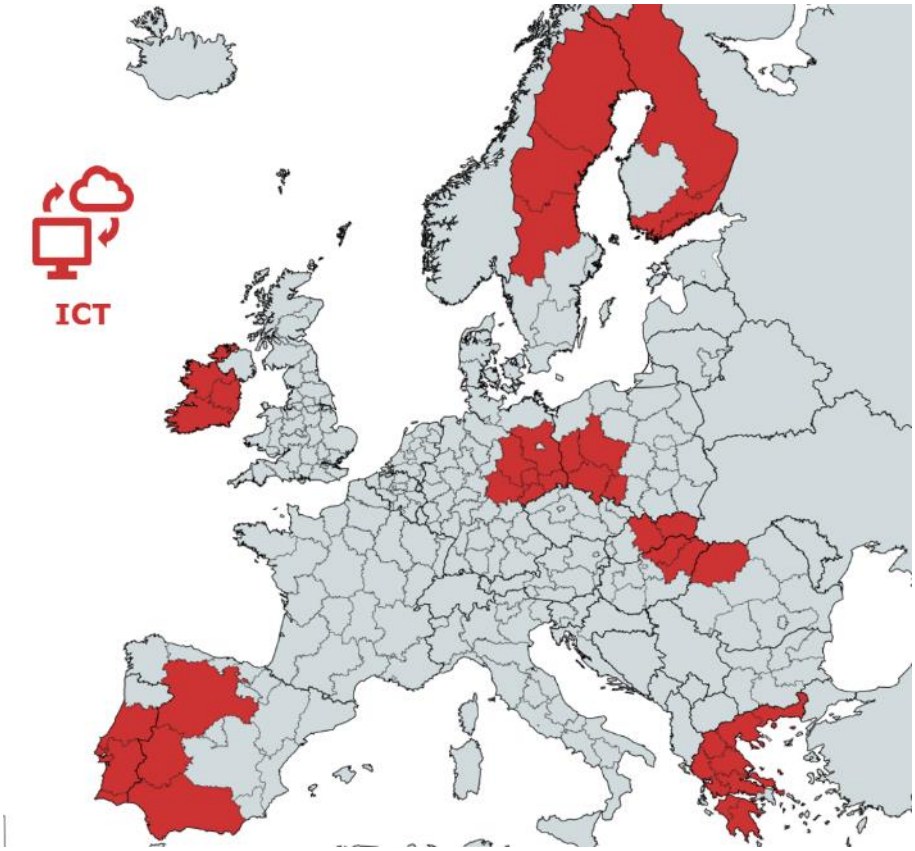


Figure 8. MIREU and neighbouring regions where ICT clustering ecosystems are present.

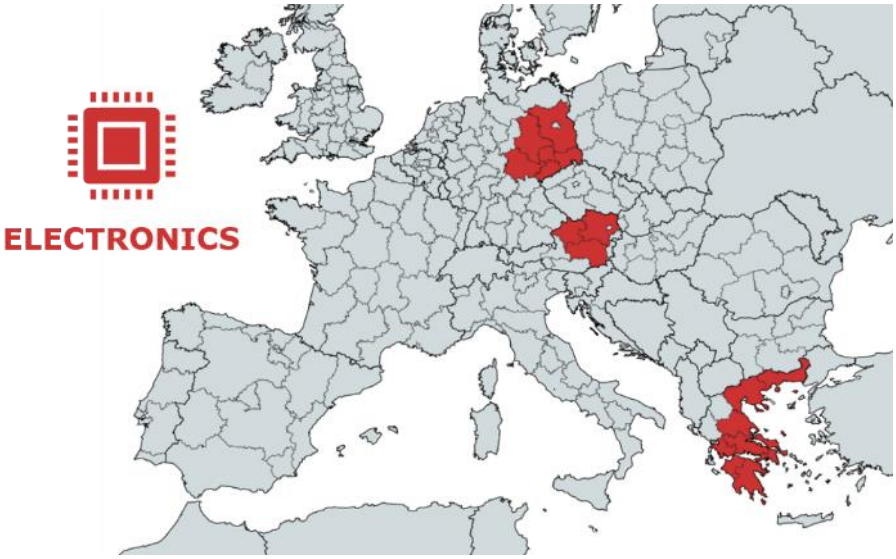


Figure 9. MIREU and neighbouring regions where Electronics clustering ecosystems are present.

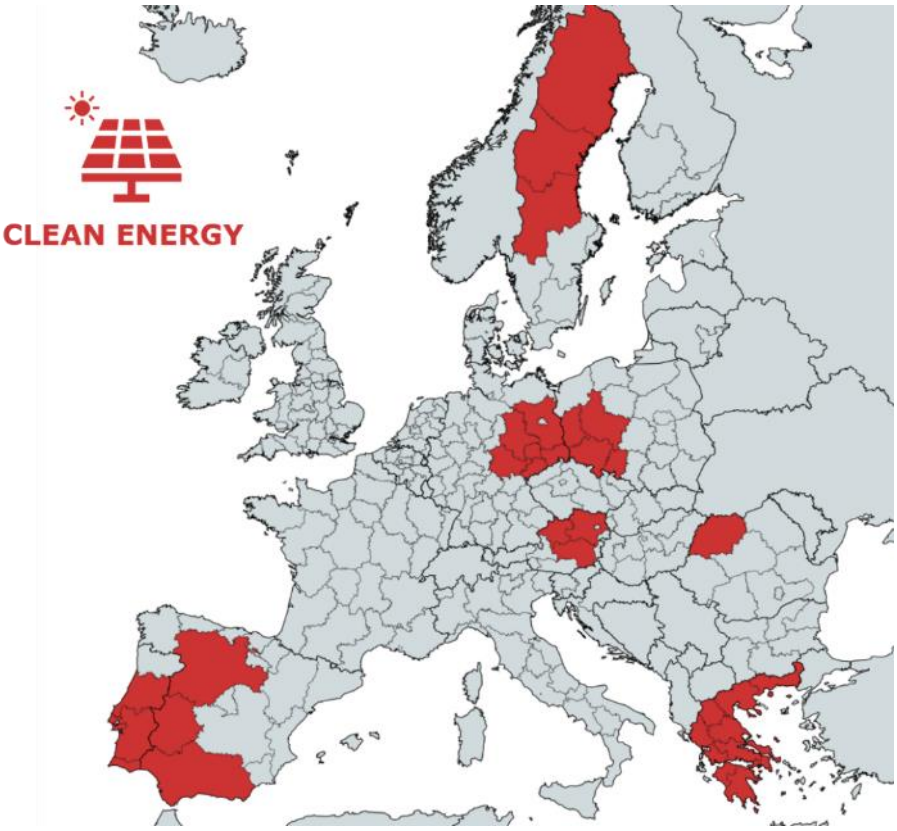


Figure 10: MIREU and neighbouring regions where Clean Energy clustering ecosystems are present.

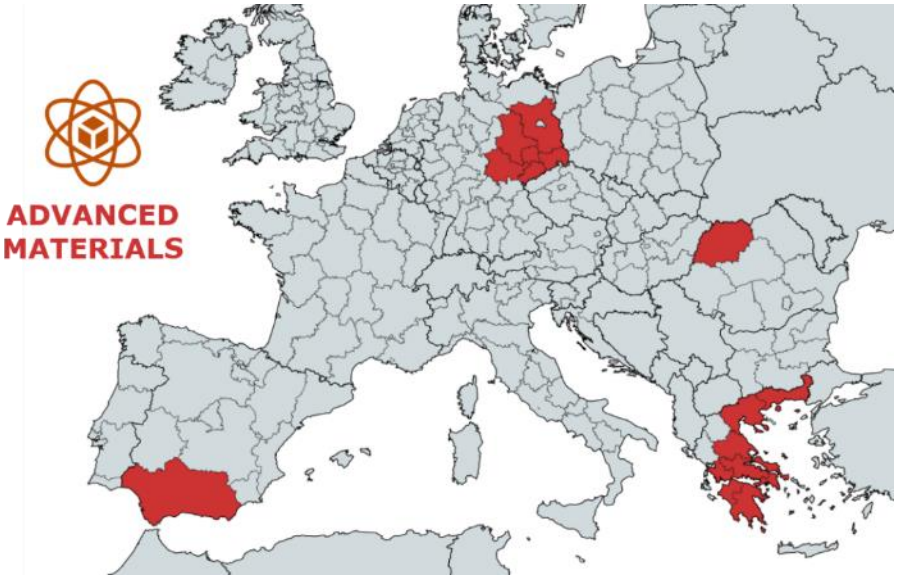


Figure 11: MIREU and neighbouring regions where Advanced Materials clustering ecosystems are present.

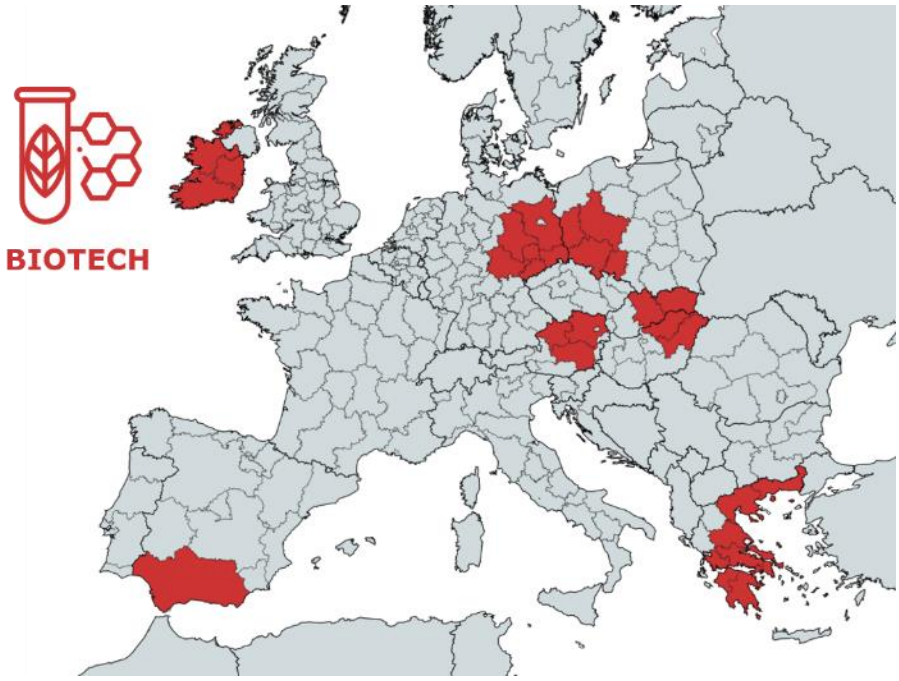


Figure 12: MIREU and neighbouring regions where Biotech clustering ecosystems are present.

Figure 13: MIREU and neighbouring regions where Transport clustering ecosystems are present.

Figure 14: MIREU and neighbouring regions where Automotive clustering ecosystems are present.

Figure 15: MIREU and neighbouring regions where Mining & Metallurgy clustering ecosystems are present.

Figure 16: MIREU and neighbouring regions where Food clustering ecosystems are present.

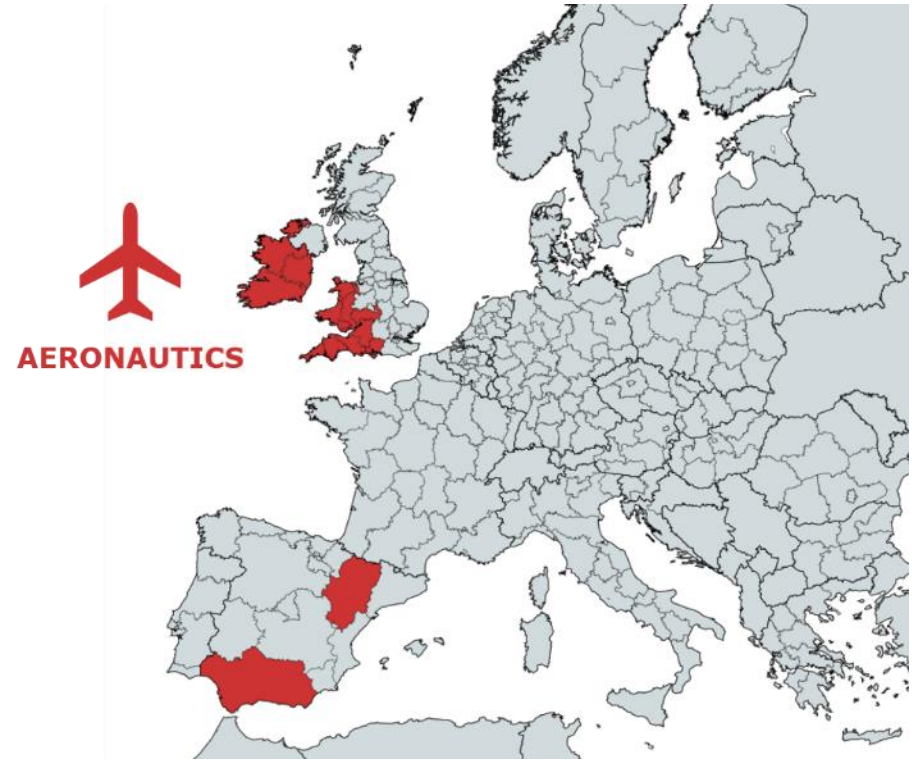


Figure 17: MIREU and neighbouring regions where Aeronautics clustering ecosystems are present.

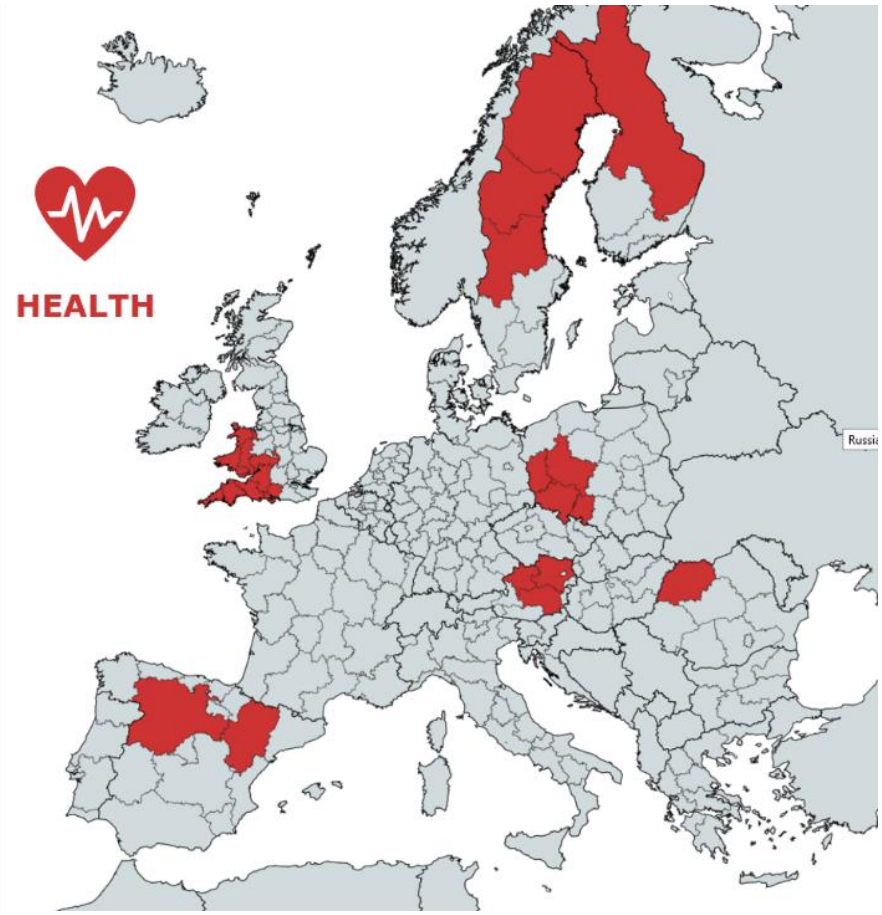


Figure 18: MIREU and neighbouring regions where Health clustering ecosystems are present.

Figure 19: MIREU and neighbouring regions where Green Technologies clustering ecosystems are present.

7.2 MINE.THE.GAP: a success story of clustering to promote innovation in the raw materials and mining sectors

H2020 MINE.THE.GAP project is an Innovation Action (IA) belonging to the programme call H2020-INNOSUP-2019 for a better innovation support of SMEs. The project, which was granted at the beginning of 2020, aims at the creation and integration of novel industrial value chains for SMEs in the raw materials and mining sectors through innovation support and services provided by the ICT, circular economy, resource efficiency and advanced manufacturing sectors.

MINE.THE.GAP is a good example of how clusters can be the main drivers of innovation in their regional ecosystems. By developing **a cross-sectoral, cross-regional exercise**, the objective of this project is to adapt the raw materials and mining sectors to current trends and technologies, promoting industrial modernisation and digitalisation by embracing, interacting and profiting from other emerging industries. The activities are specifically addressed to SMEs, who lack the financial potential of major companies to start innovative projects.

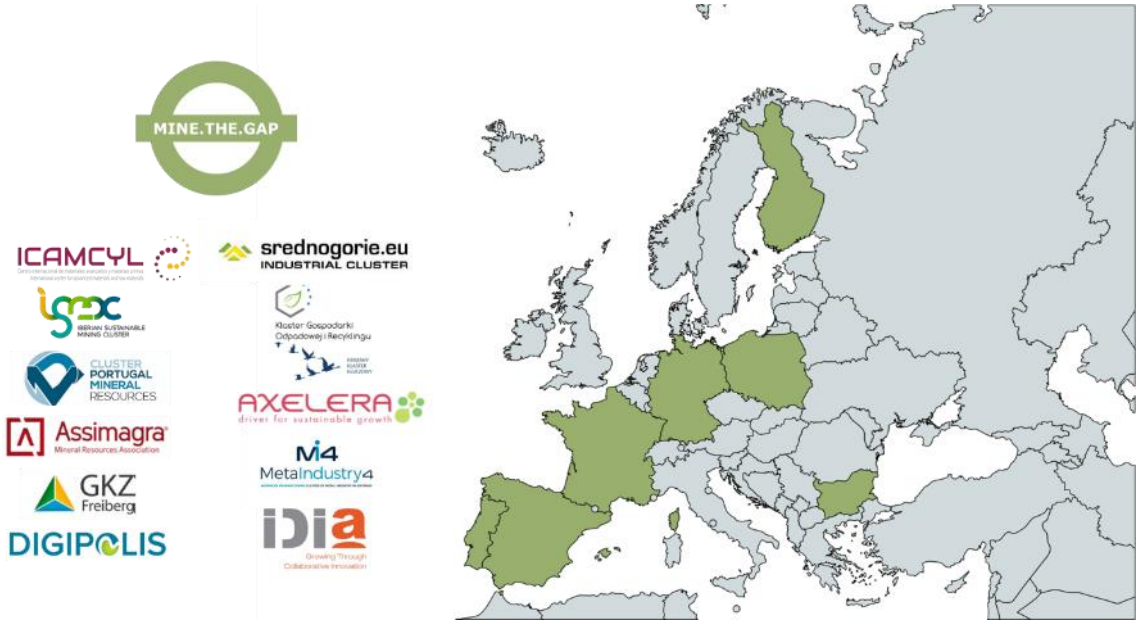
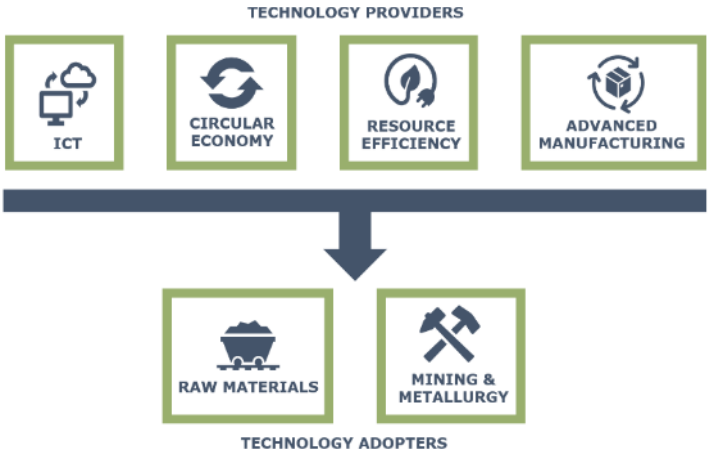


Figure 20: MINE.THE.GAP Consortium and the EU countries they represent.



MINE.THE.GAP Consortium includes **9 industrial clusters from 7 EU countries** (Germany, Bulgary, Finland, France, Poland, Portugal and Spain) **representing 6 different sectors.** These sectors have been split into two broad groups: the 'target' sectors, including the raw materials, mining and metallurgy sectors (and their associated services) and the 'providers' sectors, including the ICT, circular economy, resource efficiency and advanced manufacturing sectors. Altogether, the clusters of the consortium account for **more than 1,000 members and 500 SMEs**.

Furthermore, more than 50% of European SMEs in the target sectors are represented by the countries participating in the project, therefore building upon the innovation potential of these SMEs to foster industrial cooperation and development of added-value products and services.

Another key feature of MINE.THE.GAP project is its **strong interconnection with and contribution to the RIS3 priorities and related EU platforms (S3P)** of the participating regions. The project works towards securing funding from different public and private sources, including ESRF funds through regional RIS3 strategies, involvement in Phases 2+3 of S3P-Industry platforms for common investment projects, and private investment through private equity funds, crowdfunding, business angels, or large industries as members of the participating clusters.

The network has been thought to promote inter-cluster and interregional collaborations in the frame of ECCP & EOCI partnerships, supporting cross-fertilisation of ideas and leveraging future investment opportunities as additional tools and resources to bring novel solutions to the market, boosting SME competitiveness for the creation of new industrial value chains with a clear EU-added value in the raw materials and mining sectors. MINE.THE.GAP will take advantage of the **clusters' high potential to drive smart regional specialisation and to help SMEs to develop new, globally competitive advantages in emerging industries**, which in turn will lead to the establishment of entirely new industrial value chains, or the radical reconfiguration of the existing ones, turning ideas and opportunities into new products, processes and services with higher added value.

Two main actions are the backbone of MINE.THE.GAP project:

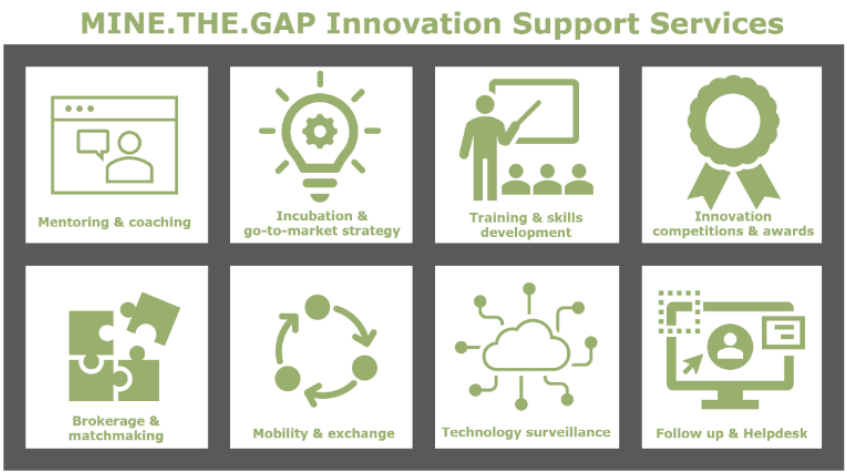
OPEN CALLS FOR SMES

MINE.THE.GAP Open Calls are designed to encourage collaboration between both the target and the providers sectors, with the aim of promoting inter-regional and international collaborations between European SMEs. One of the main expected outcomes of this project is the development of a long-term collaboration and networking platform/tool sustainable beyond the lifetime of the project providing all European raw materials & mining SMEs a tailored service to develop innovative solutions in a collaborative setting with any other relevant industrial sector.

These Open Calls provide an opportunity to European SMEs in the target raw materials & mining sectors of developing products, technologies, solutions & services in collaboration with other emerging and advanced sectors using clusters as the ideal vehicle to develop new industrial value chains through cross-sectoral and cross-regional collaboration. This strategy involves the **direct financial support with a total of 3.075M€ devoted to these actions**. With this support, it is expected that at least 87 European SMEs from the countries of the participating clusters will receive up to 50k€ to develop innovation projects with the objective to establish new inter-regional and inter-sectoral value chains.

INNOVATION SUPPORT SERVICES FOR SMES

MINE.THE.GAP will provide a number of business support services to selected SMEs in order to enhance innovation capacities, promote technology transfer and commercialisation, and boost their internationalisation. These services will support the creation of new businesses opportunities promoting growth and competitiveness of European SMEs.



In order to properly offer these services to the participating SMEs, **three different business hubs will be implemented**, where a series of specific services will be provided to strengthen the implementation and consolidation in the market of the SMEs. The thematic hubs will be: Innovation Hub (BH1); Technology Transfer & Commercialisation Hub (BH2) and Internationalisation Hub (BH3). **Three geographical nodes** have been established along the MINE.THE.GAP partners to simplify access to these services and to implement the activities designed for each of the hubs.

INNOVATION AREAS OF INTEREST

Finally, MINE.THE.GAP aims at providing SMEs from the raw materials & mining sectors with the necessary tools to improve their competitiveness, boost their growth and implement new services/solutions/products through cross-sectorial and cross-regional collaboration. For this, a comprehensive set of current demands, challenges and innovation niches have been identified based on market demands. The **identification of current innovation areas of interest** has been performed by revising several key roadmaps, documents and studies[6]. For each of the "provider" sectors the project has identified between 8 and 10 possible technological and non-technological innovations that SMEs in the raw materials & mining sectors can make use of.

INFORMATION & COMMUNICATION TECHNOLOGIES	ADVANCED MANUFACTURING
Automation & robotics: the digital mine	Industry 4.0
Connected mobility	Additive manufacturing and 3D technologies
AI prediction and planning tools	Advanced production processes
Big data solutions for data collection	

[6] "European Innovation Partnership (EIP) Raw Materials Strategic Implementation Plan"; "Accelerating the transition to the circular economy: Improving access to finance for circular economy projects" (European Commission); "Horizon 2020 Work Programme 2018-2020 Societal Challenge 5: Climate Action, Environment, Resource Efficiency and Raw Materials" (European Commission); "VERAM 2050 Roadmap"; "ERA-MIN2 Work Programme"; "Business Innovation Observatory: Sustainable Supply of Raw Materials - Case Study 59: Innovative mineral and metallurgical extraction and processing" (DG GROW, 2016); "Digital Transformation Initiative Mining and Metals Industry" (World Economic Forum, 2017); "Added value from responsible use of raw materials"; Research Highlights 13 (VTT, 2016); "Digital mining: the next wave of business transformation" (Ernst & Young Global Limited report, 2018); Tracking the trends 2018: The top 10 issues shaping mining in the year ahead" and "The digital mine: What does it mean for you?" (Deloitte, 2017-2018).

Interoperability & cybersecurity	New E&E components and systems
Earth-observation technologies	State-of-the-art hands-free processes
Drone technologies	Sorting technologies for waste minimisation
	Emerging technologies
ENVIRONMENT & RESOURCE EFFICIENCY	**CIRCULAR ECONOMY**
Product design for durability	Smart exploration, extraction and closure
Novel ventilation and climate control	Waste minimisation & valorisation
3D mapping technologies	Substitution of (critical) raw materials
Reduction of carbon emissions	Recycling and reuse of end-of-life products
Use of renewable energy sources	Reduction of energy consumption
Mining in challenging environments	Tailings management
Resource-efficient processing, production	Responsible sourcing, sustainable supply chains

8 EU MIRRORING STRATEGIES

The purpose of this section is to establish a "mirror strategy" between MIREU regions that are considered to have a high degree of similarity (mirror regions) in terms of RIS3, economic activity and social challenges. In this section we summarize work done under MIREU task 5.5, where a brief methodology has been developed in order to give certain ideas and suggest interesting regions to study mirroring actions.

8.1 Methodology

This methodology has been used successfully in previous EU projects to study similarities and develop mirroring actions, copying best practices from leading regions. Thus, the present work provides an overview of different parameters or factors from different sources to study the potential similarities, these are based on review of RIS3 of MIREU and other EU regions, industrial clusters and associations, and research projects funded by different programs such as H2020, Interreg or EIT Raw Materials.

Score 1 provided a list of the European regions that have M&M sectors as a priority on their RIS3. Thus, providing potential mirroring regions. The study is focused on MIREU regions, providing a deep study and an attempt to quantify the potential mirroring based on the RIS3 strengths determined in D5.1. Similarities among MIREU regions based on their strengths have been discussed and potential fields for mirroring activities are identified. The elaborated RIS3 affinity score is just one parameter reflecting part of the potential match, does not intend to be a total value on the potential mirroring strategy. Potential mirroring actions should consider not only this study but many other factors.

Score 2 studied the role of industrial clusters as key drivers of innovation in regional ecosystems. Using an advanced search among the MIREU regions and their immediate neighbouring areas, a complete map of sectoral clusters has been elaborated, offering a comprehensive view of the potential of these areas for technologic improvement and strategic cooperation. A group of 138 clusters from up to 20 different industrial sectors have been identify, which is a source for future cross-fertilisation with the raw materials, mining and metallurgy sectors. In addition, a whole set of sectoral maps have been depicted highlighting strongly developed clustering areas among the MIREU regions in key emerging industries such as ICT, electronics, biotech, clean energy, smart transport and many more. These maps will serve as a starting point for future cross-sectoral collaboration.

Score 3 evaluated regions innovation development through projects actions have been evaluated reviewing the participation in H2020 program, Interreg or EIT Raw materials. Additionally, the participation of the regions in S3P platforms and CoMMER has been studied.

8.2 Potential regions mirroring

This section summarizes potential mirroring projections based on the remarking conclusions of the three previous sections. As a result, a map of the 10 most similar active regions is developed. The remarked regions contain important hubs regarding the raw materials industry and great mirroring possibilities.

Considering the previous sections, some hot spots can be identified. A benchmarking has been performed based on the criteria that have been described in the scores in methodology section. These are:

- Strength of RIS3in terms of M&M and circular economy.
- Regional Clusters for innovation.
- Successful R&D and innovation projects funded by EU.
- Participation in CoMMER.
- Participation in the different S3P.

The benchmarking exercise allocates points for each section. The count of points allocated to the different regions is an attempt to identify most active regions that can project potential mirroring actions. Table 11 and Figure 34 below summarizes some of the most active areas that stand out for the explained regions.

Regarding the relationship between the MIREU mining and metallurgy regions and the existence of industrial clusters from other relevant sectors that could be key for modernisation and cross-fertilisation, the results of the benchmarking exercise indicate that most of the MIREU regions have the capacities, expertise and institutional tools to promote cross-sectoral interaction.

This is particularly relevant in fields that can promote digitalisation, resource efficiency and circularity among the raw materials value chain. For instance, 13 out of 15 MIREU regions can access industrial clusters dedicated to ICT, which is crucial for the development of the 'digital mine'. 10 out of 15 MIREU regions can access industrial clusters dedicated to clean energy production and storage, a key issue in mining activities, which are high energy consuming. It is also of high interest the existence of strong clusters in sectors as relevant for mining and metallurgy activities as transport, health, advanced materials, advanced manufacturing and electronics. They all create a well-nurtured ecosystem of industrial sectors that ensures the sustainability of already existing or new and/or reconfigured value chains around raw materials and extractive industries."

EU projects actions have been also observed from different competitive calls such as Interreg, H2020, and EIT raw materials. This can give an idea of innovation capacity and R&D activity in the fields of M&M across the region.

Table 2. Benchmarking for most active M&M EU regions

			RIS3			Sectoral cluster associations												Projects			S3P			
	Country	Region	Mining	Metallurgy	Circular economy	ICT	Electronics	Clean energy	manufacturing	Advanced materials &	Biotech	Transport	Automotive	Mining&Metallurgy	Food	Aeronautics	Health	Green technologies	H2020 projects	Interreg	EIT Raw Materials projects	Batteries	Mining	CoMMER	Count
1	Sweden	**Västerbotten**	3	3	3	1		1						1			1		1	1	1		1	1	18
2	Spain	**Andalucia**	3	3		1		1		1	1				1	1			1			1	1	1	16
3	Spain	**Castilla y León**	2		2	1		1					1	1	1		1		1	1	1	1	1	1	16
4	Finland	**Lapland**	1	1	3	1								1	1		1	1	1	1	1	1		1	15
5	Poland	**Lower Silesia**	2	3		1		1		1	1			1			1		1	1	1			1	15
6	Finland	**North Karelia**	3	3		1				1							1	1			1	1	1	1	14
7	Portugal	**Alentejo**	3	2		1		1						1	1				1	1				1	12
8	Germany	**Saxony**				1	1	1		1	1	1	1						1	1	1			1	11
9	Greece	**Sterea Ellada**				1	1	1		1	1	1							1	1	1		1	1	11
11	Romania	**North-West (Maramures)**		2		1		1		1					1		1	1			1			1	10
10	Spain	**Aragón**				1		1					1			1	1	1	1			1		1	9
12	Slovakia	**Košice**		3		1					1							1	1		1			1	9
13	Austria	**Styria**					1	1			1	1					1		1	1	1			1	9
15	Ireland	**Ireland**				1					1			1		1			1	1	1			1	8
14	UK	**Cornwall and Isles of Scilly**										1			1	1	1	1	1					1	7

According to the results on Table 11, a map has been created highlighting relevant regions that have great similarities and therefore have the highest potential for mirroring.

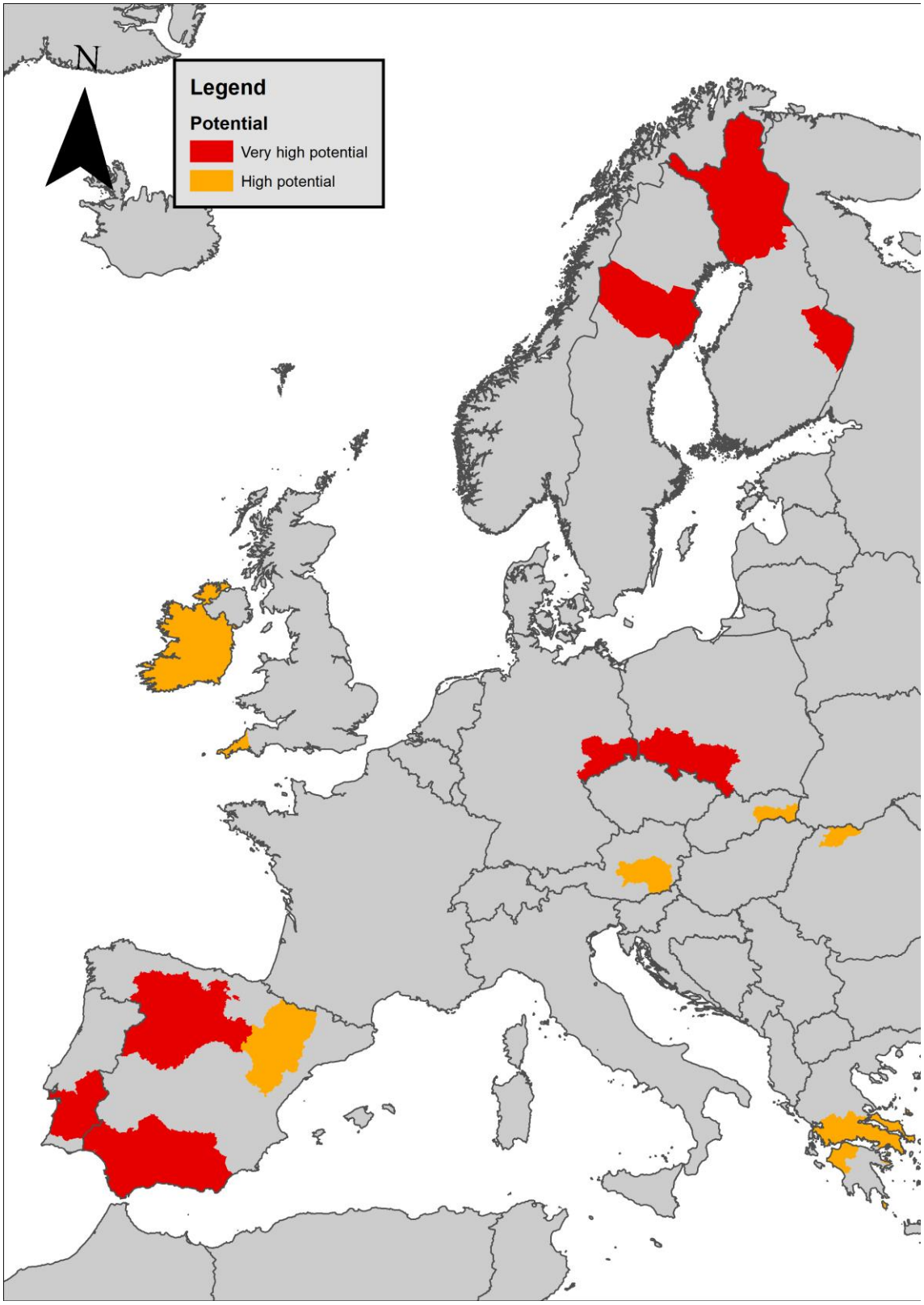


Figure 21: EU regions with high projection for mirroring

Potential strengths to target on a mirroring strategy

Processing metallurgy and certain sectors are apparently very common among MIREU regions. Processing metallurgy is mentioned in most of the MIREU regions strategies, Andalucía, Castilla y León, Kosice, Lapland, lower Silesia, North Karelia, Saxony and Västerbotten. Machinery fabrication and different processing technologies and expertise to produce new goods are very common among the strengths of MIREU. There is therefore a great potential for developing mirroring strategies and clustering.

The **Exploitation and extraction of raw materials** is also a common strength in many MIREU regions, Exploration is mentioned in Alentejo and Andalucía, and also Saxony while Exploitation is mentioned in Alentejo Andalucía Castilla y León, Lapland, North Karelia, Saxony and Västerbotten.

While **Digitalisation for the mining sector or the clustering of business around M&M are rarely mention on the S3P**. Other missing strengths in many regions are the creation of new companies and social issues

It´s noticeable that some MIREU regions do not have mining and metallurgy prioritised within their RIS3. As for example: Saxony, Ireland, Styria, Aragón, Cornwall or Sterea Ellada. This is probably due to the low weight of this sectors, being the economy dominated by other sectors. Despite the capabilities of many regions for an evolution to circular economy, there is very few mentions on their strategy in technologies related to recycling, by-products, and waste valorisation. The term circular economy is relatively new, so it is very understandable that it is not appearing under RIS3 of the regions literally. It is however in many ways described or implied by strategic actions or sectors. For example, some regions RIS3 do target waste and by-products valorisation. There´s a good number of regions that have been identified for having great capabilities on recycling recovery, and that could be also a good field for targeting mirroring strategies.

8.3 Remarks

Adopting an accurate Strategy for the right fields and reflected all the capabilities of the region is essential to maximize the impact of RIS3. A comparison of RIS3 strategies can reflect similarities and common interest. The study in section 3 provides an overview of all European regions with M&M activities in their RIS3. The regions can target different regions for mirroring activities based on their affinity by comparing their strengths and common interests. MIREU regions have quite common fields of interest and some mirroring targets are suggested based on their RIS3 strengths previously studied.

Despite high capabilities of many regions for an evolution to circular economy, few mentions on RIS3 strategies are made to technologies related to recycling, by-products, and waste valorisation.

MIREU regions reveals the high potential of clusters to promote constant improvement of industrial ecosystems and cooperation among sectors and regions. A thorough review of the cluster associations present in the MIREU and neighbouring regions shows that at least 20

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Topic: H2020-SC5-2017

industrial sectors are represented by 138 cluster organisations with more than 15,000 members of which at least 12,000 are SMEs. Furthermore, these ecosystems include more than 1,000 research organisations and dedicate their efforts to key cutting-edge technologies such as smart grids, artificial intelligence, e-health, smart cities, cybersecurity, advanced manufacturing systems, clean energy, nanoelectronics and much more.

This concentration of knowledge and resources across regions entails a perfect environment for strategic cooperation, including collective actions, resource sharing, joint development or experimentation, co-production, economies of scale and scope, all of them important functions of well-developed clusters. In this context, the raw materials, mining and metallurgy sectors present in these regions can benefit greatly from interaction with these networks.

H2020 projects, such as MINE.THE.GAP project, an Innovation Action (IA) belonging to the call H2020-INNOSUP-2019 can be an extraordinary action for a better innovation support of SMEs. Precisely, this particular project is closely related to the valorisation of clusters in industrial ecosystems, as it aims at the creation and integration of novel industrial value chains for SMEs in the raw materials and mining sectors through innovation support and services provided by the ICT, circular economy, resource efficiency and advanced manufacturing sectors. MINE.THE.GAP is a good example of how clusters can be the main drivers of innovation in their regional ecosystems.

The main objective of cohesion policy to implement the Europe 2020 strategy of the European Commission is to reduce economic and social inequalities between different regions through its cohesion policy. Regions are expected to be the main beneficiaries of European fund programs, as well as small and medium-sized enterprises and business associations or clusters.

By the end of 2016, almost € 130 billion had been invested in small businesses, research, energy efficiency and thousands of other projects focused on the EU's growth and employment priorities, within the framework of the Europe 2020 strategy. The objective is to double the use of financial instruments, planning evaluations to obtain a clearer vision of the program's performance over time.

The Council of Mining and Metallurgy European Regions (CoMMER) was born within the MIREU project as one of the activities foreseen in the WP2 - Networking Regions and although it is still in the process of constitution and it is planned to present it publicly on the closing day of the project in the Raw Materials Week 2020, it is possible to advance that the network besides providing continuity to the MIREU project, will generate an ecosystem that will improve research and innovation capacities in the field of mining and metallurgy in the member regions, supporting local and regional stakeholders covering the entire value chain of this sector, from ERRIN's offices in Brussels and in the form of working groups. Determining the sustainability of mining and metallurgical regions beyond the life of MIREU and its regions is a major challenge that will enable Europe to maintain and strengthen the steps set out in the European Raw Materials Strategy.

Under Mireu Task 5.5, a set of regions is proposed after analysing their capabilities, industrial clusters, H2020 project experience and respective RIS3, thus turning as possible targets for future actions, represented on the Figure 21.

9 CONCLUSIONS

The mining and metallurgy industries are key drivers of European sustainable development and an integral part of our smart specialisation strategies. Raw materials are essential to meet basic societal needs, as they are key enablers of many critical sectors of the economy and, more importantly, they will be crucial in the development of the technologies that will lead the transition to a low-carbon, energy-efficient and circular economy.

Mining and Metallurgy Regions of the European Union (MIREU) conform a sustainable network of a representative number of European Mining and Metallurgy Regions with the aim to fulfil the targets set by the EC and support EU level policy change towards more sustainable raw materials value chains in terms of social acceptance, environmental soundness and economic viability.

Need to get common policies approach to raw materials, mining and metallurgy policies and strategy in Europe in order to ensure that the pillars of the Raw Materials Initiative (RMI) adopted by the European Commission in 2008 are achieved, i.e., a fair and sustainable supply of raw materials from global markets, a sustainable supply of raw materials within the EU, and resource efficiency and supply of secondary raw materials through recycling. To this end, we summarise below the main barriers and concerns we have collected from stakeholders (academics, local and regional authorities, educators, industry, civil society and political institutions) at regional and local level across the most representative regions of Europe and the pathways they wish to follow in order to facilitate that MIREU regions play their full role in the forthcoming challenges regarding raw materials, mining and metallurgy.

The main barriers and concerns hindering the development of a thriving mining and metallurgy industry in Europe have been identified. Suggestions for the roadmap for most pertinent solutions to address these issues are briefly summarized here:

- **REGULATIONS AND POLICIES**

EU raw materials policy and strategies are failing to be transferred to regional and local environments, where outdated legal frameworks and discouraging fiscal regimes prevail. The long and complex permitting processes currently in place are hindering investments and dragging the whole European mining industry.

In the coming years, a clear and harmonised raw materials legislation will be essential to develop a strong EU mining industry, one that is committed to support sustainable development and robust value chains, particularly for the exploitation of critical raw materials on European soil.

The undersigned agree on the need to move towards a faster, simplified, stable, consistent and transparent EU legal framework, fully compatible with other legislations (e.g. environmental legislation) and built with the participation of all stakeholders and regions.

- **SOCIAL ACCEPTANCE OF MINING ACTIVITIES**

Lack of social acceptance of mining projects and active public opposition are considered as strong barriers for the development of the mining sector. Both public authorities and experts agree that these concerns, although legitimate, are caused by the lack of social knowledge about how sustainable mines operate in the 21st century, the essential role of raw materials in our daily

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lives and the positive impact that mining operations can have on local communities in terms of economic growth and employment.

We understand that this lack of knowledge must be addressed by following two complementary strategies: one that builds up an effective communication process both with the wide public and with local communities, and one that improves education on raw materials at all levels, since early-stage school. On the other hand, mining companies must be aware of the importance of promoting best practices and transparency in their mining projects, as well as of showing deep respect of sociocultural values of local communities.

- **FUNDING AND INVESTMENT**

The European mining and metallurgy sectors are highly dependent on foreign investment, usually due to lack of dedicated national funds and little support from public administration. Current fiscal regimes are discouraging both for foreign and local investors, who might prefer investing in mining projects out of European soil. In addition, development of new mining projects is being dragged due to the high cost of the necessary infrastructure, where public investment is essential.

Importantly, 98,5% of the EU mining industry consists of small and medium enterprises who lack the financial potential of major companies. The lack of public support to these SMEs is seriously endangering the mining and metallurgy sectors, supply and value chains, weakening EU growth and competitiveness at global level. A steady, consistent EU, national and regional investment policy must be put in place to support job creation, business competitiveness, economic growth and sustainable development in the sector.

- **NEW TECHNOLOGIES AND INNOVATION**

The undersigned agree that there is a technological gap between the availability of new technologies and innovative processes and lack of adoption of these developments by the mining and metallurgy sectors, specially by small and medium enterprises who lack access to innovation funds.

Experts agree that new technologies help reduce environmental impact of mining activities, maximise economic benefits and constitute the best European strategy in order to gain competitive advantage in the raw materials sector at global level. However, being mining an intrinsically risky endeavour, enterprises need public support to incorporate novel, sustainable technologies and generate profit from innovation. Increased investment in the sector will be crucial to overcome the underdevelopment of most mineral processing companies and will ultimately help attract commitment from private investors. Furthermore, regional development funds should promote not only novel technologies, but the means to upscale and bring this innovation to the market.

It is also worth mentioning that the mining and metallurgy sectors are not only technology adopters, but also the enablers of the upcoming technologies that will address the big challenges that humanity is facing, including global warming, energy or mobility, areas in which the European Union wants to actively lead.

- **SKILLS DEVELOPMENT**

A strong, renewed and sustainable mining and metallurgy sector will need qualified experts and new professional profiles not only within the industry workforce, but also among academics and authorities in charge of controlling and monitoring all the activities at value chain level.

The undersigned have detected an urgent need for adequate expertise, including the need for 'train the trainers' programs, more adjusted to new technologies, objectives and practices, and ameliorating the current gap between educators, entrepreneurs and other mining professionals. This include the above-mentioned need for experts with the necessary soft skills to communicate with the wide public and local communities, but also a skilled workforce capable of implementing the green, digital, modern mines of the coming years.

- **SUSTAINABLE MINING AND THE ENVIRONMENT**

Last but not least, the undersigned acknowledge that there is a perceived dissociation between environmental and mining objectives in the European Union. This perception is often reinforced by political decisions where local authorities are overruled by environmental authorities. Both legislations must be harmonised in a way that protect the industry and EU objectives in terms of economic growth and employment, but also ensures protection of our natural resources and citizens' livelihoods and quality of life.

We strongly believe that the European Union has the means to achieve this harmonisation. Innovation, improved resource efficiency, promotion of responsible sourcing measures, recovery, recycling and reuse of secondary raw materials are just a few of the myriad of possibilities to develop a green, sustainable mining and metallurgy industry, one that ensures supply of essential raw materials and, at the same time, promote respect of social and cultural values, ensure justice, gender equity and inclusiveness.

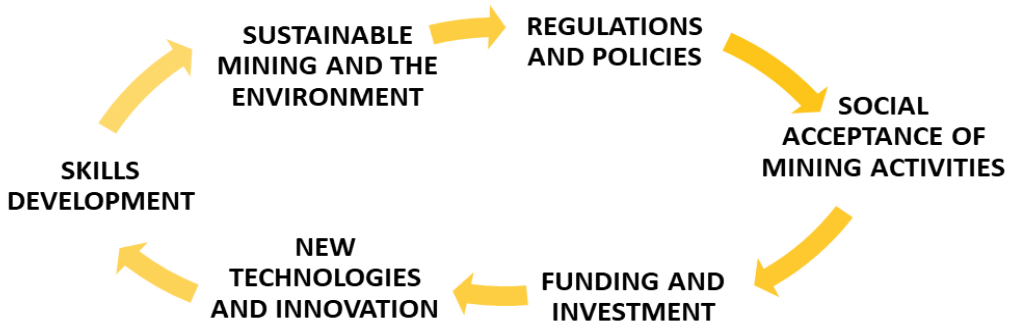

Figure 22: Schematic roadmap for most pertinent solutions to address M&M issues

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