



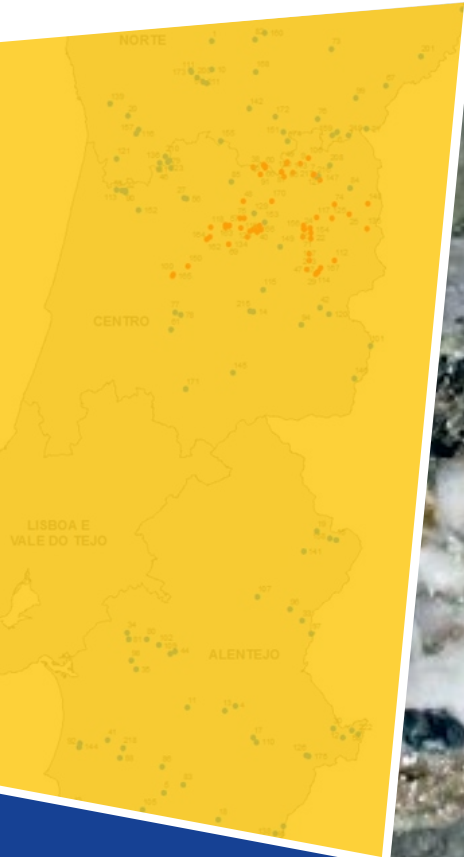
# REMIX

Interreg Europe



European Union  
European Regional  
Development Fund

Smart and Green  
Mining Regions of EU



## Action Plan Centro Region, Portugal



Research &  
innovation

Leading the European policies  
towards more sustainable mining

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# 1. General Information

REMIX Project encourages resource efficient and environmentally and socially acceptable production of raw materials, including critical raw materials. Growth and competitiveness of European industry is currently limited by the state of play in these two areas and policy instruments have been set up across Europe to address these important topics. (<https://www.interregeurope.eu/remix/>). REMIX aims to develop an European mining sector in a sustainable and environmental friendly way, while developing regions and countries of Europe promoting synergies and cooperation between partners.

Europe is consuming much more mineral resources than it produces and therefore is dependent on imports of goods, which is particularly severe for the denominated critical raw materials. The Centro Region is one of the areas of Portugal with most potential in mineral resources, which can trigger industry, employment and economics ([see Annex I](#)). The shortage of geological knowledge is an issue that should be addressed by a complementary Regional Action Plan, aligned with the objectives of National Strategy for Geologic Resources, in order to leverage the mining sector in the region.

The development of specific projects that promote the mining sector in Centro Region has been identified by the REMIX Portuguese stakeholder community that created a Local Action Group (LAG) ([see Annex II](#)). This group gathered during REMIX Phase I from January 2017 until June 2019. From the projects identified as important to be implemented in Centro Region, the following were highlighted: The inventory and geochemical characterization of mineral resources present in waste-dumps and tailings, detailed geological mapping, industrial transformation and beneficiation of raw materials. These projects will contribute to increase economic potential of the Centro Region triggering future mineral extractions, and thus contributing to circular economy. This approach at Regional Level will be important also at National Level, as a demonstration-study to fine tune complementary regulation of the National Strategy for Geologic Resources and thus contributing for its improvement. REMIX was devoted not only to critical raw materials, but also to other minerals that add value to Centro Region, since a high potential for metallic and non-metallic mineral resources exists ([Annexes I, II and III](#)).

# 2. Political and Regional Development Context

## 2.1. Centro Operational Program 2020

Centro Region Action Plan addresses Centro Region 2020 Operation Program and aims to have impact on: Investment for Growth and Jobs programme; European Territorial Cooperation programme as well as on another regional development policy instrument: “The mineral potential of the Centre Region of Portugal – mineral deposits and mining projects”.

The Centro 2020 OP is the main funding instrument available to the Region for the implementation of its development strategy for the period 2014-2020. The organisation responsible for managing and auditing the OP is the Centro Regional Coordination and Development Commission (CCDR Centro).

### Main objectives

The OP will contribute to promote the competitiveness of the Centro Region economy and its sustainable development and internal cohesion. It will also boost the Region’s ability to contribute to the achievement of the key EU and national development priorities (EC, 2018b):

- Approx. 38% of the OP resources are allocated to support competitiveness and innovation in SMEs.
- Approx. 8% will boost RTD and innovation - helping the country to reach its national Europe 2020 target to increase the proportion of GDP spent on RTD from 2.7% to 3.3% (it was at 1.5% in 2011). The OP investment is expected to foster research and innovation knowledge transfer to SMEs.
- Around 8% of the resources will be dedicated to creating sustainable and quality jobs and supporting labour mobility thus contributing to the attainment of the national Europe 2020 target of 72.8% of 20-64 year-olds in employment (68.7% in 2012).
- More than 13% will be dedicated to promoting education and qualification, helping the country to reach its national Europe 2020 target of bringing early school leaving down to 10% (from 23.2% in 2011).
- Almost 10% will be used to promote sustainable urban development.

- Almost 5% of the OP funding aims to support the shift towards a low-carbon economy (investments in energy efficiency and sustainable mobility); these funds will contribute to Portugal's national Europe 2020 target of having 31% of energy from renewable sources (27.3% in 2011). To ensure the sustainable development of the energy sector, the support will aim, in particular, to improve energy efficiency and sustainable mobility.

### **Available Funds**

Regional Development Fund (ERDF): EUR 1.751.513.979

European Social Fund (ESF): EUR 403.517.052

### **Funding priorities**

The use of European funds under the OP Centro 2020 are directed to strengthening the competitiveness of the companies based in the Region and job creation and to empower the efficient use of resources and the social inclusion of disadvantaged people.

Ten strategic priorities have been established within the programme (in brackets the amount of EU funding) (EC, 2018c):

- 1.** R&D and innovation (EUR 169 million).
- 2.** Competitiveness and internationalisation of Regional economy (EUR 818 million).
- 3.** Human potential development (EUR 288 million).
- 4.** Employability (EUR 177 million).
- 5.** Social and territorial cohesion (EUR 155 million).
- 6.** Resources sustainability (EUR 102 million).
- 7.** Sustainability of the Regional territories (EUR 126 million).
- 8.** Institutional capacity building of Regional entities (EUR 54 million).
- 9.** Urban network (EUR 212 million).
- 10.** Technical assistance (EUR 54 million).



## Priority axis

REMIX activities were only devoted to Priority axis 1 - Research, Development and Innovation, particularly – investment priority 1.2, which is presented below in more detail. The axis 1 has the main goal of reinforcing the research, the technological development and innovation. The promotion of research and innovation (R&I) infrastructures and capacities, the promotion of competence centers, the promotion of business investment in research and innovation and the development of links and synergies between companies, R&D centers and higher education (technology transfer) will be the priority investments in this axis (which should be aligned with the Regional RIS 3).

Thematic objective	Investment priority	FEDER
<b>OT 1.</b> Reinforce investigation, technological development and innovation	<b>IP 1.2.</b> the promotion of business investment in R&D, the development of links and synergetic between companies, research and development centers and the higher education sector, in particular the promotion of investment in the development of products and services, in technology transfer, in social innovation, in eco-innovation, in applications of public interest, in the stimulation of demand, in networks, clusters and open innovation through smart specialization and the support of technological and applied research, pilot lines, early actions of product validation, advanced production and first production capabilities, particularly regarding key enabling technologies, and the dissemination of general interest technologies.	169ME

**Table 1** – Summary of Thematic Objective 1 and Investment Priority 1.2

## Specific Objectives to be achieved

- Enhance the scientific production of internationally recognized quality
- Reinforce the scientific and technological knowledge transfer to the corporate sector
- Enhance the corporate investment in R&D by reinforcing the connection between companies and other regional entities of the R&I system
- Reinforce the network for innovation and internationalization of companies
- Enhance the corporate investment in innovative activities

## **Types of projects that can be supported**

### *Support for R&D projects*

- Support for strategic R&D projects, within the lines of an institution
- Support the participation in R&D programs financed by the European Union

### *Investments in Research, Development and Innovation (RDI) infrastructures and equipment*

- Investment in RDI infrastructures and equipment contained within the RNIIE – National Infrastructure roadmap of strategic interest.

### *Support to the technology transfer*

- Support to knowledge transfer projects directed to the companies, promoted by entities in the Scientific and Technological System
- Support for the patenting and licensing of industrial property
- Support for projects to develop prototypes and/or processes oriented to a specific market and/or industrial sector
- Support for investment in common infrastructures and equipment for the expansion of Science and Technology Parks

### *Support to business activities in RDI*

- Support to RDI projects by companies, either individually or in co-promotion (corporations and entities consortia and network in association with actors within the Scientific and Technological System)
- Creation and dynamization of R&I teams in enterprises
- Support to participation in other R&D programs financed by the European Union
- Support to participation of companies in industrial R&D projects on a European scale, in particular EUREKA initiative
- Support to simplified R&TD projects

### *Support to collaborative network*

- Support to demonstrative activities of the economic potential of R&TD results
- Support the creation of new clusters within the priority areas of RIS 3
- Support the promotion of cluster's activities
- Support of cluster projects to implement international affiliations, particularly in the RIS 3 innovation field

### *Business investment in innovative actions for non-SMEs*

- Support for innovation in products, processes, organizational methods and marketing



## Entities that can apply

- Public research sector
- Entities of the non-business Scientific and Technological System
- Other public or private entities that carry out R&D&I activities
- Companies
- Business associations

## Calendar of the typology of calls to open in investment priority 1.2

Scientific Research and Technologic Development Axis - IP 1.2	4T 2019	1T 2020	2T 2020	3T 2020	4T 2020
Individual projects	•*	•	•	•	•
Co-promotion		•	•	•	•
Nucleos		•			
Demostrative projects		•			
Colective Actions	•*	•			

\* Delayed open of call

## Details of the typology of calls:

- *Individual Research and Development Projects* - Enterprise-led R&D projects comprising industrial research and experimental development activities leading to the creation of new products, processes or systems, or the introduction of significant improvements to existing products, processes or systems.
- *Research and Development Centers* - Projects aimed at the creation or reinforcement of companies' internal skills and capabilities in R&D. Research Centers may be associated.
- *Demonstration Projects in Co-Promotion* - Demonstration projects of advanced technologies and pilot lines that, starting from successfully completed R&D activities, aim to highlight, before a specialized and real situation public, the economic and technical advantages of the new technological solutions. not sufficiently technologically validated for commercial use.
- *Collective Actions* - projects that contribute to the improvement of the conditions of the surrounding companies, particularly those associated with immaterial factors of competitiveness of a collective nature, which materialize in the availability of collective or public goods capable of inducing dragging effects on the economy. Typology: Transfer and valorisation of Scientific and Technological Knowledge.

## 2.2. Smart Specialization Strategy – RIS3 CENTRO

The Centro Region RIS 3 area “Sustainable Industrial Solutions” is one of the 4 priority areas which is directly connected with the REMIX goals. Starting with 2 main focus, (1) sustainable optimization of industrial production and (2) development of the materials manufacturing industry in the region, it expanded for 5 lines of action that interact with one another, in order to produce the best results possible: (1) development of processes, materials and sustainable systems with greater added value for the region, (2) efficient use of the resources and reduction of productive processes impact on the environment, (3) modernization through circular economy, (4) industrial modernization through “production centered on the human being” and (5) valorization of advanced and/or emerging technologies in higher added-value eco-innovation processes, products and systems. The core of this Centro Region RIS 3 includes three dimensions of impact: economic, social and environmental, each supporting the other.

The “Valorisation of natural endogenous resources” is another of the 4 lines of action of Centro Region RIS 3 that clearly has a link with REMIX objectives. This action is directly linked to the resources that the region in question have and how can they become and added value, concerning always the three dimensions of impact: economics, society and environment. Knowledge of these assets is crucial for setting strategies to this challenge in a long-term period, to tackle it more efficiently 3 actions were created:

- (1)** Conservation and sustainability of natural endogenous resources,
- (2)** Monitoring and integrated management of natural endogenous resources;
- (3)** Development of products, processes and services with a view to boosting value chains associated with natural endogenous resources.

In synchrony with REMIX, the natural resources are top priorities for the regions and for EU itself, in particular raw materials that are critical due to its lack of production and difficulty in supply.

REMIX objectives can be related with the previous lines of RIS3, since these are directly related with the development of projects in areas such as Nature Economy, Green Economy, innovative solutions that generate new forms of employability and self-employment, distinctive and customised tourism that

contribute to local sustainability, leverage distinctive regional assets/resources in the structuring of tourism products that are differentiated (e.g. warm springs, wellness tourism, excursion tourism, cultural tourism, etc.).

For the above reasons, Centro Region Action Plan of REMIX decided to split actions to be implemented according to these 2 thematic lines of action:

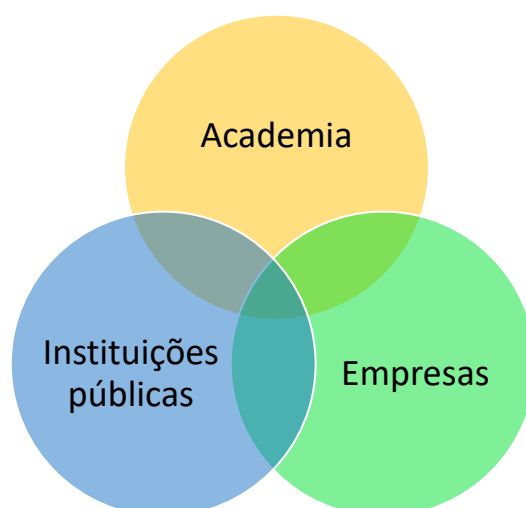
- Action-objective 1 - Sustainable Industrial Solutions;
- Action-objective 2 – Valorisation of natural endogenous resources;

These action-objective include, each of them, a series of projects/actions to be submitted to future calls of Centro 2020 OP (action 1 a total of 8 projects involving 4.1M€; action 2 a total of 10 projects involving 3.5M€) in the following typologies of projects: Individual Research and Development Projects; Research and Development Centers; Demonstration Projects in Co-Promotion and collective actions (see [figure 4](#) for details). Further details are provided in the next chapter.

# 3. Details of Actions Envisaged

## 3.1. Vision

The REMIX Action Plan for Centro Region aims to contribute to achieve the objectives of Investment Priority 1.2, by promoting the improvement of knowledge transfer from academia and public institutions to business and vice versa through fostering development of projects in co-promotion (or complementarity) between these institutions in the mining sector and in particular promoting the circular economy. This Action Plan is intended as a contribution to the implementation of the National Geological Resources Plan at regional level.



**Figure 1** - Representative scheme of the 3 major groups involved in developing the vision of REMIX Action Plan for Centro Region, with the vision of promoting improved knowledge transfer from academia and public institutions to companies and vice versa.

The vision for the Action Plan is that it will trigger the development of projects in Centro Region mining sector in co-promotion or complementarity promoting eco-innovative strategies, whether they are led by companies, public institutions or academia.

## 3.2. Actions

The projects proposed by the LAG were structured around the following lines:

1) Sustainable Industrial Solutions, 2) Improvement and enhancement of endogenous resources in alignment with the RIS3 of the Centro region, with the objective of aggregating the proposals to be submitted for funding to the Centro 2020 OP in the second phase of the REMIX project. The actions presented in the Action Plan are inspired by the various projects implemented by REMIX partners, both nationally and internationally. The REMIX project is expected to mobilize the stakeholder community to submit projects in the following domains:

### - Objective Vision 1) Sustainable Industrial Solutions

For the reasons described in the [annex I](#) metallic and non-metallic industries will have to adjust to the market and develop new technologies more sustainable and environmentally friendly. One of the major challenges will be the reduction in the production of the mining wastes and to reach this goal new technological processes must be developed and implemented to use the maximum amount of materials extracted from the ore and the wall-rock.

The mining processes must be also more energy efficient and more secure for miners and for those conditions to be met it is necessary the increase automation with the use of remotely operate vehicles and better communications systems.

The tailings can be not only waste that can produce serious impacts in the environment but be instead a source of raw materials as preconized by the mentors of the circular economy. One good example of REMIX good practice serves as inspiration for this typology of actions and it comes from Portugal, through the project REMINE H2020-MSCA-RISE. This good practice was shared during the Peer Review Visit that was held in Fundão (December 2018) where this project was presented. Large volumes of tailings are present in Panasqueira mine and represent geotechnical, physical, chemical and landscape problems. The researchers from the University of Beira Interior carried out several studies in fine tailings in order to reuse them as raw material for alkali-activated binders. Leading this research team to create a new compound used for construction

bricks that was created a more resistant, cheaper and faster to produce, emits no CO2 and does not require drinking quality water in its production. The recovery of critical raw materials from secondary resources, as well as the recycling of metals, requires specific conditions and diverse methodologies to be sustainable, many of them under investigation. There is still a strong lack of knowledge and information in this area, from its composition to its final use.

These and other inspirational technologies shared during REMIX Centro Stakeholder community (see for details section 3.3 where several applied research projects bring a circular economy approach to REMIX actions) have led to the suggestion of the following actions presented in Table 2, as well as lead partner of REMIX to adopt also these practices to propose Lapland Action Plan devoted to circular economy practices in mining industry:

Action-objective	Sustainable Industrial Solutions
<b>Main objective</b>	Development of projects involving new technological processes in order to utilize the maximum amount of materials extracted from ore, tailings and dumps, as well as improvements in mining processes in terms of energy efficiency and safety.
<b>Vision</b>	Foster co-promotion partnerships in the mining sector Centro region
<b>Current context</b>	High number of tailings and mining dumps in Centro region High number of research System entities with appropriate knowledge in circular economy, with potential for testing by business Business reluctant to investigate new mineral resources Reticence to shift from non-metallic to metallic exploitation
<b>Organizations and principal partners</b>	Academy and R&D Centers National Laboratory of Energy and Geology (LNEG) Metallic and non-metallic mining companies Technology and biotechnology companies Mineral Resource Cluster
<b>Cronogram</b>	2019-2021
<b>Inspiration</b>	REMINE H2020-MSCA-RISE + REMIX PRV

**Table 2** – Summary of Action-Objective Characteristics for Sustainable Industrial Solutions



Several projects were identified as needed to be implemented by the stakeholder group. As these are companies and research centers, the details of the projects were not provided, although high interest taking part of the REMIX LAG, in order to be able to apply the projects to the future notices of Centro2020 and Portugal2020. The following sectoral actions were thus identified:

Sectorial action	Institutions that will co-promote projects and their roles	Expected results	Estimated cost
1.1- Development and implementation of Appropriate Process Technologies (APT) for industrial beneficiation of substances produced in mining projects	Universities, R&D centres, LNEG, technological and biotechnological companies – Research and development  Metallic and non-metallic mining companies – Implementation and testing Mineral Resources Cluster – facilitator and dissemination	1 TPA implementation test project for industrial beneficiation of substances produced in mining projects	1 M€
1.2 R&D projects in automation, remote operations, telemetry, communication and intercommunication in underground environment	Universities, R&D centres and technological companies – Research and development  Metallic mining companies – Implementation and testing	2 robotics pilot projects to operate in flooded mines. Robot pilot experimentation in Urgeiriça mines.	2 M€
1.3-Development of innovative technologies for sustainable exploitation of metallic and non-metallic mineral resources with the purpose to turn the processes more efficient, less costly, and, at the same time, reducing mining waste	Mineral Resources Cluster – facilitator and dissemination  Universities, R&D centres, LNEG, technological and biotechnological companies – Research and development  Metallic and non-metallic mining companies – Implementation and testing  Mineral Resources Cluster – facilitator and dissemination	2 Pilot projects using microorganisms for bio-remediation in mine deposits  2 Pilot-test projects with new extractive technologies to apply to rejected materials	4 projects of 350 k€ each
1.4 Turn mining wastes in raw materials and also reinforcing the circular economy (e.g. metal recovery from tailings and dumps, stone aggregates, geopolymers);	Universities, R&D centres, LNEG, technological and biotechnological companies – Research and development  Metallic and non-metallic mining companies and EDM – Provide data, implementation and testing  Mineral Resources Cluster – facilitator and dissemination  Municipalities – the same as the mining companies in the case of being owners of mining wastes	2 experimental projects of circular process development in business context  2 experimental projects to develop raw material recovery in tailings deposits	4 projects of 350 k€ each
<b>TOTAL</b>			<b>5.8M€</b>

**Table 3** – Summary of the characteristics of the sectoral actions related to the Objective Action Sustainable Industrial Solutions

## **- Objective Vision 2) Improvement and valorisation of endogenous resources**

Centro Region is rich in diversity, quality and quantity of natural resources, including geological resources, as, for example, natural and thermal waters, minerals, stones, geothermal. Although its relevance for the region the lack of knowledge in this sector is, presently, an issue that needs to be addressed urgently. Geological mapping, for example, is critical for understanding the territory and to maximize existing resources or for the discovery of new mineral resources. In the Centro Region are missing 14 maps at scale 1:50.000 and most of the cartography existent in the country was created from the 50's to the 90's of the previous century. On the other hand, the new technologies that can be adapted to the mapping of these mineral resources opens new perspectives for the creation of synergies between the public sector, business and academia.

In face of the geological setting of the Panasqueira ore, related with a non-outcropping granite cupola, it is probable the occurrence of similar deposits associated to granites in depth but not easily detected by conventional exploration methods. This geological setting can be also a geothermal resource through the implementation of high enthalpy enhanced geothermal systems (EGS). Knowledge, as mentioned before, but also innovation are essential tools to build a solid basis for actions that can increase the development in the region, for all endogenous resources.

The implementation of new technologies can play a major role in all value chain concerning natural endogenous resources. From an exploration stage (discovery of mineral resources), to exploitation, risk assessments, among others, it would promote efficiency, sustainability and better use of raw materials (EDM, DGEG, 2011, The legacy of abandoned mines, the context and the action in Portugal, 2011)

The example from Poland (Lower Silesia) provides excellent models for the development of the needs found not only in Centro Region but also in other parts of Portugal (e.g. Alentejo), since they have developed a "Database with geochemical maps of selected areas". This database provides primarily information on mineral waste materials collected on old mining heaps, industrial storage sites and in post-mining settlements tanks. The database provides spatial information about each site, lithological and chemical characteristics of the waste, geo-environmental data, economic use of mineral waste the formal and legal status as well as information about surroundings of the facility, access

roads, technical infrastructure, land development, protected areas, geohazars, etc. This inspiring data base is a source of knowledge easily accessible that supports governments, local administration, mining enterprises, environment NGO's and research Institutions. This example, which LAG members were able to witness, serves as a basic idea to adapt to the regional context for the future promotion of 3 projects of similar characteristics in the Center region.

Furthermore, from Czech Republic the development of a regional policy for mining where land-planning instruments are taken in consideration when regional plans for mining are built (two regions in Czech Republic have been developing this type of approach, which was also identified as a priority for Centro Region. It is the basic idea for the future promotion of a project concerning the development of the Centro Regional Mining Policy.

These shared examples led to the suggestion of the actions presented in Table 4:

Action-Objective	Improvement and valorisation of Endogenous Resources
<b>Main Objective</b>	Development of projects involving new mapping and prospecting processes, carried out in partnership between public and private institutions, in view of the synergies created for possible licensing processes, as well as monitoring, evaluation and environmental restoration projects, in order to improve and foster the mineral resources of the Central region (including groundwater).
<b>Vision</b>	Encourage co-promotion partners in the mining sector of Centro region
<b>Current context</b>	High number of occurrences indicating presence of economically viable deposits High number of dumps and tailings in the Centro Region that lead to the need for environmental assessment and restoration High number of research system entities with appropriate expertise in environmental assessment and monitoring and new technologies available for testing Business in need of metallic mineral resources mapping for start-up, exploitation and potential evaluation Development and application of new mapping technologies Business reluctance to switch to metal due to lack of information
<b>Organizations and principal partners</b>	Universities and R&D Centers National Laboratory of Energy and Geology (LNEG) Mining Companies (Metallic and Non-Metallic) Technology and biotechnology companies Mineral Resource Cluster
<b>Cronogram</b>	2019-2021
<b>Inspiration</b>	Lower Silesia Database Development of a regional mining policy in the Czech Republic

**Table 4** – Summary of characteristics related to Action Objective 2  
- Improvement and Vaporization of Endogenous Resources

Several projects were identified as necessary to be implemented by the LAG. As these are companies and research centers, the details of the projects were not provided, although the interest in continuing to be part of the REMIX LAG, in order to be able to apply the projects to the future notices of Centro2020 and Portugal2020. The following sectoral actions were thus identified:

Sectorial action	Institutions that will co-promote projects and their roles	Expected results	Estimated cost
<b>2.1 Assessment and mapping of the potential in deep metallic deposits with focus on critical minerals</b>	Universities, R&D centres and LNEG – Research, development and mapping Metallic mining companies – Provide data, access to test sites and support research work Mineral Resources Cluster – promote links between research entities and companies as well as dissemination CCDR Centro – Surveillance of works, calls and funding	1 co-promotion project for underwater robot use	500 k€
<b>2.2 Mineral resources assessment of the mining tailing and dumps</b>	Universities, R&D centres and LNEG – Research, development and mapping Metallic and non-metallic mining companies and EDM – Provide data, access to test sites and support research work Mineral Resources Cluster – promote links between research entities and companies as well as dissemination CCDR Centro – Surveillance of works, calls and funding	1 project analysing potential use of rejected mineral resources testing new technologies	350 k€
<b>2.3 Assessment and mapping of geothermal potential for the production of electricity</b>	Universities, R&D centres and LNEG – Research, development and mapping Renewables energy companies – Provide support to research work Thermal spas owners – access to groundwater holes Directorate General for Energy and Geology (DGEG) and CCDR Centro – Surveillance of works, calls and funding.	1 Evaluation and mapping project of geothermal potential for electricity generation, testing new technologies	250 k€
<b>2.4 Assessment and mapping of lithium resources</b>	LNEG, Universities and R&D centres – Research, development and mapping Metallic mining companies – Provide data, access to test sites and support research work	1 lithium assessment and mapping project testing new technologies	300 k€
<b>2.5 Geological mapping, exploration and inventory of the available mineral resources</b>	Mineral Resources Cluster – promote links between research entities and companies as well as dissemination CCDR Centro – Surveillance of works, calls and funding	1 Geological mapping, exploration and inventory project of available mineral resources, testing new technologies	1 M€
<b>2.6 Streamline access to exploitation and sustainable supply of resources, under properly framed legal conditions, with participation and follow-up of all stakeholders and interested parties – development of Centro Region Policy for Mining</b>	Universities, R&D centres and LNEG – Research, development and mapping Metallic mining companies – Provide data, access to test sites and support research work Mineral Resources Cluster – promote links between research entities and companies as well as dissemination CCDR Centro – Surveillance of works, calls and funding	1 Centro Region Mining Policy development project	250 k€
<b>2.7 Innovative technologies to restoration, environmental monitoring and control of the old mining sites</b>	Universities, R&D centres and LNEG – Research, development and mapping Metallic and non-metallic mining companies and EDM – Provide data, access to test sites and support research work Mineral Resources Cluster – promote links between research entities and companies as well as dissemination CCDR Centro – Surveillance of works, calls and funding	4 innovative technology projects for restoration, environmental monitoring and control of former mining contamination facilities	4 projetos de 200 k€ cada
<b>2.8 Assessment of the groundwater resources and the impacts of global change</b>	Universities, R&D centres and LNEG – Research, development and mapping Renewables energy companies – Provide support to research work Thermal spas owners – access to groundwater holes Directorate General for Energy and Geology (DGEG) and CCDR Centro – Surveillance of works, calls and funding	1 groundwater resources and global climate change impact assessment project, using new technologies, new mathematical models and new climate scenarios to study adaptation and mitigation options	200 k€

**Table 5 – Summary of characteristics related to the sectoral actions of the Action Objective II - Improvement and Valorisation of Endogenous Resources**

### 3.3. Financial Resources, actions and calendar

Centro 2020 OP could finance the projects under action 1 “Sustainable Industrial Solutions” and action 2 “Valorisation of Endogenous Resources” under IP 1.2 - the promotion of business investment in R&D, the development of links and synergetic between companies, research and development centers and the higher education sector, in particular the promotion of investment in the development of products and services, in technology transfer, in social innovation, in eco-innovation, in applications of public interest, in the stimulation of demand, in networks, clusters and open innovation through smart specialization and the support of technological and applied research, pilot lines, early actions of product validation, advanced production and first production capabilities, particularly regarding key enabling technologies, and the dissemination of general interest technologies. In accordance with thematic objective 1.

Business sector and R&I system (see table for roles) would co-finance the needed resources to achieve actions results. According to Centro 2020 OP and future Centro OP (2020-2030) could include the financing of these activities. A total of 9.7M€ are needed to implement to fully implement action 1 (5.8M€) and action 2 (3.9M€), allowing to make a better allowing for better fund allocation with a clear notion of the needs of the Centro region.

The implementation of these actions should be articulated with National and regional funds available: Centro 2020OP and PT2020. The involvement of other institutions outside Centro Region can be an added value for mining industry consolidation in a new circular market, benefitting from other outside technological knowledge (which is foreseen in the submission of projects to have mixed funds from Centro 2020 OP but also from other Portuguese regions, enabling knowledge transfer from other Portuguese regions to Centro). The typology of calls, identified with CCDR Centro, that will open during this framework period that are in line with this Action Plan are described below.

## Typology of calls:

- *Individual Research and Development Projects* - Enterprise-led R&D projects comprising industrial research and experimental development activities leading to the creation of new products, processes or systems, or the introduction of significant improvements to existing products, processes or systems.
- *Research and Development Centers* - Projects aimed at the creation or reinforcement of companies' internal skills and capabilities in R&D. Research Centers may be associated.
- *Demonstration Projects in Co-Promotion* - Demonstration projects of advanced technologies and pilot lines that, starting from successfully completed R&D activities, aim to highlight, before a specialized and real situation public, the economic and technical advantages of the new technological solutions. not sufficiently technologically validated for commercial use.
- *Collective Actions* - projects that contribute to the improvement of the conditions of the surrounding companies, particularly those associated with immaterial factors of competitiveness of a collective nature, which materialize in the availability of collective or public goods capable of inducing dragging effects on the economy. Typology: Transfer and valorisation of Scientific and Technological Knowledge.

## Financing Features:

For companies, R&D projects and demonstrator projects:

- Business Sector
- For projects with an incentive of less than or equal to € 1 million per beneficiary: non-refundable incentive (lost fund)
- For projects with an incentive of over € 1 million per beneficiary: non-refundable incentive (lost fund) up to € 1 million
- For mobilizing programs 3 M € - 10 M €
- Maximum duration - between 24 months and 36 months.
- Non-Commercial Sector, IR System: Non-Refundable Incentive



In accordance with the PT2020 notice opening plan (where the notices in which the Centro2020 participates are located), and the respective notice schedule expected to open in the third and fourth quarter of 2019, the following actions are considered to be carried out and monitored in phase II of the REMIX project:


- Preparatory Actions – designed to alert promoters to the need to prepare for project development and concrete content as well as alert LAG to the opening of the different types of calls and their alignment with the execution of this Action Plan.
- Definition of projects – concrete definition of projects and project writing by LAG members
- Project submission – LAG application alignment with the Action Plan
- Beginning of Execution – after the evaluation and approval phase, monitoring of projects funded in the Centro region.

In this context, figures 2, 3 and 4 summarize the actions to be taken within the scope of phase II of the REMIX project (July 2019 to June 2021):




**Figure 2** – Chronological scheme of actions to develop during REMIX phase II

For action 1 we expect LAG to submit a total of 7 projects to Centro 2020 OP, with a financial envelop of 4.1M€, while the remaining 3 projects identified are expected to be submitted to next framework program with a financial envelop of 1.7M€ (see [figure 4](#) for details). This is expected to happen since the stakeholder community is small and the capacity to apply to the same thematic calls is limited due to human resources needed to prepare the applications.

	2019		2020				2021				2022				Foreseen budget
	3ºT	4ºT	1ºT	2ºT	3ºT	4ºT	1ºT	2ºT	3ºT	4ºT	1ºT	2ºT	3ºT	4ºT	
<b>Calls Opening</b> 	IP&D co-promotion	IP&Dind Nucleos Demonstr ColectA	IP&Dind Nucleos Demonstr ColectA								After REMIX phase II				
Communication actions															
Preparatory actions															
Submission of projects															
Evaluation															
Execution															
1 - Sustainable Industrial Solutions	1	3	7				3	3			LAG monitoring				5 800 000 €
2 - Improvement and Valorisation of Endogenous Resources	2	4	6				3	4							3 900 000 €

**Figure 3** – Integrated scheme of open calls, number of estimated projects to submit in each notice for each action line and actions to be undertaken during phase II of REMIX.

For action 2 we expect LAG to submit a total of 10 projects to Centro 2020 OP, with a financial envelop of 3.5M€, while the remaining 2 projects identified are expected to be submitted to next framework program with a financial envelop of 0,4M€ (see [figure 4](#) for details). This is expected to happen since the stakeholder community that has technological potential is small and the capacity to apply to the same thematic calls is limited due to human resources needed to prepare the applications.

	2019		2020				2021				2022				Budget foreseen
	3 <sup>o</sup> T	4 <sup>o</sup> T	1 <sup>o</sup> T	2 <sup>o</sup> T	3 <sup>o</sup> T	4 <sup>o</sup> T	1 <sup>o</sup> T	2 <sup>o</sup> T	3 <sup>o</sup> T	4 <sup>o</sup> T	1 <sup>o</sup> T	2 <sup>o</sup> T	3 <sup>o</sup> T	4 <sup>o</sup> T	
<b>Calls Opening</b> 	IP&D co-promotion	IP&Dind Nucleos Demonstr ColectA	IP&Dind Nucleos Demonstr ColectA								After REMIX phase II				
<b>1 - Sustainable Industrial Solutions</b>	<b>1</b>	<b>5</b>	<b>2</b>												<b>4.1M€</b>
1.1- Development and implementation of APT in mining projects		1									LAG Monitoring				1M€
1.2 R&D projects in automation,..., in underground environment		1									LAG Monitoring				1M€
1.3-Development of innovative technologies for sustainable exploitation of metallic and non-metallic mineral resources	1	1									LAG Monitoring				0.7M€
1.4 Turn mining wastes in raw materials and also reinforcing the circular economy		2	2								LAG Monitoring				1.4M€
<b>1 - Sustainable Industrial Solutions</b>	<b>NEXT FRAMEWORK PERIOD - 3 projects</b>													<b>1.7M€</b>	
<b>2 - Improvement and Valorisation of Endogenous Resources</b>	<b>2</b>	<b>3</b>	<b>5</b>												<b>3.5M€</b>
2.1 Assessment and mapping of the potential in deep metallic deposits with focus on critical minerals	1										LAG Monitoring				0.5M€
2.2 Mineral resources assessment of the mining tailing and dumps		1									LAG Monitoring				0.35M€
2.3 Assessment and mapping of geothermal potential for the production of electricity		1									LAG Monitoring				0.25M€
2.4 Assessment and mapping of lithium resources			1								LAG Monitoring				0.3M€
2.5 Geological mapping, exploration and inventory of the available mineral resources			1								LAG Monitoring				1M€
2.6 Development of Centro Region Policy for Mining			1								LAG Monitoring				0.25M€
2.7 Innovative technologies to restoration, environmental monitoring and control of the old mining sites	1	1									LAG Monitoring				0.4M€
2.8 Assessment of the groundwater resources and the impacts of global change			1								LAG Monitoring				0.2M€
2.9 Assessment of the potential of unconventional water sources (quarries and other abandoned sites)			1								LAG Monitoring				0.2M€
<b>2 - Improvement and Valorisation of Endogenous Resources</b>	<b>NEXT FRAMEWORK PERIOD - 2 projects</b>													<b>0.4M€</b>	

**Figure 4** – Integrated scheme of open calls, number of estimated projects to submit in each notice for each action line to Centro 2020 OP.

This action plan has been [endorsed by CCDR Centro](#).

**Subject:** Interreg Europe Project REMIX - Action Plan endorsement

Centro Regional Coordination and Development Commission - CCDRC, as the Managing Authority of the Regional Operational Program for Centro Portugal - CENTRO2020 - , expressed from the outset all support to the **Universidade NOVA de Lisboa, Faculdade de Ciências e Tecnologia (NOVA FCT)** as REMIX partner of the Centro Region of Portugal, and has also been a member of the Local Group of Stakeholders.

We had the opportunity to participate in five meetings of the Local Stakeholder Group and five interregional events (Prague, Valladolid, Delphi, Fundão and Wroclaw).

In these contexts, it was possible to follow and participate in the development of the project and to be aware of the quality of the work developed.

The Action Plan results and brings together the contributions of all the stakeholders involved and constitutes a working tool of great utility for the development of this important sector at Centro region.

In this context, we endorse the Action Plan submitted by the **Universidade NOVA de Lisboa, Faculdade de Ciências e Tecnologia (NOVA FCT)** in the context of the Interreg Europe project REMIX.

Coimbra, June 2019

Sincerely yours,



Prof. Ana Abrunhosa

President of Centro Regional Coordination and Development Commission



# 4. Acknowledgments and References

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# Annex I: History and legal context of the mining industry in Centro Region

## History

Tungsten, one of the EU critical raw materials (EC, 2017), is exploited in the region for over 120 years in the Panasqueira mine. The potential for this metal is high in the region with over 110 occurrences (oc.) registered in the national database SIORMINP (The Portuguese Mineral Occurrences and Resources Information System). Apart from tungsten, the potential for tin (153 oc.), lithium (several known potential areas, e.g. for Guarda-Mangualde or Argemela), uranium (409 oc.) and gold (51 oc.) is also high (SIORMINP, 2018). Associated to those, other less abundant metals can occur, like niobium, tantalum and beryllium, also labeled as critical raw materials (DGEG, 2017). These last metals can be part of the mineral paragenesis of the major mineral deposits and be exploited as by-products.

Non-metallic mineral resources are also very important to Centro Region, with the ornamental stone and the industrial minerals to have a great impact in the regional economy. The number of companies and the total production of these metallic and non-metallic resources are increasing in the region but, in some of them as tungsten and tin in Panasqueira mine, are dependent of the world market for these kinds of commodities. In the period between 2007 and 2016, the production of non-metallic resources, including ornamental stone, was much higher comparing to metallic resources.

The annual average production of metallic minerals in the region was around 1600 tons and for the non-metallic, in the same period, reach more than 750.000 tons (DGEG, 2017). The average revenue of the all non-metallic sector is around 18.000.000 € and for the metallic is 5.500.000 €. Both are extremely important sectors in the region and like other industries the future demand will be expectedly high; by consequence, leading companies will have to adjust to the market and develop new technologies in a more sustainable and environmentally friendly procedures.

One of the main challenges that companies will face is the transition from carbon dependent to green energies (solar, wind power, etc.). The mining industry is nowadays seen as reticent to this transition, however the renewable energies need high amounts of mineral resources, some of them critical. For example, the infrastructure of a wind turbine is filled with cement (limestone, aggregates, etc.), solar panels have quartz, turbines have copper and iron, and the most popular example is lithium and cobalt for electric car batteries.

To optimize and maximize the potential of an extractive activity there are several factors that can be considered, from exploration to metallurgy, involving all value chain. Included are secondary resources, tailings and rejected materials. These contain low grade ore and possibly other elements with economical value (e.g. critical raw materials) as well as materials that can be used for mainly construction purposes (mineralization host rock).

As mentioned before, European mining activity is low particularly considering the metallic sector. This paradigm needs to change and to tackle it the industry has to be more competitive and stronger. The lack of economic mineral deposits, the unpredictable commodities value variation, low social acceptance, environmental problems are common obstacles for the follow-up of mining projects. The absence of proper metallurgical infrastructures to increase the concentration of the ore is fundamental to companies and could increase the creation of mining activity. This case is particularly present in Europe. Circular economy and modernization through technology are already patent in the region through several national or international projects, involving companies, sectors and clusters (see chapter 3.1 for details). More investment has been directed to non-metallic resources which generates more economical revenue, employment and the creation of companies in the region, especially for the ornamental stone sector.

## Legal context

Until 2015, Mining industry was regulated by the Decree-Law 90/90, of March 16, which established the General Regime for the Discovery and Use of Geological Resources and by specific Regulations for each type of mineral resource (Decree-Law 84/90, of March 16, which established the Spring Waters Regulation; Decree-Law 85/90, of March 16, which established the Heavy Waters Regulation; Decree-Law 86/90, of March 16, which established the Mineral Waters Regulation; Decree-Law 87/90, of March 16, which established the Geothermic Resources

Regulation; Decree-Law 88/90, of March 16, which established the Mineral Deposits Regulation and Decree-Law 270/2001, of October 6, which established the Quarries Regulation).

In June 2015, the Legal Framework for the Discovery and Use of the Geological Resources located in Portugal (including National Maritime Space) – Law 54/2015 of 22 June – was enacted (the “Geological Resources Law”). The Geological Resources Law revoked Decree-Law 90/90, of March 16. The main changes around the new Mining Code (Law 54/2015) were:

- Addition of more resources (ex: geological heritage, natural mineral waters, spring waters)
- “Public Domain” includes more mineral resources such as gypsum, white clays and special sands (Public Domain=mineral deposits, mineral waters, mineral industrial waters, geothermic resources, geological resources located in the seabed and subsoil of the national maritime space; Private Domain=quarries and spring waters;
- The granting of rights over the public domain goods is subject to the award of a concession contract, while the granting of rights over the private domain goods is subject to a licensing procedure, with increase relevance of experimental exploitation permits;
- Financial funding supported by the mining industry (through royalties) to be used in research, knowledge, geological heritage protection and valuing of geological resources, among others.

The creation of this new legal regime derived from the National Strategy for Geological Resources (ENRG-RM) – Council of Ministers Resolution 78/2012 – which envisaged the establishment of a new – more efficient – legal and institutional framework. **The ENRG-RM main purposes are to promote the mining sector in order to be more:**

- 1.** Dynamic, ensuring the uptake and holding of investment and proper exploitation of the resources;
- 2.** Sustainable at economic, social, environmental and territorial levels;
- 3.** Capable to promote the growth of the national economy, by ensuring supply of essential raw materials and reinforces its contribution to the national Gross Domestic Product and exports growth and
- 4.** Capable to promote regional development, ensuring the economic revenues and employment for local people and development of the local communities.

## Governance aspects

According to Decree-Law No. 90/2018 of 9 November, the Ministry of Environment and Energetic Transition (MEET) is the main government body that drives, executes, formulates and evaluates, among others, climate change, climate, energy and geology in a sustainable developing perspective and social and territorial cohesion. This ministry has power over the Directorate General for Energy and Geology (DGEG), which is responsible for the definition, implementation and evaluation of the geological and energy policies, is also the main administrative entity on the licensing, granting and claiming of mining concessions.

The Geological Resources Law acknowledges and regulates the concept of exploration. To conduct exploration, an entity must hold a prior evaluation right over area/areas designed for the exercise of activities for the use of metallic mineral deposits. Such right is granted under an administrative contract (with a maximum non-renewable term of one year) and may be requested to DGEG by any entity with recognised technical, economic and financial suitability. Prior evaluation rights entitle the holder of such rights to develop studies to allow a better knowledge of the geological potential of the envisaged area, namely through the analysis of available information and samples taken from the area.

To conduct exploration of mineral deposits, one must hold an exploration and research right or an experimental exploitation right. The procedure for obtaining exploration and research rights may be initiated by the interested parties through the submission of an application, or by the Portuguese State through a tender procedure (subject to the provisions of the Public Procurement Code), while the experimental exploration rights are granted at the request of the interested parties. These rights may only be granted over available areas (except if there is no incompatibility between the concessions granted, or to be granted, and the prospecting and research rights) and to legal entities who give proof of suitability and financial and technical capacity to perform these activities. The contract for prospecting and research activities and for experimental exploitation rights has a maximum term of five years.

A prospecting and research title give the right to develop activities aimed at the discovery of resources and the definition of their characteristics, until the determination of the economic value of any resources found. If the discovered resources fail to have the necessary conditions to initiate their immediate and effective exploitation, the interested parties may submit an application

for experimental exploitation rights. These rights are granted through an administrative contract, with a maximum legal term of five years, and entitle their holder to perform the same activities as those entrusted to a holder of an exploitation title.

Both, exploration and research (1) and experimental exploitation right holders (2) have the right to temporarily use the land necessary for the performance of works (and establishment of the facilities) and the granting of those rights is accompanied by the creation of an administrative easement over the relevant area. The holders of a concession agreement (exploitation right) may obtain, by means of an administrative act, the necessary administrative easements for the exploitation of resources. In certain circumstances, neighbouring land may be subject to said easement. These administrative easements have the maximum legal term of seven years, without prejudice to the possibility of continuing occupying land with the consent of the owner of the land.

Rights	Short description	Area and conditions
<b>Preliminary permit</b>	First approach for undertake studies in order to increase knowledge in mineral resources of an area mainly through analysis of available information and from samples from the study area	<b>Maximum area</b> - 15 km <sup>2</sup> <b>Duration</b> - 1 years <b>Decision</b> - Directorate General for Energy and Geology
<b>Exploration and Research</b>	Development of activities for increase the level of knowledge and related characteristics of the geological resources. Estimation of resources (economic value)	<b>Maximum area</b> - 500 km <sup>2</sup> (onshore) <b>Duration</b> - 5 years (max) <b>Decision</b> – Ministry of Environment and Energetic Transition
<b>Experimental Exploitation</b>	Before applying for an exploitation permit and there is not the necessary level of knowledge of a mineral deposit. Can be defined as an extension of the exploration and research phase	<b>Duration</b> - 5 years (max) <b>Decision</b> – Ministry of Environment and Energetic Transition
<b>Exploitation</b>	Extraction and beneficiation of mineral resources	<b>Duration</b> - 90 years (max) <b>Decision</b> – Ministry of Environment and Energetic Transition

**Table 6** – Summary of the typologies of mining contracts

The start and end of a mining activity involving geological resources are subject to technical rules, environmental protection, sustainability and landscape recovery measures:

- Decree-Law No. 151-B/2013 of 31 October, as amended by Decree-Law No. 179/2015 of 27 August, provides that mining projects are subject to an Environmental Impact Assessment (EIA), which includes an Environmental Impact Statement (EIS), in order to determine the direct and indirect effects and consequences of the project on the environment, and to recommend sustainable remedies to compensate or minimise those effects. The EIS is a document prepared by the proposer under the EIA protocol, which contains a summary description of the project, identification and assessment of the likely positive and negative impacts of the project in the environment.
- An environmental license is also required. This license is an administrative instrument that ensures that the best industrial techniques available are used, including remedies to minimise waste production, and air, noise, water and soil pollution.

The main environmental authorisations applicable to mining activities are: (1) a favourable environmental impact assessment (EIA) declaration – issued under the environmental impact assessment legislation; or (2) a favourable (more simplified) environmental assessment declaration – issued according to Natura 2000 legislation. The type of authorisation shall depend on the size, location and area occupied by the operation at stake. Specific authorisations, such as the licensing for the use of water resources, shall also be necessary.

Pursuant to the Geological Resources Law, a financial guarantee shall be delivered together with the exploration and research, experimental exploitation and exploitation agreements in order to ensure compliance with the contract, the landscape recovery and the closure of mines. In accordance with the Regulation on Waste Management of Mineral Deposits' Exploitation, the holder of the mining right must submit a waste management plan, which must be reviewed every five years. The facilities for the storage of tailings or other waste products are subject to a licensing procedure with DGEG or the Regional Directorate of Environment and Energetic Transition, depending on the type of the facility. Closure obligations include the removal of all constructions and installations, the removal and delivery of all waste to a final destination in a duly licensed facility and the environmental recovery of the area according to an environmental and landscape recovery plan previously approved by the authorities.



Mining operations may only be carried out in areas designated for these activities in the applicable municipal zoning plans or in areas where mining is considered compatible with the use foreseen in the municipal zoning plan. In some cases, the municipal plan may not be completely updated in relation to special zoning plans approved by the Government determining legal restrictions for environmental purposes and, therefore, said plans and restrictions must also be taken into account.

## Reinforcement mechanisms

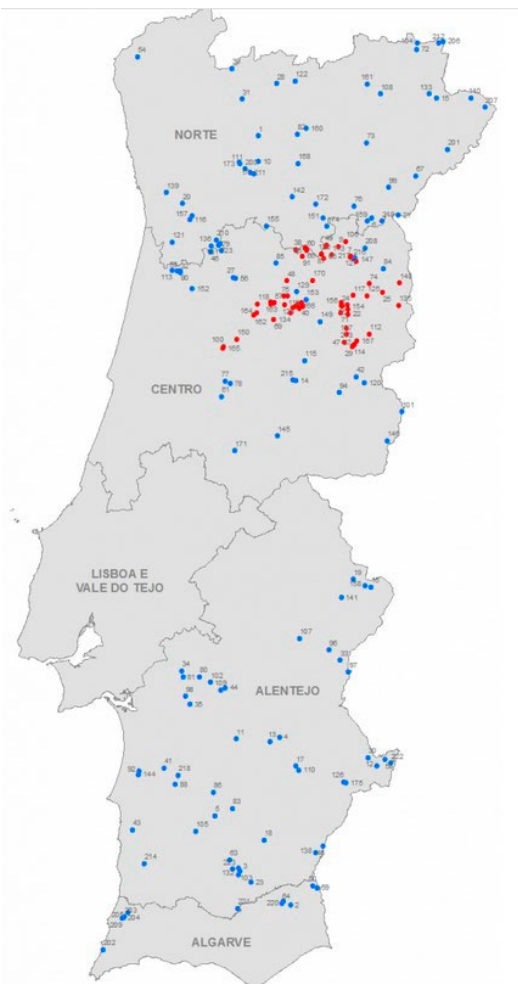
As any industry, there are positive and negative impacts in the environment and society. Mineral resources are exploited since the beginning of ages with no concern for land, populations or the environment, in the Portuguese territory that activity is still very well preserved. Iron, copper, lead, gold, silver, tungsten and tin were strongly exploited in the past mostly in the Alentejo, Centro and North regions.

In the Centro Region tungsten, tin, gold, silver and uranium were the most exploited substances and particularly uranium led to the most prejudice for the environment. The production of radioactive ores started in the XX century and ended in the beginning of the XXI, at this time from tailings. The exploitation of the Panasqueira mine (over 120 years) have also produced a large amount of tailings (around 8.000.000 m<sup>3</sup>) that contain significant quantities of arsenic, lead, copper and iron. More than 190 sites are identified as requiring remediation works in the country, 62 are related to radioactive ores and the remaining for polymetallic sulphides and non-metallic minerals (<https://edm.pt/area-ambiental/inventariacao-de-areas-mineiras/>).

In the Centro Region there are 91 sites identified: 60 related to radioactive ores, 15 for tungsten and tin, 10 for gold, silver, copper, zinc and lead and 6 for non-metallic minerals (e.g. quartz and feldspar) (<https://edm.pt/area-ambiental/inventariacao-de-areas-mineiras/>). In Portugal, the State conferred to Empresa de Desenvolvimento Mineiro (EDM), S.A., the concession for the environmental remediation of abandoned mines (Decree-Law No. 198-A/2001). The enforcement mechanism is patent in the main goals of this state company:

- Eliminate the risk factors for public health and safety, resulting from water pollution, soil contamination, heaps and any unprotected areas;
- Rehabilitate the surrounding landscape and natural conditions of development in accordance with the previous Habitat;

- Ensure the preservation of significant heritage of old mines, both economic and archaeological and the valorisation of archaeological remains related to mining activity;
- Provide conditions for future use of reclaimed areas such as agricultural or forestry use, tourist and cultural promotion, or another that promotes the community development.



**Figure 4** – Map of Portugal with the location of the 199 abandoned mining areas according to EDM inventory (*for more information see: <https://edm.pt/area-ambiental/inventariacao-de-areas-mineiras/>*). In red are represented the radioactive areas and in blue the remaining.

**The investment for these operations were the following:**

- 98 M € (2000-2015)
- 43 M € (2016-2020)
- 65 M € (estimated for the remaining)

**As for the funding sources:**

- Cohesion Funds
- Portuguese mining operators royalties

The rehabilitation, remediation, monitoring and maintenance works that are being carried out by EDM following Decree-Law No. 198-A/2001. Upon on the conclusion of the Environmental Remediation of Old Mining Areas Plan, Portugal will correct environmental liabilities and impacts of centuries of mining activity. Some sites have already been remediated (as shown in Figure 4) and are being monitored for mining waste management, water treatment, soil decontamination, landscape and habitat integration, heritage preservation and acid mining drainage control and reduction. These works are being carried out by Portuguese state owned company EDM, with aid of cohesion and mining operators royalties as well as EU funding programmes (see chapter 3.1 for details). Several stakeholders (companies, universities, municipalities, etc.) are also active members and contribute greatly to this public service and national/international projects have been carried out related to these subjects.

# Annex II: Methodology and works developed

## Methodology

The methodology used by REMIX in the Centro Region has gone through several steps with the objective of building the Action Plan here presented, in order to foster the number of mining industry projects developed under the investment priority 1.2 of Centro 2020 OP, fostering partnerships between business and research institutions, contributing to develop more sustainable and environmentally friendly circular business models.

### **In this context, the following steps were implemented:**

- 1.** Creation of Local Action Group (LAG) with representatives from public, private and research institutions
- 2.** Exchanging knowledge within LAG to promote synergies
- 3.** Collect and compile information on past funded mining sector projects in Centro Region
- 4.** Presentation of point 3 to LAG
- 5.** Identification and sharing of national and international good practices
- 6.** LAG discussion of strategic mining actions for the Centro region
- 7.** Definition of actions with the LAG
- 8.** Identification of potential funding calls for submission of identified project lines of action
- 9.** Communication and consultation with the LAG of draft action plan
- 10.** Further improvement considering LAG consultation
- 11.** Completion of the first phase of REMIX

## Funding evolution of projects of mining industry in Centro Region

During REMIX project Phase I a digital database was created for the Centro Region of Portugal, with different types of information but closely related to the mining sector. One of the focus were the projects financed from national/international funds since the early XXI century, that concerned the beneficiation from regional endogenous natural resources (metallic and non-metallic raw materials, R&D and innovation in sectorial SMEs, clean energies, remediation of old mining sites, etc.). Such a dense amount of data was stored in a Microsoft Excel data sheet containing the programmes and projects summarized in Table 7.

**Table 7** – Summary of National and European funding programmes analyzed in the search for mining projects carried out in Centro Region.

PROGRAMME	START YEAR	END YEAR	FUNDING
Sixth Framework Programme (FP6)	2003	2007	European Comission
FP7	2007	2013	European Comission
Horizon 2020 (H2020)	2015	2017	European Comission
POVT	2007	2013	Cohesion Fund
PT2020 (PO SEUR)	2016	2018	ERDF, Cohesion Fund, ESF, EAFRD*, EMFF*
MAIS CENTRO	2008	2014	ERDF
CENTRO2020	2015	2017	ERDF
COMPETE2020	2015	2017	ERDF

Legend: FP7 - 7th Framework Programme for Research and Technological Development; POVT - Operational Programme 'Territorial Enhancement'; PO SEUR – Operational Programme for Sustainability and Efficient Use of Resources; ERDF - European Regional Development Fund; ESF - European Social Fund; EAFRD - European Agricultural Fund for Rural Development; EMFF - European Maritime and Fisheries Fund; \*Not related to this study. The colors refer for the transition between programs; start and end year of the allocated projects consulted for this study.

In this chapter, the number of projects that fall inside each operational programme, their objectives, costs, contributions, participants (if possible), and the sector of the natural resources that were financed is presented. This last factor will be relevant to check which sector had or has more investment, the metallic resources sector (contains the major of EU critical raw materials), non-metallic resources sector (industrial minerals, natural stone, etc.), energetic resources, geotourism, rehabilitation of old mining areas and geothermic resources; some projects can have more than one subject.

The gathering of data was only for **Portuguese programmes and international programmes with Portuguese participation**, the information was downloaded from the web through the following websites:

- <https://www.portugal2020.pt/Portal2020/conheca-a-lista-de-projetos-aprovados-do-portugal-2020>
- <http://www.centro.portugal2020.pt/index.php/projetos-aprovados> (CENTRO2020)
- <http://www.poci-competite2020.pt/Projetos> (COMPETE2020)
- <http://www.maiscentro.qren.pt/index.php?acao=projectos&m=m7&s=0> (MAISCENTRO)
- <https://poseur.portugal2020.pt/pt/candidaturas/candidaturas-aprovadas> (POVT)
- <https://ec.europa.eu/programmes/horizon2020/en/h2020-sections-projects> (H2020)
- [https://cordis.europa.eu/guidance/archive\\_en.html](https://cordis.europa.eu/guidance/archive_en.html) (FP6, FP7)

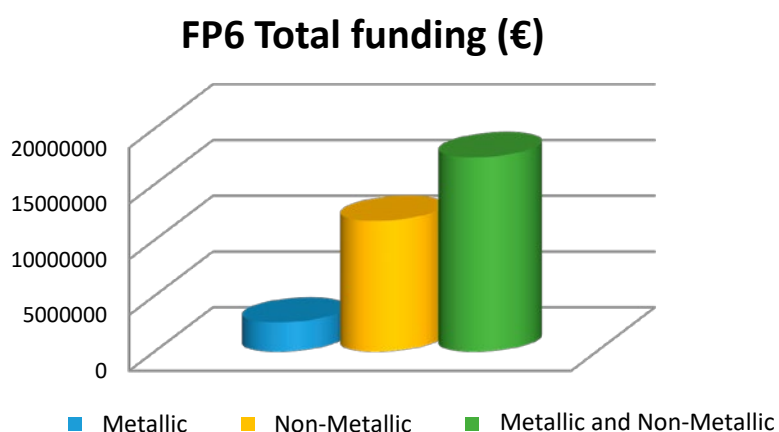
After the collection of this massive amount of data, the projects were categorized in the previous types of subjects (metallic, non-metallic, geotourism, etc.) and then compiled for future consultation and development of the Action Plan Actions to be developed.

### FP6 - Sixth Framework Programme (2003-2007)

From the Sixth Framework Programme (FP6) 3 projects were identified:

- Biotechnology for Metal bearing materials in Europe (1)
- Monitoring deep seafloor hydrothermal environments on the Mid-Atlantic Ridge (2)
- Re-engineering of natural stone production chain through knowledge-based processes, eco-innovation and new organizational paradigms (3).

For the FP6 it was not possible to obtain the contribution awarded to each country but only the entire funding per project with Portuguese participation in the consortia (Figure 5), being the investment made higher in non-metallic mineral resources (see [Annex I](#) for details on funding).



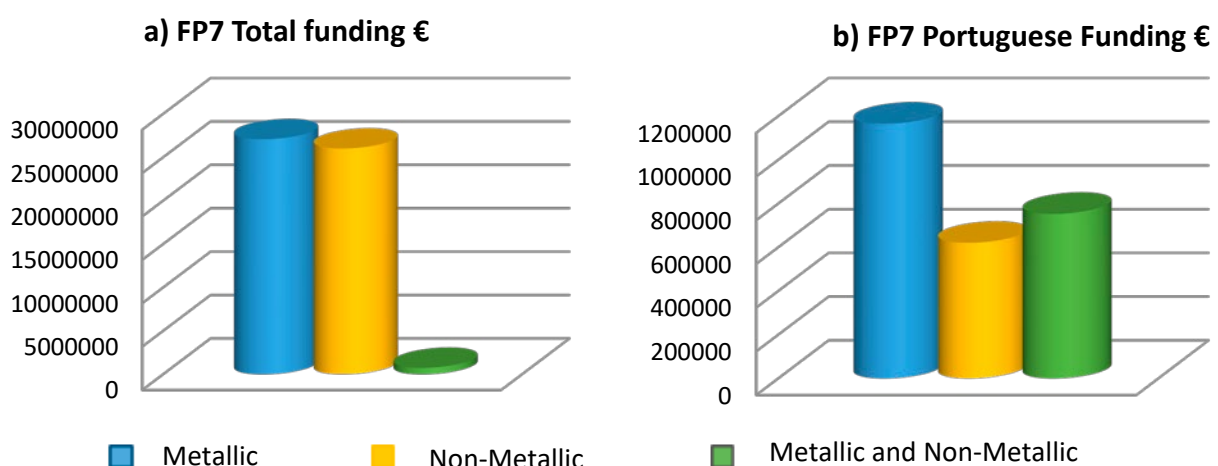
**Figure 5** – Total funding in FP6 with Portuguese Participation discriminated by metallic, non-metallic and metallic and non-metallic (mix).

### FP7 Framework Programme (2007-2013)

In the 7th Framework Programme 10 projects were identified:

- Integrated Methods for Advanced Geothermal Exploration (1)
- Development of a Novel Stone Sawing Equipment to valorise Undersized and Irregular Stone Blocks for a more rationale Use of Natural Stone Quarry Resources (2)
- Development of an automated classification system for polished stone slabs and tiles (3)
- Geothermal ERA NET (4)
- Minerals Intelligence Network for Europe (5)
- European Research Area - Network on the Industrial Handling of Raw Materials for European Industries (6)
- Managing Impacts of Deep-sea reSource exploitation (7)
- Breakthrough Solutions for the Sustainable Exploration and Extraction of Deep Sea Mineral Resources (8)
- Nano-particle products from new mineral resources in Europe (9)
- SUSTainable, innovative and energy-efficient CONcrete, based on the integration of all-waste materials (10)

In Figure 6 we can see that tough in European Union the total funding between metallic and non-metallic is similar, the analysis of the funding attributed to Portugal is higher for metallic resources. For details on funding attributed consult [Annex I](#).



**Figure 6** – FP7: a) Total funding of consortia with Portuguese participation; b) Portuguese funded participants, discriminated by metallic, non-metallic and metallic and non-metallic (mix).

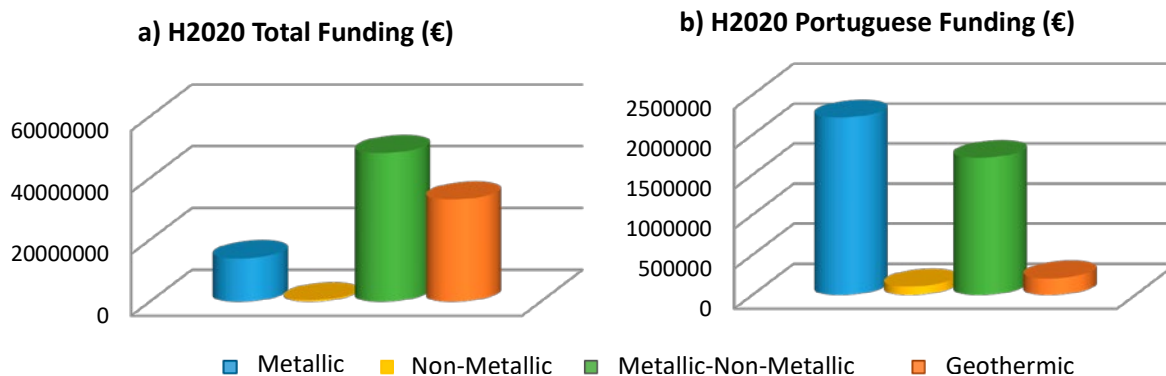
## **H2020 (2015–2017 period analysed)**

In Horizon 2020, in the period 2015-2017 analyzed, the following 13 projects were identified:

- Combined Heat, Power and Metal extraction from ultra-deep ore bodies (1)
- Viable and Alternative Mine Operating System (2)
- International cooperation on Raw materials (3)
- ERA-NET for materials research and innovation (4)
- Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe (5)
- Developing a concept for a European minerals deposit framework (6)
- National Contact Points for Climate action, Raw materials, Environment and Resource Efficiency (7)
- Real-time optimization of extraction and the logistic process in highly complex geological and selective mining settings (8)
- GEOTHERMICA - ERA NET Cofund Geothermal (9)
- Integrated mineral technologies for more sustainable raw material supply (10)
- Autonomous Underwater Explorer for Flooded Mines (11)
- Sustainability-driven international/intersectoral Partnership for Education and Research on modelling next generation CONCRETE (12)
- Reuse of mining waste into innovative geopolymeric-based structural panels, precast, ready mixes and insitu applications (13)

The analysis of Figures 6 and 7 shows that, in the European Union, there was a tendency to increase the amounts attributed to projects devoted to metallic and mix (metallic and non-metallic), with a big decrease in funded projects exclusively dedicated to non-metallic resources. We can also note an increase in the amounts attributed to geothermic project ([Figure 4](#)). The Portuguese participation in the programme is mainly at metallic and mix level. For details on funding attributed consult [Annex I](#).





**Figure 7** – H2020: a) Total funding of consortia with Portuguese participation; b) Portuguese participants funded, discriminated by metallic, non-metallic, metallic and non-metallic (mixt) and geothermic.

### POVT - (2007-2013)

In the Operational Programme ‘Territorial Enhancement’, in the period 2007-2013, 20 projects were identified, related to the environmental rehabilitation and monitoring of old mining areas. From construction works, safety works, monitoring and control, to requalification of these areas, the identified projects are mainly in Centro Region but also in the North and Lisbon. Empresa de Desenvolvimento Mineiro (EDM), as the public entity and unique responsible for these operations in Portugal, was the main beneficiary of the Cohesion Funds. The total cost of the 20 projects were 27.731.870,58 €, most of the projects being related to old radioactive mine sites.

### PT2020 PO SEUR - (2016-2018)

In PT2020 PO SEUR - Operational Programme for Sustainability and Efficient Use of Resources, several projects (5) were directed for environmental rehabilitation and monitoring of old mining areas, the remaining 4 projects were related to non-metallic resources. EDM was the only beneficiary of the 23.435.506,39 € for remediation works. Biomass use for energy production and the potential for hydrogen in Portugal were the remaining projects, being the beneficiaries Laboratório Nacional de Energia e Geologia I.P. and DGEG (Direcção Geral de Energia e Geologia), with funds of 526.032,9 €. All these projects were implemented in Centro Region.

### MAIS CENTRO (2008-2014)

In the programme MAIS CENTRO, in the period 2008-2014, 9 projects were identified: 4 related to geothermal and thermal resources (Beneficiaries: Associação das Termas de Portugal; Meda Municipality; Viseu Municipality – Total funds 2.439.322,51 €), 1 for geotourism (Beneficiaries: Idanha-a-Nova

Municipality - Total funds 668.664,16 €), 1 for metallic resources (Beneficiaries: University of Aveiro - Total funds 889.713,56 €) and 3 projects for non-metallic resources (Beneficiaries: University of Aveiro; CTCV company; Arganil Municipality - Total funds 17.032.667,45 €). All these projects were implemented in Centro Region.

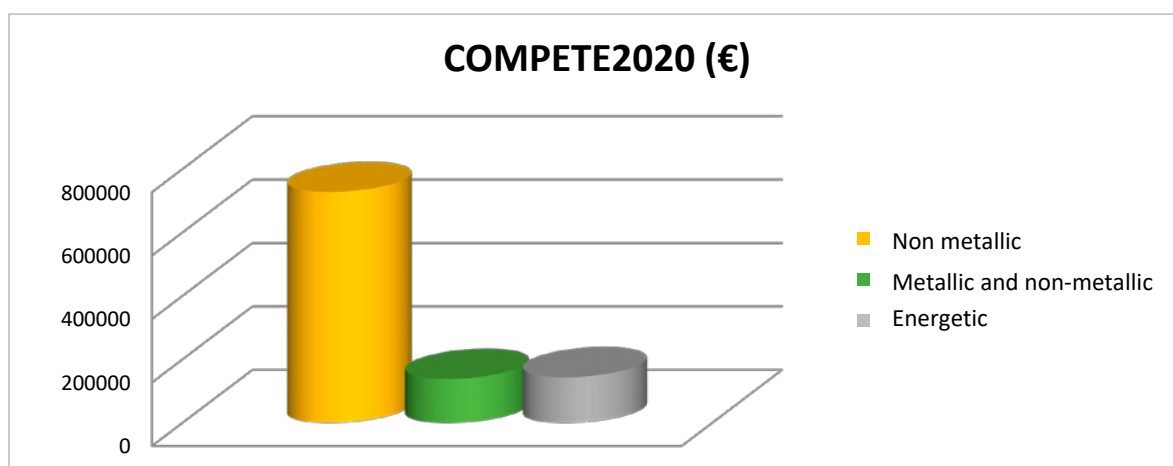
### **CENTRO 2020 (2015-2017)**

In the programme CENTRO 2020, in the period 2015-2017, 35 projects were identified. One project related to metallic resources shows the importance of lithium in Guarda region (Beneficiaries: Polytechnic Institute of Guarda - Total funds 125.758,38 €), 32 related to non-metallic resources (due to the high number of projects the entire list is not be presented. The projects were part of the research, development and innovation (a) and competitiveness and internationalization on the regional economy (b) priority axis, the funding involved is of 13.566.584,57 €, divided between academia and companies. One project is related to metallic and non-metallic resources, denominated “ReNATURE - Valorização dos Recursos Naturais Endógenos da Região Centro” (Beneficiaries: University of Coimbra - Total funds 1.359.991,80 €), and the remaining project is related to energetic resources and the funding was 215.400,85 €. All these projects were implemented in the Centro Region).

### **COMPETE 2020 (2015-2017)**

From COMPETE 2020, in the period 2015-2017, 7 projects were identified:

- Management and dynamization of the actions of the Cluster of Mineral Resources (1)
- mSCM: Mobile technologies for the supply chain of ceramic raw materials (2)
- FlexStone: New Technologies for the Competitiveness of Natural Stone (3)
- INOVSTONE 4.0: Advanced Technologies and Software for Natural Stone (4)
- RnMonitor: Online Monitoring Infrastructure and Strategies for Active Mitigation of Radon in the Indoor Air in Public Buildings of the Northern Region of Portugal (5)
- CALCITEC: blue limestone and chromatic alteration, innovation and technology (6)
- IN STONE: SMART NATURAL STONE (7)
- For details on funding consult [Annex I](#).



**Figure 8** – COMPETE 2020: Total funding discriminated by non-metallic, metallic and non-metallic (mix) and energetic.

From the above information there is a **clear dominance of funded projects related to metallic resources**, mainly in projects funded directly by European Union (FP7, H2020). The number of projects funded by the EU related to raw materials are increasing, as shown from the transition from FP6 to H2020 programmes. In Portugal and in Centro Region, although the Portuguese participation in EU projects, the National funds attributed were mainly devoted to non-metallic resources, and more directly for the **natural stone sector and the remediation of old mining areas**. There are occurrences of critical raw materials in the Centro Region (including the tungsten Panasqueira mine), that are part of the **metallic resources, but there is not significant investment to allow the development of these resources and possibly trigger their exploration and exploitation**. REMIX Action Plan hopes to contribute to foster eco-innovative ways of exploring metallic resources in Centro Region, as well as to the current development of natural stone and remediation activities.

## Good practices from Portuguese mining sector

**NOVA University of Lisbon (PP6) identified 3 good practices that are already stored in the REMIX project database:**

- 1.** REMINE H2020-MSCA-RISE intersectoral action aiming the valorization of mining and other mineral wastes into construction materials, particularly by alkali-activation technology;
- 2.** Remediation of abandoned mines in Centro Region of Portugal: The Urgeiriça uranium mining area example;
- 3.** Abandoned quartz mine transformed into a museum - an example of Geological Heritage Preservation.

These good practices are related with (1) remediation and rehabilitation of abandoned mining areas and (2) about the tailings and waste rock associated with past extractive industry with direct association with the previous.

### **1) New materials from mining waste – circular economy**

The critical raw material tungsten is exploited for over 120 years in the Panasqueira mine, currently owned by Almonty group. Tungsten is the main commodity exploited in the mine but tin and copper are also exploited as by-products. The typical mineralogy of this mineral deposit includes several sulphides (copper, iron, lead and arsenium) and silicates. Large volumes of tailings are present in Panasqueira and represent geotechnical, physical, chemical and visual issues. Some waste material from the mine is used in road construction and for bituminous mixtures, but there is still large volumes of rock with no end use. More recently researchers from the University of Beira Interior carried out several studies in fine tailings in order to reuse them as raw material for alkali-activated binders. Through the project REMINE H2020-MSCA-RISE, and its research team, a new compound used for construction bricks was created with alkali activation technology that is more resistant, cheaper and faster to produce, emits no CO<sub>2</sub> and does not require drinking quality water in its production. These researchers also created a startup company (Eco2blocks) that won an international competition (ClimateLaunchpad) with innovative blocks composed of the same “green” compound (Figure 9).



**Figure 9** – Eco2blocks receiving the International Competition Prize from Internacional ClimateLaunchpad.

## 2) Urgeiriça remediation

Mine water management and treatment are part of an important work performed by EDM integrated in the environmental rehabilitation design projects. One of the main objectives of mine waste confinement is to prevent the contact of rainwater and runoff with the wastes to avoid the leachates generation. The confinement solutions should be complemented with clean water and leachate separated drainage systems (Carvalho et al., 2015).

After collection the contaminated waters are treated either recurring to active or passive treatment systems. In 2015 EDM had treatment plants for uranium and radium contaminated water in the following old mines Urgeiriça, Cunha Baixa, Quinta do Bispo, Castelejo, Bica, Vale da Abrutiga and Prado Velho. In those cases, the active treatment systems consist in adding lime milk or sodium hydroxide and barium chloride in a set of mixing tanks followed by sedimentation ponds/tanks. The passive treatment systems have some variations but in general include steps of aeration and/or open limestone drains, sedimentation ponds, biological treatment (aerobic wetlands) and final filtration in limestone, barite and activated carbon (Carvalho et al., 2015).

Long term maintenance of these areas considers a gradual transition from active treatment plants to passive treatment systems of mine water and leachates having as a perspective of more sustainable management post-remediation mining areas and also the decrease in contaminates concentrations (Diamantino et al., 2015).

In Urgeiriça a passive treatment system was installed in 2012 in the old mine shaft n° 4 to decontaminate seepage water that outflows and as a result of the controlled mine flood (Figure 10). The monitoring results in the last three years proved that this system is efficient by promoting the decrease and significant removal of radionuclides and heavy metals concentrations to levels below regulatory standard limits. The calculated removal efficiency rates by comparing initial and final average concentrations along treatment path (medium values in the first semester 2015) are greater than 90% for Fe, Mn, Utotal and Ra-226 (Diamantino et al., 2015; Pinto et al., 2015).



**Figure 10** - Urgeiriça (shaft n.º 4) mine water passive treatment system layout and hydraulic data (V= Volume; Q= Flow; RT = Retention time) (Pinto et al., 2015)

Removal efficiency rates of mine water passive treatments were calculated based on laboratory results from chemical and radiological analysis and considering main contaminants for some mines (Table 8). Preliminary results demonstrated that EDM is implementing this type of systems with demonstrated success, in some cases associated with groundwater natural attenuation processes for uranium, radium-226 and other metals (Diamantino et al., 2015).

Mining area	pH initial(final)	Removal efficiency	Iron (mg/L)	Manganese (mg/L)	Utotal (ppb)	Ra-226 (Bq/L)
Urgeiriça (Shaft4)	6,37(7,47)	RE (%)	97%	96%	89%	99%
		Ci(Cf)	4,80(0,15)	5,54(0,22)	250(27)	1,214(0,013)
Bica	4,67(7,76)	RE (%)	98%	97%	89%	99%
		Ci(Cf)	10,48(0,22)	4,08(0,12)	45,5(4,86)	0,853(0,010)
Freixiosa	6,20(7,09)	RE (%)	90%	37%	89%	99%
		Ci(Cf)	6,46(0,67)	0,78(0,49)	8,97(1,00)	0,690(0,010)

RE - Removal efficiency (%); Ci - initial concentration; Cf - final concentration, after passive treatment

**Table 8** - Removal efficiencies rates of passive treatment systems (average values from first semester 2015) (Diamantino et al., 2015)



The high removal efficiency of the radioisotopes from the contaminated water combined with the removal and confinement of the residues of the old tailings led to a high reduction in the exposure of the population to ionizing radiation in the old uranium mining areas. Data collected in Urgeiriça and Cunha Baixa allowed to calculate the effective dose before and after the remediation works and the values are now close to those estimated for the natural background of Beiras region.

### 3) Quartz Museum

Also near Viseu, quartz was exploited by the “Companhia Portuguesa de Fornos Eléctricos”, in the local known as “Santa Luzia Hill”. For 25 years a large quartz vein was extracted altering the landscape of the area, and the result was the creation of a crater with several meters, deforestation and other negative visual impacts for the local community. With the vision of geologists and the Viseu Municipality, the exploitation was rehabilitated and a museum dedicated to quartz was built, being unique in the world. This activity promotes education and heritage with special attention to the mineral quartz, as well as the rehabilitation of the old mining area.



**Figure 11** – Outside view of the Quartz Museum

Source: [https://pt.wikipedia.org/wiki/Museu\\_do\\_Quartzo](https://pt.wikipedia.org/wiki/Museu_do_Quartzo)

**Figure 12** – Interior aspect of Quartz Museum.

Source: [https://www.google.com/search?q=museu+do+quartzo&rlz=1C1CAFA\\_enPT624PT628&source=lnms&tbn=isch&sa=X&ved=0ahUKEwic3aK7tfXiAhVu1-AKHQ2ZC1QQ\\_AUIECgB&biw=1280&bih=529#imgrc=2drLZMwITNKsM:](https://www.google.com/search?q=museu+do+quartzo&rlz=1C1CAFA_enPT624PT628&source=lnms&tbn=isch&sa=X&ved=0ahUKEwic3aK7tfXiAhVu1-AKHQ2ZC1QQ_AUIECgB&biw=1280&bih=529#imgrc=2drLZMwITNKsM:)





#### 4) Other examples from Portugal – Water Remediation

There are more examples of successful cases of old and abandoned mining areas rehabilitation and remediation. Mainly related to the exploitation of base metals, contaminated waters with a pH below 3 are a serious risk for fauna and flora, the more severe cases in Portugal are in Lousal, Aljustrel and São Domingos (all mines inserted in the Iberian Pyrite Belt). In Lousal the treatment of effluents deriving from the multiple run-offs that take place through contaminated lands led to the setting up of the passive treatment of 17 lagoons with floating macrophytes (water plants), rooted in an alkaline substrate, over an area with 2 hectares. This treatment is undergoing monitoring and assessment but is already showing, considering the high content of metals in the water to be treated ( $\text{pH} < 3$ ), a reduction in the main contaminating components, specifically in terms of sulphates, arsenic, aluminium, iron, copper and chrome, even if the pH correction has not yet occurred. This feature requires the introduction of complementary systems for the correction of this parameter (DGEG-EDM, 2011).



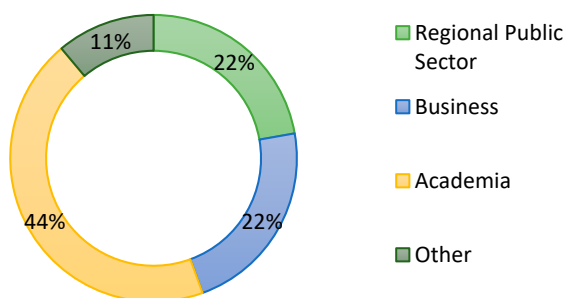
**Figure 13** – Lousal mine. Pictures represent the acidic waters and the lagoons with floating macrophytes for reduction of pH and metals concentrations.

Source: <https://edm.pt/projetos/recuperacao-ambiental-da-antiga-area-mineira-do-lousal/>

## Stakeholder Contributions

According to the REMIX methodology, the Local Action Group (LAG) was created with the aim of adding to the project various types of knowledge and visions about the mining sector, in order to promote synergies to catalyse the development of future projects. REMIX in Centro Region aimed at boosting the circular economy and at the same time reducing the negative impact that some of the mining operations have at various levels. The objective was to structure a LAG that ensured a broad representation of sectors (business, academia and the public sector - Figure 14) and thematic areas of the various stakeholders. A total of 17 institutions, 65 participants, were involved. A total of 5 meetings were held (Table 9) to which an international peer review meeting was added in which the LAG participated.

LAG member typology



**Figure 14** – Typology of members of the REMIX Local Action Group in the Centro Region.

### The Local Action Group was constituted by the following entities:

- Public Sector: Fundão City Hall, Guarda City Hall, Nelas City Hall, Mangualde City Hall, CCDR Center, Alentejo CCDR, National Engineering and Geology Laboratory (LNEG);
- Companies: Mining Development Company (EDM), Beralt Tin and Wolfram (Portugal), SA, Pegmatítica Lda;
- Academy: Faculty of Science and Technology of the NOVA University of Lisbon, Pedro Nunes Institute (IPN), University of Coimbra (UC), University of Beira Interior (UBI), University of Évora, Polytechnic Institute of Guarda (IPG), Polytechnic Institute of Viseu (IPV), Polytechnic Institute of Castelo Branco;
- Others: Geological and Mining Engineering College of the Engineers Professional Board, Cluster Portugal Mineral Resources, UNESCO NaturTejo Geopark

The following is a summary description of the main objectives, activities and results of the LAG consultations.

### **Kick-off LAG meeting**

Coimbra, 27.07.2017 (8 participants)

#### *Purpose/activities*

To engage with the stakeholders and present context, the legal framework, the objective and the agenda of the REMIX project INTERREG Europe

Support of SME and new spin-offs and the benefits of an integrated approach were in the centre of the discussion as a mean to develop the Centro Region's economy and create sustainability.

Other themes such as knowledge transfer with focus on collaboration between Enterprises – Universities – Polytechnic Institutes – Technological Centre's, the promotion of Research & Innovation in the mining sector (more specifically Research and prospection), the social-economic benefits and the extractive industry were part of the discussion.

#### *Outcome*

The main conclusions where the importance on the expansion of the Portuguese stakeholder group to enhance a structured engagement. Debate on how to approach important SME's on the mining sector, R&I experts and others. Means to bring together a larger group of stakeholders.

### **Second LAG meeting**

Guarda, 19.12.2017 (26 participants)

#### *Purpose/activities*

Dissemination of REMIX and other projects developed and being implemented in Centro Region was done to leverage their results, finding and/or creating synergies between them were part of the discussion.

Due to the positive results of the previous meeting, a much larger group was present in the second Stakeholder group meeting and that required a presentation of the REMIX Project by Alexandra Ribeiro, FCT UNL, therefore engaging the newcomers. So that everyone gets up to speed the latest schedule of upcoming activities was shared.

The agenda provided the opportunity for stakeholders to present their cases from the Centro Region, including ongoing and/or completed projects:

- Geology as the basis of quality of life? The sustainability of lithium in the village of Gonçalo (Guarda) - Ana Maria Antão and Pedro Melo Rodrigues, IPG;
- REMINE H2020-MSCA-RISE - Reuse of mining waste into innovative geopolymeric-based structural panels, precast, ready mixes and in situ applications - João Castro Gomes, UBI.

To sum up the meeting it was discussed the development opportunities in the Centro Region, Portugal.

The company Pegmatítica – Mineral Society of Pegmatite Lda. granted access to the Mine facilities and the Geologist Alexandra Carolino gave the group a visit tour to C-57 lithium mine, located in Gonçalo - Guarda, Portugal. The preparation of the peer review (PRV) to be carried out in Portugal at the end of the 4th semester started to be formulated.

### *Outcome*

As a result of project “Geology as the basis of quality of life? The sustainability of lithium in the village of Gonçalo (Guarda - Portugal)” the authors concluded that there is no evidence of negative effects produced by the lithium extraction on the quality of water and soil. And that for the air quality, there is an evidence of a negative influence of the mine exploitation on the PM10 concentration, yet below the legal limit of 50  $\mu\text{g}/\text{m}^3$  (daily mean). This outcome may affect the local SME’s in the Centro Region in a constructive way.

As far of the impact of the project “Reuse of mining waste into innovative geopolymeric-based structural panels, precast, ready mixes and in situ applications” the aim is to take advantage of the recent developments in the areas of materials science, processing engineering, structural engineering, infrastructure systems, arts and design and market perspectives, turning mining waste into valuable materials for infrastructure and building products.

Schedule of upcoming activities including the local action group meeting was also prepared.

### Third LAG meeting

Nelas, 9.05.2018 (36 participants)

#### *Purpose/activities*

To better disseminate REMIX and other projects in the Centro Region, to leverage their results, by trying synergies between them. Preparation of the Peer Review to be take place on the December 2018, in Portugal, continued to be formulated. Brainstorm session with stakeholders, inviting them to formulate projects they would like to be integrated in the Action Plan for Centro Region, which is the basis for the presentation of this Action Plan.

The larger stakeholder group (compared to the second stakeholder group meeting) required a presentation of the REMIX Project by Alexandra Ribeiro, FCT UNL, and a background information presentation “The mineral potential of the Centro Region of Portugal: mineral deposits and mining projects” by Frederico Martins, José Kullberg & José Almeida, FCT UNL;

The agenda also provided the opportunity for stakeholders to present their cases from the Centro Region, including ongoing and/or completed projects/works:

- Projects BioCriticalMetals and PTW: bio(micro)technologies to support a circular economy of raw materials - Paula V. Morais, CEMMPRE, Department Sciences of Life, FCT, UC;
- Microorganisms in bioremediation: the case study of Urgeiriça – Romeu Francisco, CEMMPRE, Department Sciences of Life, FCT, UC;
- Environmental remediation of abandoned mines in Portugal – Edgar Carvalho, Empresa de Desenvolvimento Mineiro ;
- Quantification of the radiological risk associated to the exploration of radioactive minerals, before and after the rehabilitation: the case of the old mining area of Urgeiriça – Alcides Pereira, Department of Earth Sciences, UC;
- The national and Regional activity of the Colégio de Engenharia Geológica e de Minas da Ordem dos Engenheiros; Cluster Portugal Mineral Resources – Luís Martins, LNEG;
- Skills and capacities of the Department of Environment of the School of Management and Technology, IPV, in the area of interest of the REMIX project, including the presentation of the “basic idea” of a Regional development project - Luis Simões, Sérgio Lopes and Pedro Baila, IPV;
- ESMIMET project - Development of interRegional capacities: strategies in metallic mining - Ana Manaia and Cecília Lavrador, IPN.

At the end of the session Alexandra Ribeiro made a synthesis presentation followed by a discussion that allowed the stakeholders to contribute in the scope of the Action Plan for the Central Region.

During the afternoon with the contribution of Empresa de Desenvolvimento Mineiro, S.A (EDM) the stakeholders were invited to visit the environmental requalification of the area of the old chemical treatment workshops and buildings of the former mining perimeter, guided by Eng. Edgar Carvalho. Afterwards, the stakeholders were invited to visit the Quartz museum – Galopim de Carvalho Interpretation Center.

#### *Outcome*

The project BioCriticalMetals and PTW is conceived as a need-driven-research, focused on the concept (mandatory) that waste can become a valuable resource, supplying metals that are extracted today by other processes, promoting recycling, minimizing harmful waste and hazard and dissipation. The selection of the target minerals/ metals in the project addresses the need for continuous supply of these in Europe for technology, anticipating a future cost effectiveness potential of the practical application of the expected research results.

Schedule the upcoming local action group meeting, share of knowledge about the Centro Region and current projects involving the smart specialisation and green mining, discussion/overview of the problematic areas of the Centro Region, brainstorm about how to overcome these problems, development of new project ideas in the line of the OP and RIS3 actions that the REMIX project aims to gather the contributes that are included in this action plan.

### **Fourth LAG meeting**

Fundão, 7.11.2018 (15 participants)

#### *Purpose/activities*

Logistic aspects related to the international meeting (8PRV) to be held on 11th and 12th December, Fundão, Portugal. Workshop preparation: important subjects and questions to be discussed in each parallel session by all the peers.

#### *Outcome*

Establishment of four subjects and questions to be addressed by the peers in each four workshop sessions. Assignment of stakeholders to moderate or rapporteur of the round tables.



## International Peer-review meeting

The 8th Peer Review Visit (PRV) of REMIX was held in Fundão between the 10 and 12th of December 2018. The total attendance of the 3 days event was of 66 persons from 9 European Union countries, from different typologies of stakeholders ranging from business to academia. The objective of this PRV was to share experiences with international REMIX project partners and their stakeholders, so that the conclusions could be included in the Action Plan.

The peer meeting was divided into two sessions, in a first session the following presentations were made:

- Reflection on the mining sector and suggestion on sectoral policies – Carlos Caxaria, Geological & Mining Eng. College, Engineers Professional Board
- R&D, sustainability and inventory of resources in the mining sector – Daniel de Oliveira, National Laboratory of Energy and Geology (LNEG)
- The importance of clusterization: Portuguese examples in circular economy and in land use planning – Luís Martins, LNEG
- Environmental remediation of old mining areas in Centro Region, Portugal – Edgar Carvalho, Empresa de Desenvolvimento Mineiro S.A. (EDM)
- UNESCO Naturtejo Geopark best practices in sustainable development and geotourism – Carlos Neto Carvalho, UNESCO Naturtejo Geopark
- MIREU current status and cooperation with REMIX – Santiago Cuesta Lopez, International Center for Advanced Materials and Raw Materials of Castilla y Leon and Ilari Havukainen, Regional Council of Lapland
- e.THROUGH H2020-MSCA-RISE – Alexandra Ribeiro, FCT NOVA
- REMINE H2020-MSCA-RISE – João Castro Gomes, University of Beira Interior



**Figure 15** – Presentation by Carlos Caxaria (College of Geological and Mining Engineering of the Order of Engineers)



These presentations were followed by a workshop session that was divided in four groups that discussed four different themes previously sent to the participants: **1.** Education and social acceptance of mineral resources exploration and mining; **2.** Circular economy; **3.** Innovation and technology in mining and value chain; **4.** The importance of geological knowledge, in order to identify problems and solutions to them in each of them.

### *Results*

#### Session 1 - Education and Social Acceptance of Mineral Resources Exploration

The issue of social acceptance is one of the most important that mining industry faces today. In order to diminish this negative perception, it is necessary for experts to inform the population correctly and to explain the importance natural resources have on modern day to day life. This is a direct consequence of poor earth science education at an early age and general public's lack of awareness of the role of mineral resources in the world.

#### *Session 2 - Circular Economy*

After a strong debate, the main conclusions reached were:

- Need for business association for problem solving (cascade use by different companies)
- Database to solve the problem related to information access
- Virtual marketplace to support/help new business models
- Governmental funding (eg grants for research/infrastructure development; tax reduction for recycled materials)
- Open innovation for new technology problems
- Need of market research for alternative products
- Research

The recovery of critical raw materials from secondary resources, as well as the recycling of metals, requires specific conditions and diverse methodologies to be sustainable, many of them under investigation. There is still a strong lack of knowledge and information in this area, from its composition to its final use. The solutions presented focused on business associations, funding and research.

#### *Session 3 - Innovation and Technology in Mining and Value Chain*

Both innovation and technology are side by side, linked to the evolution of the mining industry. Not only by discovering new mineral deposits, but also by maximizing existing resources (primary and secondary); improve energy use and efficiency while making gradual transition to clean energy sources; the knowledge associated with this area and the importance of synergies between universities and industry; The gradual implementation of Industry 4.0 were the themes identified as priorities by this working group.



**Figure 16** – Private session group dynamics dedicated to Innovation and technology in mining and value chain

#### *Session 4 - The Importance of Geological Knowledge*

This working group has concluded that major surface deposits have already been explored and, as a result, the challenge that mining companies face today is to find deep to very deep mineral deposits. This reality means that companies must invest more in project exploration phases. Geosciences and engineering can together play a key role in this area. With the transition to electric vehicles and the demand for specific metals, mining projects must re-evaluate their potential as suppliers of these metals. National and international investment in mining projects, especially in Europe, is low, so the promotion, dissemination and synergies of such projects may possibly trigger more economic movements in various regions and countries. Ease of access to data was a much-discussed topic during this session, which is reflected in the identification of priority 2) of this Action Plan.

### **Fifth LAG group meeting**

#### *Purpose/activities*

Revision of the draft version of the REMIX Action Plan, which sought to compile all actions that the LAG considered relevant for the development and implementation of a more eco-efficient and circular mining industry in the Centro region: Action 1 - Sustainable Industrial Solutions; Action 2 - Improvement and valorisation of endogenous resources; and Action 3 - Territorial Innovation.

## Result

Identification of the appropriate measures to follow up in current Centro 2020 OP, the measures that should be excluded for legal and/or other reasons and which could potentially be incorporated into the documents of the next Centro OP.

Meeting location	Date	Part	Activities	Main conclusions
Coimbra	27.07 .2017	8	Kick-off meeting; Engage with the stakeholders; Share the vision of REMIX of promotion of the economic, social and environmental sustainability.	The REMIX goals responded to stakeholder interest. Solutions to overcome the problems in the involvement of other stakeholders and expansion of the Local Action Group
Guarda	19.12 .2017	26	Sharing of Centro Region's Projects; Discussion of development opportunities in the Centro Region; Scheduling of upcoming activities; Aspects related to the international meeting (8 <sup>th</sup> PRV, Fundão, Portugal, December 10-12 <sup>th</sup> , 2018).	Larger understanding on what activities are on going in the Centro Region
Nelas	9.05. 2018	36	Sharing of Centro Region's Projects; Discussion of development opportunities in the Centro Region; Scheduling of upcoming activities and aspects related to the 8 <sup>th</sup> PRV, Fundão, Portugal, December 10-12 <sup>th</sup> , 2018; Engagement with the stakeholders to contribute for the Centro Region's Action Plan.	Inputs for the Centro Region Action Plan, including actions (NOVA University).
Fundão	7.11. 2018	15	Logistics aspects related to the international meeting (8 <sup>th</sup> PRV, Fundão, Portugal, December 10-12 <sup>th</sup> , 2018); Peer Review workshop framework; Workshop preparation: parallel sessions of Peer Review of the Centro Region.	Proposal of topics to be discussed in each session; Contributions: complementary issues for each theme.
Coimbra	22.04 .2019	27	Review of actions that should merge in the Action Plan to promote the development and implementation of a more eco-efficient and circular mining industry in the Center region; Discussion and improvement of draft Action Plan	Identification of measures to be followed in the next framework program.

**Table 9** – Summary of the main conclusions of the LAG meetings

# Annex III: Summary of projects funded in centro region related to mining sector

## 6th Framework Programme (2003-2007)

From the 6FP, in the period 2003-2007, 3 projects were identified:

- (1) Biotechnology for Metal bearing materials in Europe
- (2) Monitoring deep seafloor hydrothermal environments on the Mid-Atlantic Ridge
- (3) Re-engineering of natural stone production chain through knowledge based processes, eco-innovation and new organizational paradigms

Project	Subject	Total Cost €	EU Contribution €	Participants	PT Participant(s)
(1)	<i>Metallic and non-metallic</i>	17.442.380	11.566.000	PL;UK;BE;DE;EL;ES;FR;NL;FI;ZA;SE;RO;PT	Instituto nacional de Engenharia, Tecnologia e Inovação
(2)	<i>Metallic</i>	2.618.044	2.618.044	DE;UK;ES;SE;PT;FR	Fundação da Universidade de Lisboa Universidade dos Açores
(3)	<i>Non-metallic</i>	11.742.650	6.759.934	EL;SE;AT;BE;DE;ES;NL;DK;PT;IT;IE;CH;RO;BG;PL;UA;AR;RU	CEVALOR

**Table 10** – Summary of projects funded under 6th FP that involve Portugal partners

### 7th Framework Programme (2007-2013)

From the 7FP, in the period 2007-2013, 10 projects were identified:

- (1) Integrated Methods for Advanced Geothermal Exploration
- (2) Development of a Novel Stone Sawing Equipment to valorise Undersized and Irregular Stone Blocks for a more rationale Use of Natural Stone Quarry Resources
- (3) Development of an automated classification system for polished stone slabs and tiles
- (4) Geothermal ERA NET
- (5) Minerals Intelligence Network for Europe
- (6) European Research Area - Network on the Industrial Handling of Raw Materials for European Industries
- (7) Managing Impacts of Deep-sea resource exploitation
- (8) Breakthrough Solutions for the Sustainable Exploration and Extraction of Deep Sea Mineral Resources
- (9) Nano-particle products from new mineral resources in Europe
- (10) SUSTainable, innovative and energy-efficient CONcrete, based on the integration of all-waste materials

Project	Subject	Total Cost €	EU Contribution €	Participants	PT Participant(s)
(1)	Non-metallic	13.402.774,21	10.051.044,75	FR;NO;ES;CH;IS;PT;DE;IT;CZ;NL	EDA Renováveis, S.A.
(2)	Non-metallic	1.625.962,32	1083489	PT;EL;IT;ES;TR;BE	Mármore Galvão-Eduardo, Galvão Jorge & Filhos SA (73363,94€); IST (?)
(3)	Non-metallic	1.497.907,47	1.130.614,95	PT;EL;IT;ES;TR;BE	Frontwave – Engenharia e Consultadoria SA (173706,42€); MASERC-Mármore, SA (92097,24€); IST (9507,95€)
(4)	Metallic and non-metallic	2.365.068,61	1.999.958	IS;DE;TR;NL;IT;FR;PT;HU;CH;SK;SI	EDA Renováveis SA (25680€)
(5)	Metallic and non-metallic	2.784.588	1.999.000	AT;CY;NL;RO;EL;AL;DE;BE;HR;PT;IT;FR;DK;C;H;SK;NO;CZ;SE;HU;ES;PL;IE;SI;UK	Laboratório Nacional de Energia e Geologia I.P. (43121€)
(6)	Metallic	1.692.771,58	1.490.000	ES;DE;NL;RO;TR;FI;SE;HU;FR;SK;PL;PT	FCT (60000€)
(7)	Metallic	12.349.937,79	8.997.112	NO;DE;FR;NL;UK;PL;BE;ES;PT;IT;RU	IMAR (509730€); University of Algarve (220771€)
(8)	Metallic and non-metallic	14.741.716	9.999.999	DE;NL;BE;UK;PT;NO	FFCUL (434711€)
(9)	Metallic and non-metallic	17.232.739,1	10.999.664	SE;NL;FR;PT;PL;FI;EL;MT;DE;UK;ES	LNEG (473806€); AGC Minas de Portugal Lda. (175932€)
(10)	Non-metallic	7.128.681,01	4.500.000	IT;DE;PT;NL;EL;UK;RO;TR;TW;ES	CENTITVC (246242,60€)

**Table 11** – Summary of projects funded under 6th FP that involve Portugal partners from Centro region

## **H2020 (2013-2017 period analyzed)**

From H2020, in the period 2013-2017, 13 projects were identified:

- (1) Combined Heat, Power and Metal extraction from ultra-deep ore bodies
- (2) Viable and Alternative Mine Operating System
- (3) International cooperation on Raw materials
- (4) ERA-NET for materials research and innovation
- (5) Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe
- (6) Developing a concept for a European minerals deposit framework
- (7) National Contact Points for Climate action, Raw materials, Environment and Resource Efficiency
- (8) Real-time optimization of extraction and the logistic process in highly complex geological and selective mining settings
- (9) GEOTHERMICA - ERA NET Cofund Geothermal
- (10) Integrated mineral technologies for more sustainable raw material supply
- (11) Autonomous Underwater Explorer for Flooded Mines
- (12) SUsustainability-driven international/intersectoral Partnership for Education and Research on modelling next generation CONCRETE
- (13) Reuse of mining waste into innovative geopolymeric-based structural panels, precast, ready mixes and insitu applications

Project	Subject	Total Cost (€)	EU Contribution (€)	Participants (Country abbreviation)	PT Participant(s)
(1)	<i>Metallic and Geothermal</i>	4.235.567,5	4.235.567,5	ES;HU;AT;FR;IS;PT;RO;SE;BE;UK	Laboratório Nacional de Energia e Geologia I.P. (107500 €)
(2)	<i>Metallic</i>	9.200.000	9.200.000	BA;ES;FR;AT;UK;PT;DE;NL;SI	INESC (951070 €); EDM (36503,50 €); MINERALIA (26364 €)
(3)	<i>Metallic and non-metallic</i>	2.111.375	2.104.800,88	UK;ZA;PT;ES;AT;BE;DE;AU;HU;SI;US	FCT (81175 €); APIMR (65000 €); RECIFEMETAL (97250 €)
(4)	<i>Metallic and non-metallic</i>	52.015.473,73	12.750.000	LT;ES;EE;NL;IS;DE;FR;CY;IT;SE;RU;TW;BE;HU;LU;CZ;BR;NO;SK;PL;BG;TR;RO;LV;ZA;IL;SI;IE;PT	FCT (200084 €)
(5)	<i>Metallic and non-metallic</i>	31.303.030,39	10.000.000	DE;LV;LU;FR;BA;MK;IT;BE;AL;RS;HU;AT;MT;PL;CZ;FI;UA;IS;NO;ES;PT;EL;HR;RO;SK;SE;DK;LT;IE;SI;CY;UK	Laboratório Nacional de Energia e Geologia I.P. (191982,69€)
(6)	<i>Metallic and non-metallic</i>	2.092.687,5	2.092.687,5	PT;BA;UK;ES;AT;IE;HU;BE;FR;RS;RO;SI;SE;PL;IT;ME;SK;HR;NL	FFCUL (59557,99 €); FCIENCIAS (29067,01 €)
(7)	<i>Metallic and non-metallic</i>	2.092.683,75	1.999.932	EE;IS;FR;CY;CZ;BE;EL;FI;PL;MD;RS;HR;CH;SK;NL;ES;LU;IL;SI;IT;PT	FCT (56050 €)
(8)	<i>Metallic and non-metallic</i>	6.566.702,5	5.629.199,75	DE;UK;NL;PT;FR	Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento (375583,75 €)
(9)	<i>Metallic and non-metallic</i>	33.109.160	8.589.210,30	CH;FR;IS;DE;IT;PT;ES;NL;TR;RO;SI;IE;DK;BE	FRCT (104140,74 €); DGEG (104140,74 €)
(10)	<i>Metallic</i>	7.915.364,25	7.915.364,25	FI;FR;AT;ES;UK;ZA;DE;PT;TR	SOMINCOR - Sociedade Mineira de Neves-Corvo SA (498875 €)
(11)	<i>Non-metallic</i>	4.862.865	4.862.865	ES;FR;HU;UK;SI;FI;PT	INESC (984750 €); GEOPLANO (105625 €); EDM (149750 €);
(12)	<i>Metallic and non-metallic</i>	504.000	468.000	PT;ES;NL;DE	Universidade do Minho (108000 €)
(13)	<i>Metallic and non-metallic</i>	567.000	567.000	PT;ES;PL;IT;UK	Universidade da Beira Interior (103500 €); SOFALCA (27000 €); BEIRA SERRA (27000 €)

**Table 12** – Summary of projects funded under 6th FP that involve Portugal partners from Centro region



### COMPETE 2020 (2015-2017 period analysed)

From the programme COMPETE 2020, for the period 2015-2017, 7 projects were identified:

- (1) Management and dynamization of the actions of the Cluster of Mineral Resources
- (2) mSCM: Mobile technologies for the supply chain of ceramic raw materials
- (3) FlexStone: New Technologies for the Competitiveness of Natural Stone
- (4) INOVSTONE 4.0: Advanced Technologies and Software for Natural Stone
- (5) RnMonitor: Online Monitoring Infrastructure and Strategies for Active Mitigation of Radon in the Indoor Air in Public Buildings of the Northern Region of Portugal
- (6) CALCITEC: blue limestone and chromatic alteration, innovation and technology
- (7) IN STONE: Pedra Natural Inteligente

Project	Subject	Investment (€)	Beneficiaries	Region
(1)	<i>Metallic and non-metallic</i>	139.221,97	ACPMR - Associação Cluster Portugal Mineral Resources	Alentejo, Centro, North
(2)	<i>Non-metallic</i>	20.000	Adelino Duarte da Mota S.A.	Centro
(3)	<i>Non-metallic</i>	1.583.140,77	CEI - Companhia de Equipamentos Industriais LDA	North, Centro, Alentejo, Metropolitan Area of Lisbon
(4)	<i>Non-metallic</i>	5.736.877,35	CEI - Companhia de Equipamentos Industriais LDA	North, Centro, Alentejo, Metropolitan Area of Lisbon
(5)	<i>Energetic</i>	144.396,31	Polytechnic Institute of Viana do Castelo	North, Centro
(6)	<i>Non-metallic</i>	478.286,85	SOLANCIS - Sociedade Exploradora de Pedreiras S.A.	Alentejo, Centro
(7)	<i>Non-metallic</i>	708.565,95	SOLANCIS - Sociedade Exploradora de Pedreiras S.A.	Centro, North

**Table 13** – Summary of projects funded under 6th FP that involve Portugal partners from Centro region