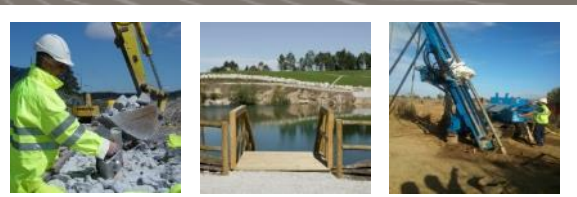
Interreg Europe

European Union | European Regional Development Fund

REMIX - Smart and Green Mining Regions of EU

# Environmental remediation of old mining areas in Centro Region, Portugal

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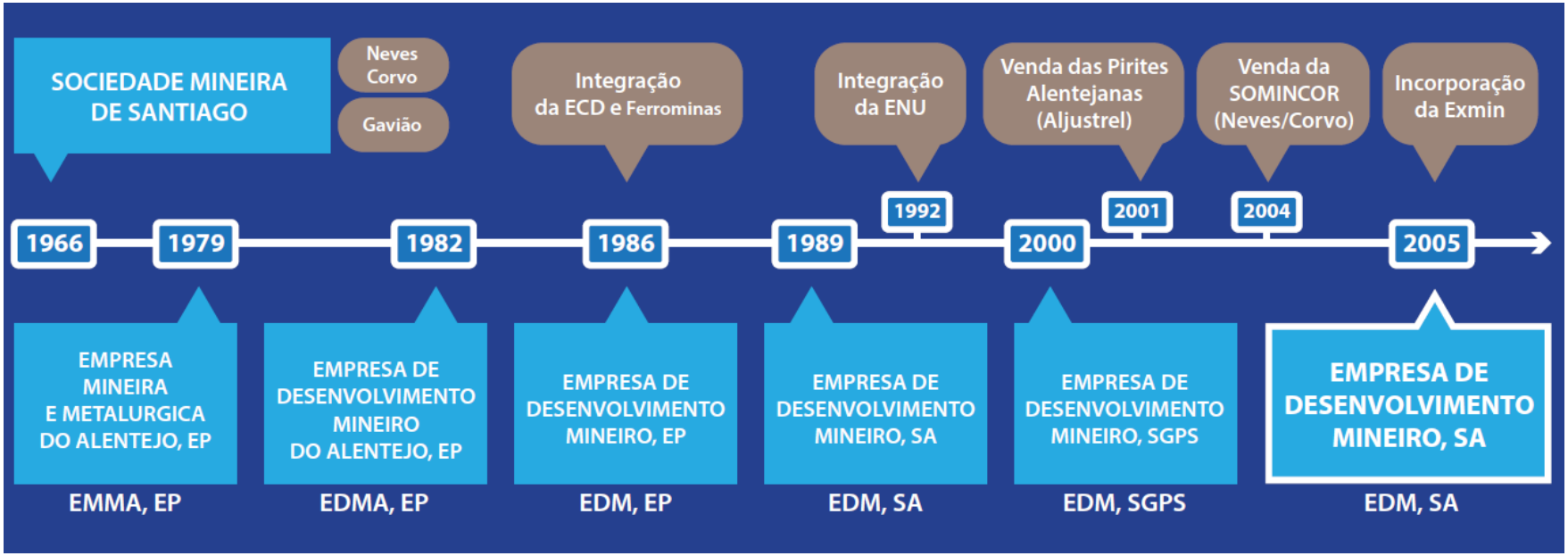
11th December 2018

edm

Empresa de Desenvolvimento Mineiro, SA

# EDM - Empresa de Desenvolvimento Mineiro

- EDM, a company with more than 50 years
  - Involved in almost all reference mining projects in Portugal






Empresa de Desenvolvimento Mineiro, SA

# EDM – Empresa de Desenvolvimento Mineiro

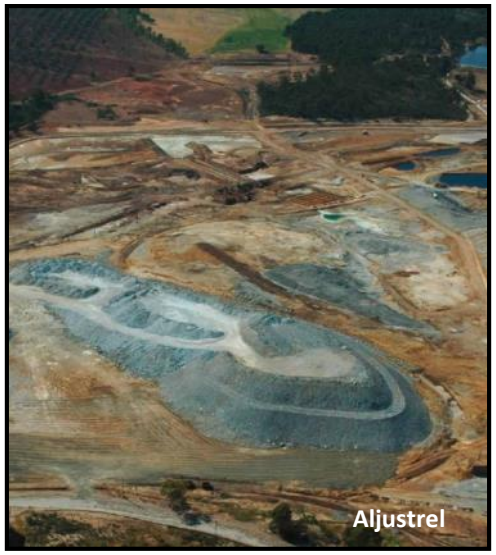
- EDM is a Portuguese State owned company, which operates mainly in two areas:
  - **Mineral Resources Exploration:**
    - By itself or in Joint-Ventures, develops exploration activities of mineral deposits in world class metallogenic provinces of Portugal aimed at maximizing its mineral resources potential for exploitation
  - **Environmental remediation of old mining areas**
    - In an exclusive basis, under a concession contract with the Portuguese Government, develops and conducts the **environmental remediation** and monitoring of abandoned mining sites in Portugal

# Environmental remediation of old mines

- Why?
  - Mining is a very old activity in Portugal
  - During Roman times (from I B.C. to IV A.C.), the territory was extensively explored and exploited for gold;
  - 1850 – 1990: main period of mining activity in Portugal;
  - Mines of tungsten, tin, uranium, pyrite, copper, lead, gold and silver;
  - **Environmental impacts from the exploitation and essentially from the abandonment of mining activities**

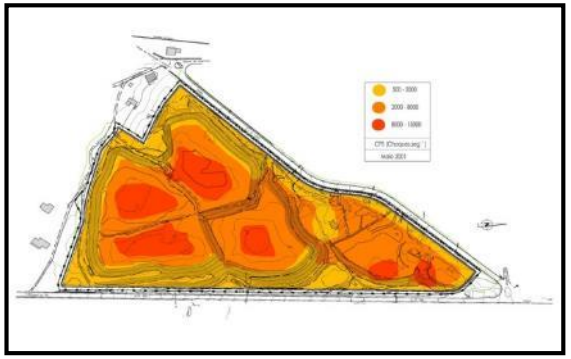
# Environmental remediation of old mines

- Mining wastes







# Environmental remediation of old mines

- Mine water/Acid Mine Drainage

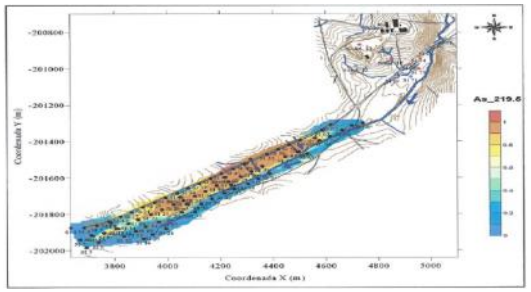

Covas


Algares - Aljustrel


Barranco de S. Domingos

# Environmental remediation of old mines

- Safety risks
- Soil contamination
- Landscape impacts
- Contaminated and degraded infrastructures
- Cultural heritage impacts



Spatial Probability Distribution of As > 219.5




# Portuguese approach

**Considering:**

- Environmental Framework Law (DL 11/87 of 7 April)
- National Plan of Environment Policy (1995)
- Mining Framework Law (DL 90/90)
- The National Environment Legislation
- European Directives

**THE PORTUGUESE STATE CONFERS TO EDM THE CONCESSION FOR THE ENVIRONMENTAL REMEDIATION OF ABANDONED MINES (DECREE-LAW NO. 198-A / 2001).**

That aims to:

_ Eliminate the risk factors for public health and safety, resulting from water pollution, soil contamination, heaps and any unprotected areas;

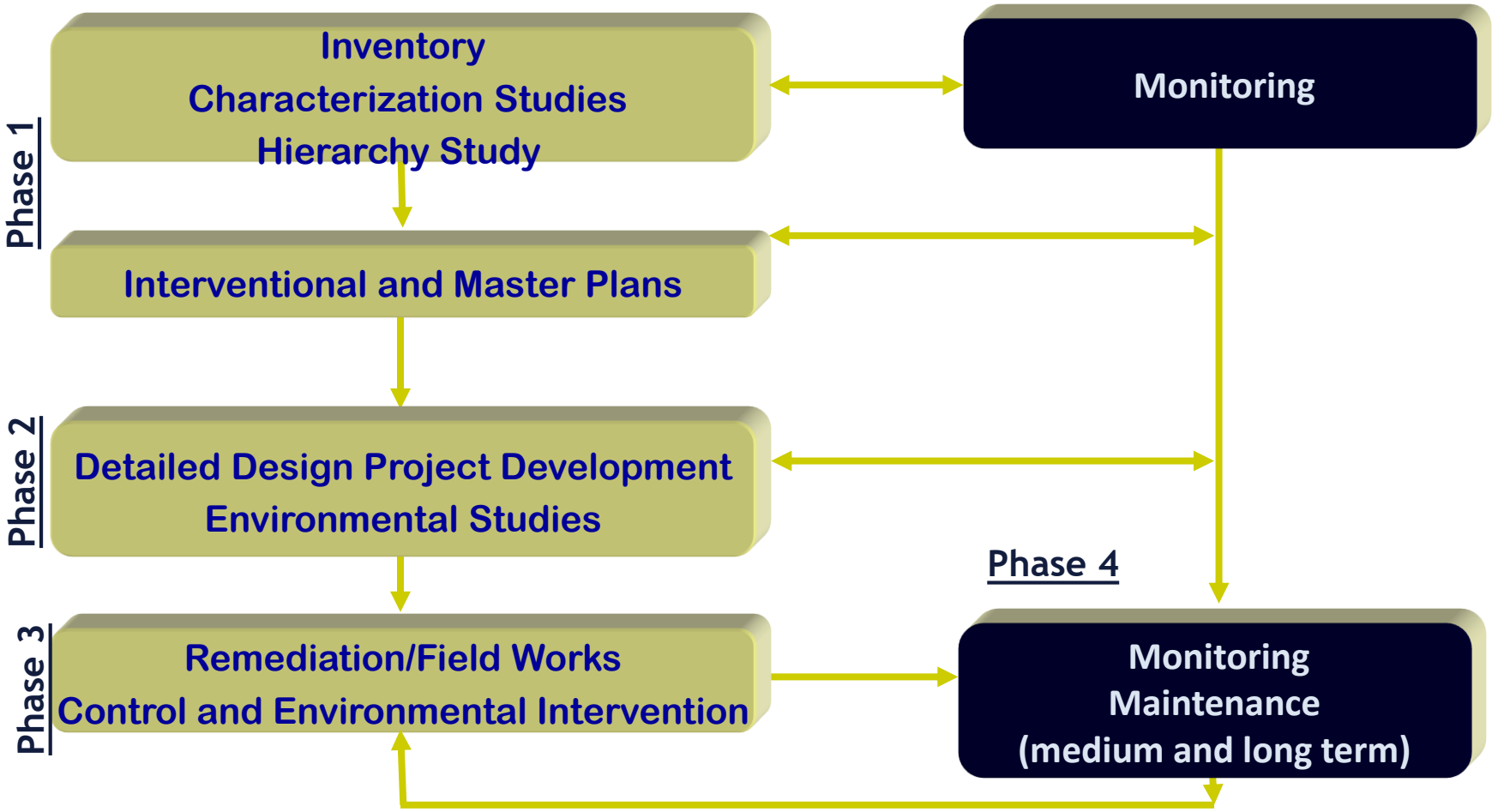
_Rehabilitate the surrounding landscape and natural conditions of development in accordance with the previous Habitat;

_Ensure the preservation of significant heritage of old mines, both economic and archaeological and the valorization 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.

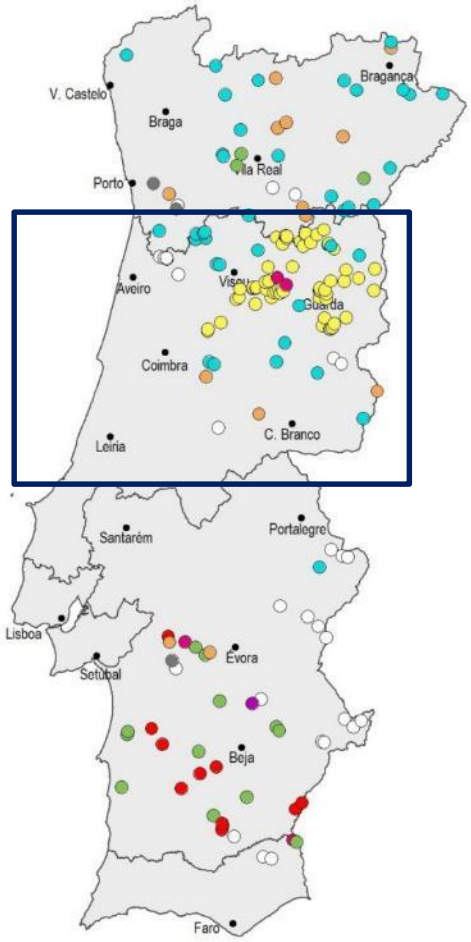
# Portuguese approach

- Developed strategy



# Portuguese approach

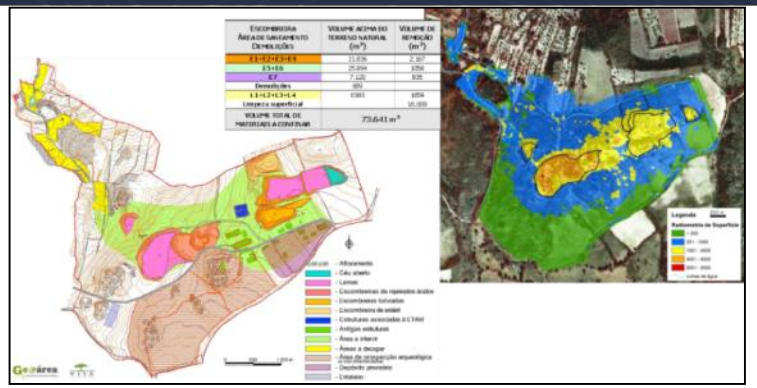
- Abandoned Mine Inventory

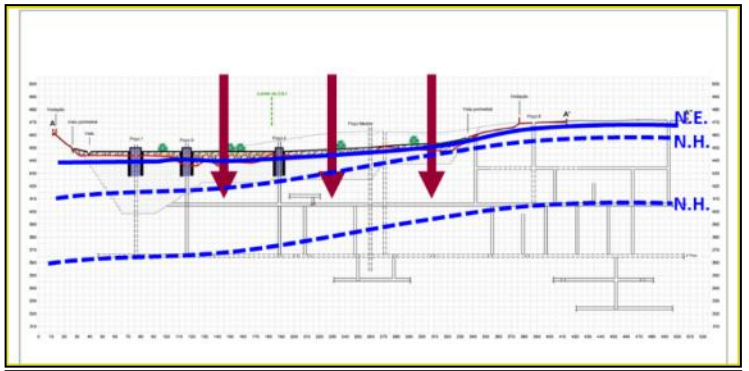


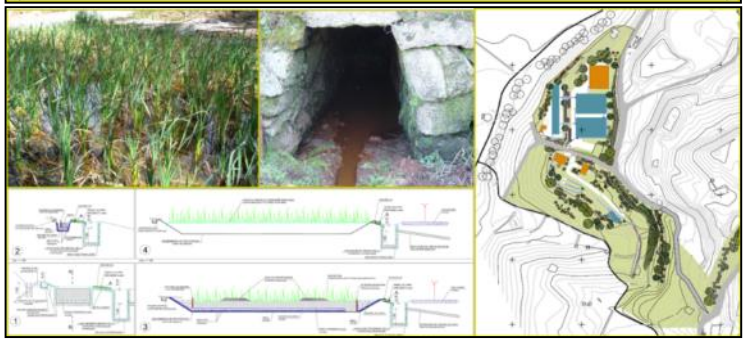

| MINERAL TYPE GROUPS | NUMBER OF MINES | MOST RELEVANT OLD MINES |
|---|---|---|
| **Radioactive minerals** | **61** | Urgeiriça, Quinta do Bispo, Cunha Baixa e Bica |
| **Polimetallic Sulphides** | **10** | São Domingos, Aljustrel, Lousal e Caveira |
| **Tin and Tungsten** | **40** | Argozelo, Covas, Montesinho e Terramonte |
| **Base Metals** | **28** | Terramonte, Coval da Mó e Miguel Vacas |
| **Iron and Manganese** | **16** | Orada, Cercal / Rosalgar e Ferragudo |
| **Coal** | **3** | São Pedro da Cova e Pejão |
| **Gold** | **12** | Jales, Penedono e Freixeda |
| **Others** | **4** | Gouveia de Baixo e Cortes Pereira |
| **Asbestos** | **1** | Arado do Castanheiro |
| **TOTAL** | **175** | **→ 199** |

# Portuguese approach

- Technical objectives
  - Mining Waste Management
  - Mine water and AMD Control and Reduction
  - Mine Water Treatment Systems (Passive, Active and hybrid)
  - Soil decontamination
  - Landscape and habitat integration
  - Heritage preservation
  - Achieve desired End-state conditions according to potential uses





# Portuguese approach

- Results Portugal:
  - 103 mining areas interventioned until 2018
  - 8 mining areas with ongoing remediation works
  - 56 planned interventions, and 32 with restraints…

| Mining Areas | Inventary | Concluded | Ongoing | Planned | With restraints* |
|---|---|---|---|---|---|
| | | 2001-2018 | | 2018-…. | |
| Radioactive | 62 | 40 | 7 | 15 | 0 |
| Pollymethalic Sulphides | 137 | 63 | 1 | 41 | 32 |
| **Total** | **199** | **103** | **8** | **56** | **32** |
| | | **111** | | | |
| | | **199** | | | |

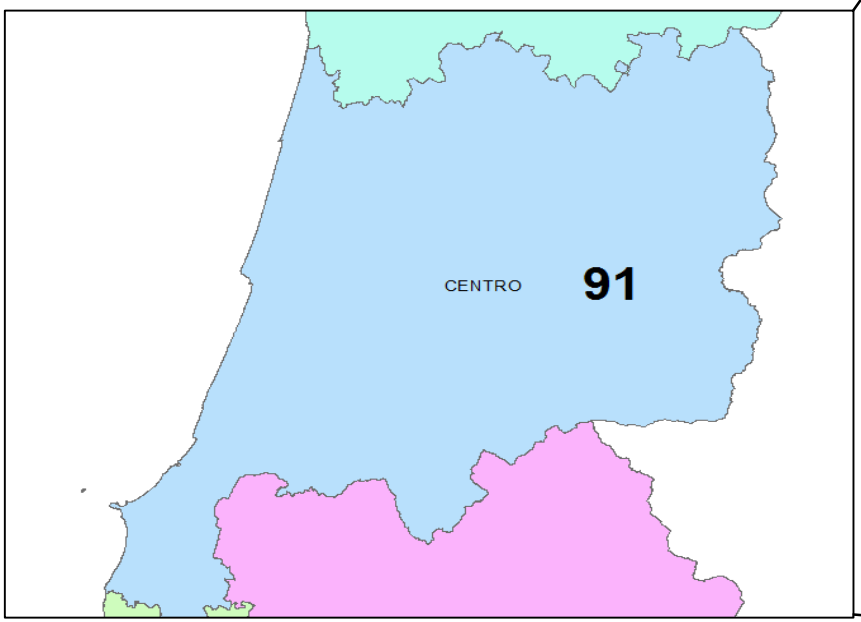
# Portuguese approach

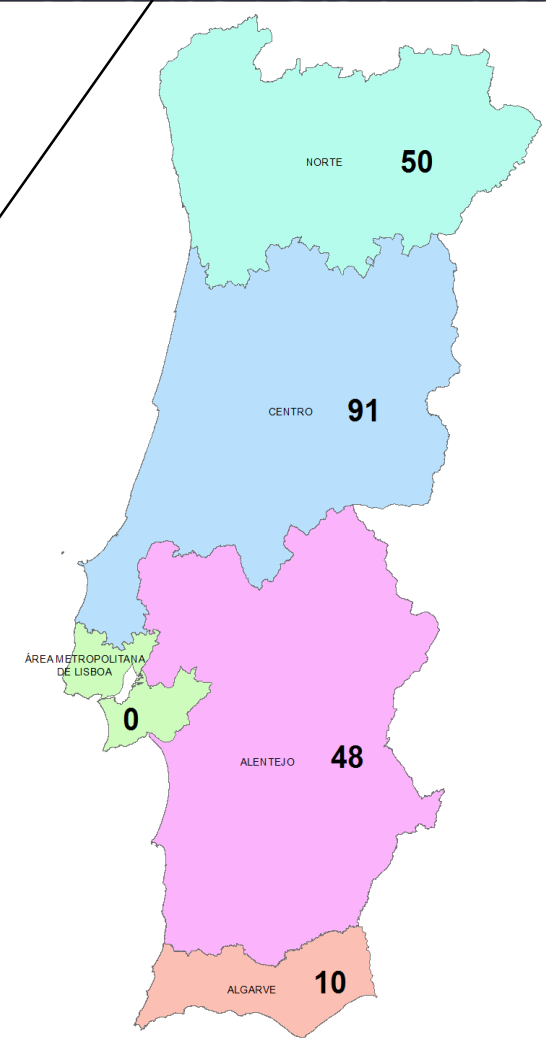
- Investment:
  - 98 M€ between 2000-2015
  - 43 M€ approved for 2016-2020
  - 65 M€ estimated for the remaining

- Main funding sources:
  - Cohesion Funds
  - Portuguese mining operators royalties

# Centro Region

- 91 abandoned mines
  - 60 radioactive ores
  - 15 W and Sn
  - 10 Au, Pb, Cu, Ag and Zn
  - 6 Qz, Feldspar and other




Áreas mineiras abandonadas por NUTS 2

| Nº | MINA |
|---|---|
| 1 | Adória |
| 2 | Alcaria Queimada |
| 3 | Algaré |
| 4 | Algares de Portel |
| 5 | Aljustrel |
| 6 | Almendreiras |
| 7 | Alto da Rasa |
| 8 | Alto da Várzea |
| 9 | A. do Cavalo |
| 10 | Alto do Sião |
| 11 | Alvito |
| 12 | Aparis |
| 13 | Arado do Castanheiro |
| 14 | Argemela |
| 15 | Argozelo |
| 16 | Azeiteiros |
| 17 | Azenhas |
| 18 | Balança |
| 19 | Balôco |
| 20 | Banjas |
| 21 | Barca d'Alva |
| 22 | Barracão (Fábrica) |
| 23 | Barrigão |
| 24 | Barroca Funda |
| 25 | Barrôco D. Frango |
| 26 | Barrôco I |
| 27 | Bejanca |
| 28 | Bessa |
| 29 | Bica |
| 30 | Botefa |
| 31 | Borralha |
| 32 | Braçal |
| 33 | Bugalho |
| 34 | Caeira |
| 35 | Caeirinha |
| 36 | Canto do Lagar |
| 37 | Carrasca |
| 38 | Carril |
| 39 | Carris |
| 40 | Castelejo |
| 41 | Caveira |
| 42 | Ceife |
| 43 | Cercal e Rosalgar |
| 44 | Chaminé |
| 45 | Chança |
| 46 | Chãs |
| 47 | Coitos |
| 48 | Corga de Valbom |
| 49 | Corguinha e Prazos |
| 50 | Cortes Pereira |
| 51 | Costas do Marão |
| 52 | Cótimos |
| 53 | Coval da Mó e Bocanha |
| 54 | Covas |
| 55 | Cruz da Faia |
| 56 | Cume |
| 57 | Cunha Baixa |
| 58 | Defesa das Mercês |
| 59 | Eira do Brejo |
| 60 | Evideira |
| 61 | Escádia Grande |
| 62 | Espinho |
| 63 | Ferraguedo |
| 64 | Ferrarias |
| 65 | Ferreiros |
| 66 | Fontainhas e Gradiz |
| 67 | Fonte Santa |
| 68 | Fonte Velha |
| 69 | Fontinha |
| 70 | Formiga |
| 71 | Fonte Velho |
| 72 | França |
| 73 | Freixeda |
| 74 | Freixinho |
| 75 | Freixiosa |
| 76 | Freixo de Numão |
| 77 | Góis Sra Guia |
| 78 | Góis Vale Pião |
| 79 | Gouim |
| 80 | Gouveia de Baixo |
| 81 | Grou |
| 82 | Iales |
| 83 | Juliana |
| 84 | Ladeira das Vinhas |
| 85 | Lagares de Rebentão |
| 86 | Lagoas do Paço |
| 87 | Lenteiros |
| 88 | Lousal |
| 89 | Luz |
| 90 | Malhada |
| 91 | Maria Dónis |
| 92 | Martinelo |
| 93 | Massueime |
| 94 | Mata da Rainha |
| 95 | Mestras |
| 96 | Miguel Vacas |
| 97 | Mociços |
| 98 | Moinho da Ordem |
| 99 | Moncorvo |
| 100 | Mondego Sul |

| Nº | MINA |
|---|---|
| 101 | Monfortinho |
| 102 | Monges |
| 103 | Monte dos Mestres |
| 104 | Montesinho |
| 105 | Montinho |
| 106 | Montórios |
| 107 | Mostardeira |
| 108 | Murçós |
| 109 | Nogueirinha |
| 110 | Orada |
| 111 | Ordes |
| 112 | Pai Moniz |
| 113 | Palhal |
| 114 | Pedreiros |
| 115 | Peixeiro |
| 116 | Pejão |
| 117 | Pêra do Moço |
| 118 | Picoto |
| 119 | Pinhal do Souto |
| 120 | Pinheiro |
| 121 | Pintor |
| 122 | Poço das Freitas |
| 123 | Pousadela |
| 124 | Póvoa de Cervães |
| 125 | Prado Velho |
| 126 | Preguiça |
| 127 | Quinta das Seixas |
| 128 | Quinta do Bispo |
| 129 | Raseira |
| 130 | Reboleiro |
| 131 | Regoufe |
| 132 | Horta da Reveza |
| 133 | Ribeira |
| 134 | Ribeira do Bôco |
| 135 | Ribeira do Ferro |
| 136 | Rio de Frades |
| 137 | Rosmaneira |
| 138 | São Domingos |
| 139 | São Pedro da Cova |
| 140 | São Martinho da Angueira |
| 141 | Santa Eulália |
| 142 | Santa Leocádia |
| 143 | Barrôco do Ouro (S. Domingos) |
| 144 | Saramaga |
| 145 | Sarzedas |
| 146 | Segura |
| 147 | Senhora das Fontes |
| 148 | Sentinela |
| 149 | Serra de Bois |
| 150 | Sevilha |
| 151 | Santo António de Penedono |
| 152 | Talhadas |
| 153 | Tapada do Lobo |
| 154 | Tapada dos Mercados |
| 155 | Tarouca |
| 156 | Tentinolho |
| 157 | Terramonte |
| 158 | Tinoca |
| 159 | Torrão da Moita |
| 160 | Três Minas |
| 161 | Tuela |
| 162 | Urgeiriça |
| 163 | Valdante |
| 164 | Vale Côvo |
| 165 | Vale da Abrutiga |
| 166 | Vale da Videira |
| 167 | Vale d'Arca |
| 168 | Vale das Gatas |
| 169 | Vale do Tamão |
| 170 | Vales |
| 171 | Várzea dos Cavaleiros |
| 172 | Várzea de Trevões |
| 173 | Vieiros |
| 174 | Vieiros de Penedono |
| 175 | Vila Ruiva |
| 200 | Alto Figueira |
| 201 | Brunhosinho |
| 202 | Carrapateira (Bordeira) |
| 203 | Cerro da Amendoeirinha |
| 204 | Cerro do Penedo |
| 205 | Corte do Sobro |
| 206 | Guadramil |
| 207 | Ifanes |
| 208 | Azêvo Machorrinho |
| 209 | Margalhos |
| 210 | Muro |
| 211 | Ramalhosa |
| 212 | Rio de Silos |
| 213 | João Antão |
| 214 | Torgal |
| 215 | Recheira (mina do Alemão) |
| 216 | Massueime-Cabeço da Ponte |
| 217 | Massueime-Ferradosa |
| 218 | Azinheira dos Barros |
| 219 | Pai Afonso |
| 220 | Couraça (Santa Justa) |
| 221 | Barranco do Vale Covo |
| 222 | Minancos |
| 223 | Portelrinhos |

# Centro Region

- Results:
  - 59 mining areas interventioned until 2018
  - 7 mining areas with ongoing remediation works
  - 21 planned interventions, and 4 with restraints…

| Mining Areas | Inventary | Concluded | Ongoing | Planned | With restraints* |
|---|---|---|---|---|---|
| | | 2001-2018 | | 2018-…. | |
| Radioactive | 60 | 38 | 7 | 15 | 0 |
| Pollymethalic Sulphides | 31 | 21 | 0 | 6 | 4 |
| **Total** | **91** | **59** | **7** | **21** | **4** |
| | | **87** | | | |
| | | **91** | | | |

# Centro Region Examples

- Urgeiriça (Nelas)

# Centro Region Examples

# Centro Region Examples

Urgeiriça Santa Barbara Leisure Park (Old industrial area and ore deposit)

# Centro Region Examples

Urgeiriça Santa Barbara Leisure Park (Old industrial area and ore deposit)

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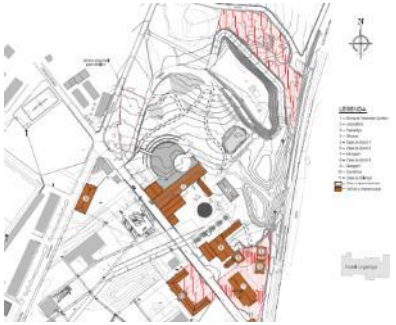
Urgeiriça Mine Water Treatment Plant:
Active and Passive treatment

# Centro Region Examples

- Urgeiriça Old Chemical Treatment Facility
  - Decontamination and requalification for future public uses

Before

After (2019)



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# Centro Region Examples

- Espinho (Mangualde)

# Centro Region Examples


Civil Protection Training

# Centro Region Examples

- Barracão Radium Fabric (Guarda)

# Centro Region Examples


- Barracão Public Park



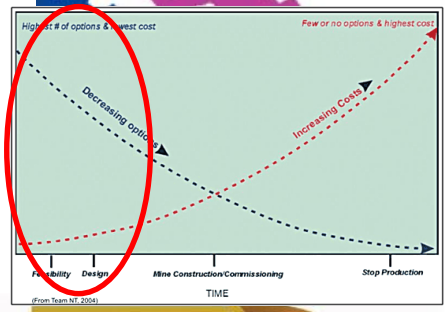
Empresa de Desenvolvimento Mineiro, SA

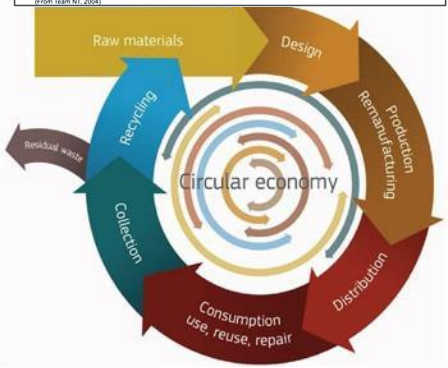
# Challenges in mining remediation

- New vision/paradigma:

  *"mining waste not only as an environmental issue, but as a secondary source of mineral raw materials"*

  - More efficient use of resources, although lagged temporally
  - More efficient environmental remediation
  - Potential economic revenue:
    - Business development / profit generation
    - Partially offset remediation, maintenance and monitoring costs

# Challenges in mining remediation

- R&D Projecs
  - **ERAMIN / 7th Framework Program**

**ENVIREE** – ENVIronmentally friendly & efficient methods for extraction of REE from secondary sources

**BIOCRITICAL METALS** - Recognition of microbial functional communities and assessment of the mineralizing potential (**bioleaching**) for high-tech critical metals

  - **Life**

**LifeNoWaste** - Management Of Biomass Ash And Organic Waste In The Recovery Of Degraded Soils: A Pilot Project Set In Portugal

  - **H2020**

**UNEXMIN** – Autonomous Underwater Explorer for Flooded Mines

# Challenges in mining remediation

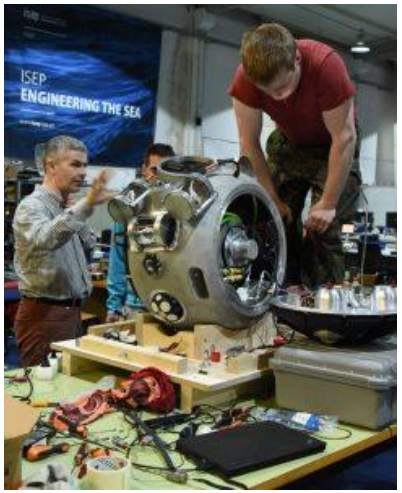
- R&D Projecs
  - **UNEXMIN** – Autonomous Underwater Explorer for Flooded Mines
    - use non-invasive methods for autonomous 3D mine mapping for gathering valuable geological, mineralogical and spatial information
    - Pilot test in Urgeiriça Mine, Portugal, 2019

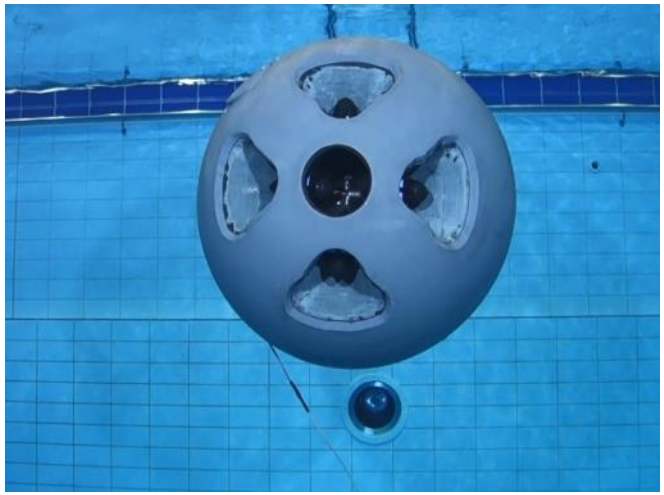
HORIZON 2020

UNEXMIN

https://www.unexmin.eu/

**Project starting date:** 1 February 2016
**Duration:** 45 months
**Budget:** EUR 4 862 865
**Output:** 3 working prototypes





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# Final Considerations

- With the conclusion of the Environmental Remediation of Old Mining Areas Plan, Portugal will correct environmental liabilities and impacts of centuries of mining activity.
- Strong improvements in safety issues, soil, water and air quality, mining heritage preservation and reclamation of these degraded areas for further uses.
- Mining wastes should be seen as potential secondary sources of mineral resources.
- Open to innovative solutions and R&D Programs.
- Contribute to change public perception of mining and promote reopening of old mines, when possible.


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