

RAW4RES



RAW4RES

Enhancing responsible
mining policies and raw
materials resilience in
EU regions

Summary Report

Activity A3.2: Workshop on best practices for
valorising mining waste and revitalising closed
mines

MAY 2024

EXECUTIVE SUMMARY

This summary report encapsulates the comprehensive discussions and case studies presented during the workshop on best practices for valorising mining waste and revitalizing closed mines. Held virtually on March 3rd, 2024, within the framework of the RAW4RES Interreg project, the workshop was facilitated by ADRBI, fostering collaborative engagement among project partners and regional stakeholders.

Initially, the report presents the key participation metrics, and the feedback received from participants concerning the organisation and facilitation of the workshop. Participants' perspectives on the barriers to mine waste valorisation and the policy solutions presented are also incorporated.

The report then focuses on the workshop's activities and outcomes. It provides a concise overview of the three thematic discussions, centring on participants' insights regarding territorial aspects, alongside the presentation of exemplary case studies. Following this, the report presents the key conclusions and insights drawn from both discussions and case studies, emphasising their implications from a territorial policy perspective. Lastly, the report outlines a set of policy recommendations aimed at supporting project partners in incorporating the lessons learnt into their regional policies.

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LIST OF ABBREVIATIONS

- ◆ ADR-BI Bucharest-Ilfov Regional Development Agency
- ◆ CCS Carbon Capture & Storage
- ◆ CCUS Carbon Capture Utilisation and Storage
- ◆ CRM Critical Raw Materials
- ◆ CSR Corporate Social Responsibility
- ◆ DFG Deutsche Flussspat GmbH
- ◆ e.g. *exempli gratia* (for example)
- ◆ EU European Commission
- ◆ i.e. *id est* (that is)
- ◆ Q&A Questions and Answers
- ◆ R&D Research and Development
- ◆ RM Raw Materials
- ◆ TSF Tailings Storage Facility

CHAPTER A - INTRODUCTION

A.1 - RAW4RES ACTIVITY A3.2

Aiming to facilitate interregional learning and promote capacity building among project partners and key stakeholders of the RAW4RES project, activity “A3.2 – Workshop on best practices for valorising mining waste and revitalising closed mines” was organised by the Bucharest Ilfov Regional Development Agency (ADR-BI) and took place virtually on March 3rd, 2024 using Cisco Webex platform.

During the workshop’s activities, including presentations by experts in the field of the mining sector and group discussions, participants had the opportunity to exchange experience and elaborate on common challenges and policy gaps that inhibit mine waste reuse and the reopening of mines. They also discussed the transferability of good practices to their own territories, taking into account regional specificities regarding the mining industry.



Figure 1: The RAW4RES partnership

A.2 - CLOSING THE LOOP IN THE MINING SECTOR

Mining and quarrying represent the very first link of long and complex supply chains¹, providing downstream industries with extracted raw materials essential for the manufacturing of important technological products, such as batteries, wind turbines, processors, etc. However, mining operations also generate a significant amount of waste, often containing hazardous and toxic substances such as arsenic (As), mercury (Hg), and cyanide. In the traditional mining scheme, a particular mine focuses its operation on one primary raw material (i.e., metal, rare earth, etc.) while the rest of the ore is classified as waste, which is either discarded or stored in what are called Tailings Storage Facilities (TSF) if deemed hazardous. The quantity of mine waste generated is directly linked to the size of the mining operation, while the exact composition of mine waste produced correlates to the mineralogical composition of the ore and the mining method employed.

To address the growing demand for raw materials within the EU's technology sector, but also reduce reliance on imports, the European Commission (EC) has shown growing interest in increasing extraction and recovery of raw materials across EU^{2,3}. Leveraging advancements in technology that enable the efficient mining of low-grade ores, and research developments which facilitate the sustainable extraction of metals from mining waste streams, the EC aims to harness the mining sector's untapped potential to support and accelerate the Union's twin green and digital transition.

National governments of EU member states are considering reopening old mines to mine second and low-grade ores, but also allowing the reprocessing of old stored mine tailings to mitigate environmental impacts associated with tailings and extract valuable materials. At the same time, in their effort to make their extractive industries more circular, mining companies are trying to minimise the generation of waste by recycling and reusing waste to turn it into new products.

CHAPTER B - PARTICIPANTS' WORKSHOP EVALUATION

B.1 - WORKSHOP AGENDA

09:00 – 09:15	Welcome Workshop objectives & Agenda overview ADR-BI
09:15 – 09:30	Participants' introductions all participants
09:30 – 10:00	Introduction to Workshop's Thematic Presentation of the Input Document Tero PC Q&A session
10:00 – 10:30	Case Studies ReMined products, IMERYS & Bauxite residue valorisation, MYTILINEOS ADR-BI Q&A session
10:30 – 10:50	Thematic A - Valorisation of mine waste Group discussion among participants about policy measures and regulations influencing mine waste reuse *Moderator: ADR-BI
10:50 – 11:10	Short Break
11:10 – 11:30	Thematic B - Reopening of mines Group discussion among participants about permitting processes and compliance requirements for mines' reopening *Moderator: ADR-BI
11:30 – 11:50	Thematic C - Reprocessing of TSF Group discussion among participants about environmental and economic benefits of TSF reprocessing *Moderator: ADR-BI
11:50 – 12:30	Lunch Break

Presentations of Good Practices from Romania

Exploiting waste from metallurgy as secondary raw materials: complex characterization and subsequent processing towards new functionalities

12:30 – 13:00

| National Institute of Materials' Physics

&

Improved integrated solution for steel slag recycling: ZERO waste approach | DESTRO SlagCem

13:00 – 13:10

Conclusions of the workshop | ADR-BI

13:10 – 13:20

Workshop wrap-up

Next steps & upcoming activities | ADR-BI

B.2 - PARTICIPATION METRICS



24

Participants



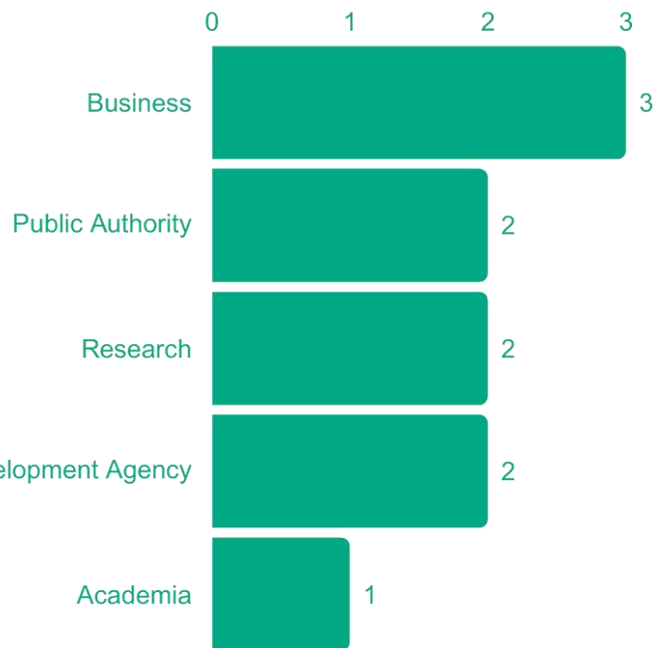
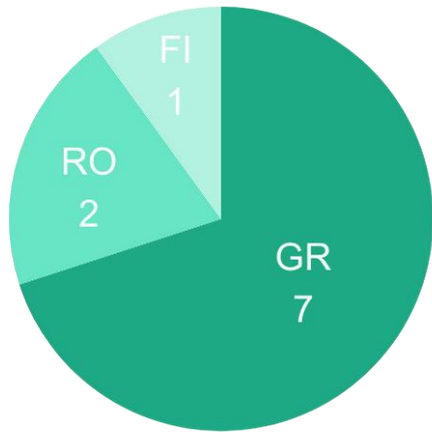
- Research
- Regional Development Agencies
- Business Organisations
- Public Authorities
- Businesses
- Academia



** Participation metrics have been computed from the registration forms submitted and participants' explicit consent for use of their data. Of the 43 participants, 24 gave their consent to use and process their data.*

B.3 - EVALUATION OF THE WORKSHOP'S ACTIVITIES

Evaluation Metadata



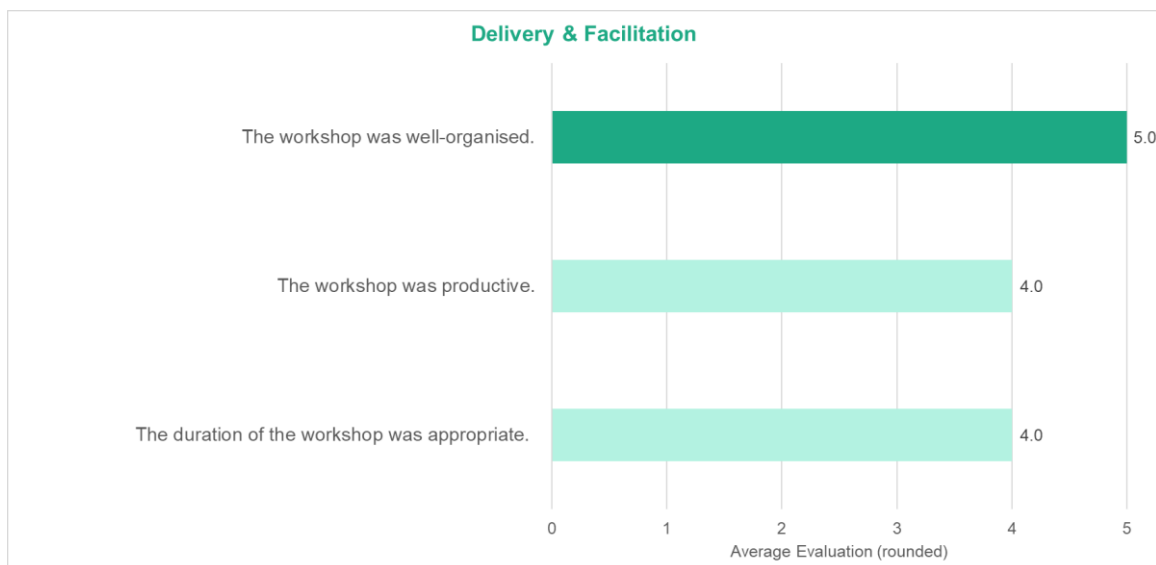
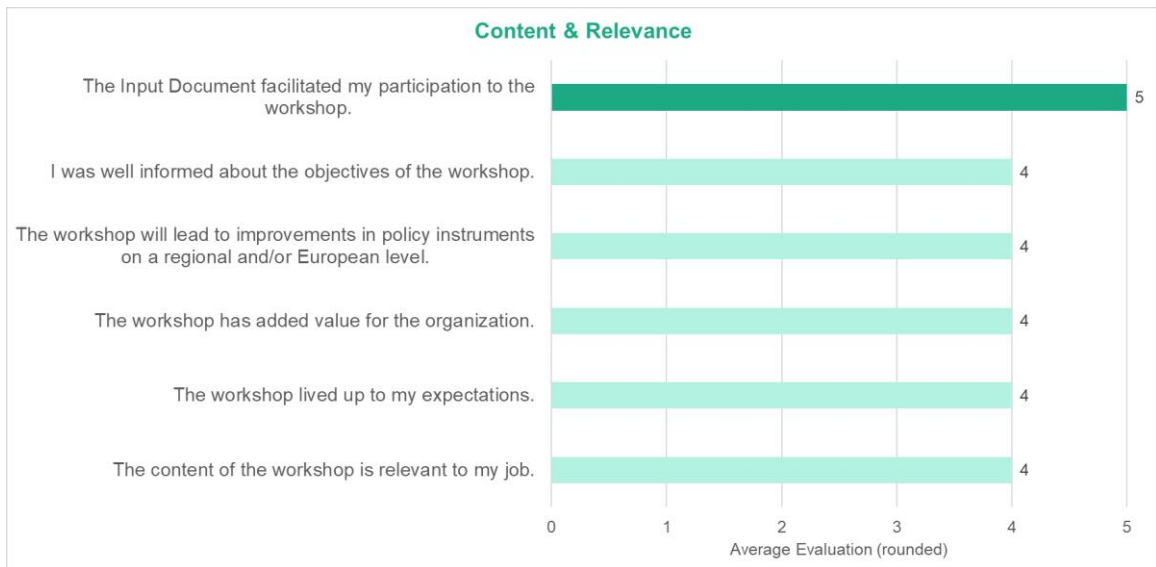
** Participation metrics have been computed from the evaluation forms submitted, with explicit consent of participants to use of their data.*

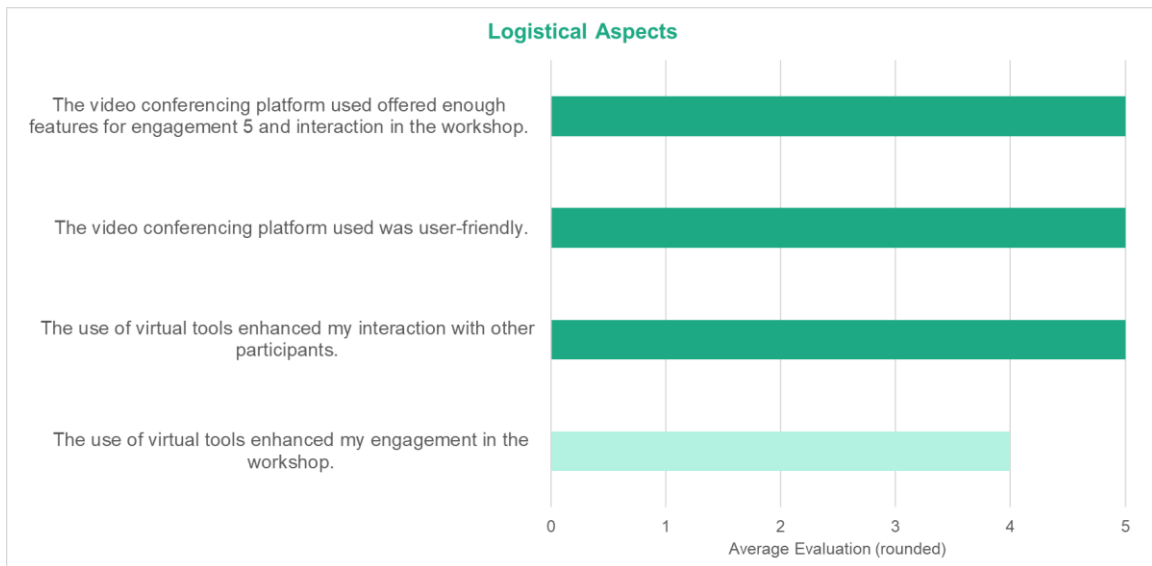


- 1 - Strongly disagree
- 2 - Disagree
- 3 - Undecided
- 4 - Agree
- 5 - Strongly Agree

Aggregated Evaluation

- Content & Relevance - 4.3**
- Delivery & Facilitation - 4.5**
- Logistical Aspects - 4.5**
- Participant Experience & Satisfaction - 4.3**





B.4 - EVALUATION OF LESSONS LEARNT & KEY OUTCOMES



Respondents regarded the discussion on **"Valorisation of mine waste"** as particularly enlightening offering the most lessons learned and practical outcomes for both participants and their respective organisations.



Barriers to mine waste reuse

- Legislation gaps
- Lack of clear guidelines
- Increasing strict environmental requirements
- Lack of funding to industrialise technologies at pilot scale
- High capital investment
- Social opposition
- Low efficiency of disposal/recovery facilities
- Low cost of raw materials

Barriers to mine reopening

- Exploration challenges
- High capital investment
- Legislative barriers
- Complex administrative procedures
- Local opposition
- Lack of green extractive technologies
- Associated environmental risks

Barriers to TSF reprocessing

- TSF safety & environmental risks
- Logistics
- High capital investment
- Lack of policy incentives
- Outdated legislative framework
- Lack of green technologies for processing TSF



Effective & transferable policy measures to address barriers to:

mine waste reuse

- Simplification of permit granting processes
- Financial incentives
- Financing mine waste related research

reopening of closed mines

- Financial incentives
- Clear environmental & safety regulatory framework
- Simplification of permit granting processes

reprocessing of TSF

- Financial incentives
- Comprehensive regulatory framework for TSF reprocessing
- Simplification of permit granting processes

CHAPTER C - WORKSHOP OUTCOMES

The RAW4RES workshop utilised an interactive and deliberative approach to optimise knowledge sharing, foster engagement, and facilitate the formation of well-informed perspectives and arguments. Its three facilitated roundtable discussions allowed ample time and opportunity for participants to acquire new insights and engage in thorough discussions regarding the different topics on the basis of their prior experience and the knowledge of the current state of affairs in their respective territories.

C.1 - OVERVIEW OF ACTIVITIES

At the beginning of the workshop, Berghin Osman from ADRBI welcomed the participants, provided an overview of the agenda, explained the workshop's logistics, and informed participants that the workshop was being recorded. Following that, each RAW4RES partner was asked to briefly present the organisation they were representing, as well as the stakeholders they had invited to participate to the workshop.

C.1.1 - INTRODUCTORY PRESENTATION

Prior to the roundtable discussions, an external expert from TERO Consulting, introduced participants to the workshop's theme. She provided overview of the European mining landscape, highlighting key statistics regarding the EU's mineral deposits and commonly extracted raw materials. Transitioning to the pressing concern of the workshop, she discussed the issue of mine waste, with a focus on mine tailings, supported by recent (2018-2020) pertinent data from EUROSTAT. The latter part of her presentation was dedicated to exploring two alternative approaches in the framework of circular economy aimed at minimising mine waste. Firstly, she elaborated on the potential of re-using mine tailings, emphasising the innovative techniques of bioleaching and geopolymerisation. Secondly, she discussed the prospect of reopening closed mines, either for the extraction of previously disregarded low-grade ores or for processing stored mine tailings.

During the Questions & Answers (Q&A) session participants highlighted the **complexity of integrating sustainability practices into mining operations**. They

stressed the challenges phased, when it comes to assessing the business viability for the reuse of mine tailings, specifically in the context of bioleaching and geopolymerisation. They placed particular emphasis on the fact that any evaluation of such investments needs to be on a-case-by-case basis, considering the locally applicable legislative framework, available financial incentives, and the environmental impact on the surrounding area.

Moreover, Spanish stakeholders provided valuable insights into a noteworthy initiative undertaken at the Marmato gold mine in Colombia. They elaborated on the potential of reusing dry stack tailings to supply building material for local community infrastructure projects. As they underlined, this **approach of reusing dry stacking** could, if adopted by EU mining companies, offer a big boost to the EU mining community and the broader EU economy. Not only does it minimise waste production, but it also fosters social engagement and delivers tangible benefits to the surrounding communities.

C.1.2 - CASE STUDIES

To provide a better understanding for participants ADRBI had a short presentation of two well established case studies of businesses in an industrial symbiosis framework work together reusing mine tailings.

The first case refers to the **ReMined products by IMERYYS**, a multinational company specialised in the production and processing of industrial minerals. In recent years, IMERYYS has launched the ReMined products which utilise mine tailings as a key component, such as the ReMined 15 which is a processed calcitic-marble from high calcium carbonate waste tailings. As it was noted, in the end of 2023, Imerys and Seitiss, an impact start-up, announced their joint venture “Seitiss Imerys Circular Minerals” (Seitiss Imerys Minéraux Circulaires). The joint venture aims to develop circular solutions for the repurposing waste minerals from diverse industrial activities. Leveraging innovative tools developed by Seitiss along with the industrial and commercial expertise of IMERYYS, as well as the company’s financial support, the venture seeks to expedite the development of a technological solution for valorising recycled calcium carbonate from industrial processes.

The second case referred to the **valorisation of bauxite residue performed by MYTILINEOS**, a leading industrial producer of alumina and aluminium in south-eastern Europe. Annually, the company processes more than 1.4 million tonnes of it to produce 820,000 tonnes of alumina. In an effort to transition to a more circular and sustainable business model, Mytilineos has been actively engaged in research collaboration aimed at maximising the value of bauxite residue. This includes the use of the byproduct in the cement industry as iron/alumina source in clinker, the brick and tile industry as substitution for clay, the production of geopolymer bricks, vegetation coverage, and road base construction. Particularly noteworthy is the sustainable symbiotic value chain established between Mytilineos and three cement companies in Greece and Cyprus, namely TITAN, AGET, and VASILIKO. These companies incorporate bauxite residue provided by MYTILINEOS as an iron/alumina source in Ordinary Portland Cement (OPC) clinker, substituting 1.5-3% of the clinker's composition. Through this collaborative effort, MYTILINEOS has successfully recycled over 330,000 tonnes of bauxite residue between 2012 and 2021.

C.1.3 - ROUNDTABLE DISCUSSIONS

Three roundtable discussions, all facilitated by ADRBI, took place, each one around a different overarching thematic area. The first discussion centred on the policy aspects of valorising mine waste. The second one addressed the permitting and compliance challenges associated with reopening mines. Lastly, the third discussion explored the advantages of reprocessing stored tailings.

Thematic Roundtable Discussion #1 – Valorisation of mine waste

During the first roundtable discussion project partners and stakeholders discussed territorial (local, regional, national) policy measures that support the reuse of mine waste.

During the discussion, participants noted the **impact both the policy framework and the opinion of the local community** can have on the mining sector's transition to a more circular and sustainable operational and governance model. Mining operations are often linked with numerous adverse environmental impacts and alterations to landscapes, which in turn negatively affect the quality of life of local

communities. Consequently, the prospect of reopening a mine may provoke strong resistance from locals and encounter bureaucratic hurdles from local authorities.

Furthermore, they highlighted the **significant role of technological advancements** backed by short-term small-scale geological surveys in enabling the reconsideration of closed mines for economically viable operations, benefiting both large mining corporations and smaller enterprises. Such is the case of the revitalised Aguablanca mines in the southern Extremadura region. In compliance with the new legislative requirements, mining operations will employ energy efficient processes and will also be conducted underground, the latter aimed at mitigating the adverse visual impact of mining on the landscape.

Thematic Roundtable Discussion #2 – Reopening of mines

The second thematic discussion sparked significant interest among participants. Project partners and stakeholders from Greece, Spain, Romania, Slovenia, and Denmark, actively engaged in the discussion. They shared insights on the existing national legislative landscape in their respective countries concerning the licensing of a mining operation.

Participants emphasised that the **complex, lengthy, and time-consuming procedures in reopening or retrofitting mines** with environmentally sustainable technologies pose significant barriers to investment and business activities. These processes often involve navigating through the legislative requirements of a number of authorities at local, regional, and national level, which causes delays and increased bureaucratic burden for project developers. An illustration of such challenges is that of the Spanish legislative framework governing mining operations and the licensing processes. Reopening a mine in Spain necessitates compliance with three key procedures: obtaining the mining permit, securing the water conservation permit, and undergoing the Environmental Impact Assessment (EIA) process. In addition, the EIA and the water permit are overseen at the regional levelⁱ,

ⁱ [Law 16/2015 on Environmental Protection of the Autonomous Community of Extremadura](#)

while the final mining license falls under national jurisdictionⁱⁱ with each Autonomous Region having its own legislative requirements governing mining operations.

Regardless of the specifics of the legislative frameworks, participants acknowledged the crucial **role of public engagement and awareness campaigns in mitigating opposition to new mining ventures**. They stressed that civil society must not be overlooked as the transition to environmentally friendly practices needs to be equitable. Both regional/local governments and mining companies should undertake efforts to educate the public, particularly vulnerable mining communities, about the green mining technologies and the economic benefits for the local economy. Furthermore, during the exploration phase of mining projects, establishing public consultations was recommended to foster a sense of community involvement and address any concerns, thereby reducing social opposition to mining activities.

The discussion also addressed the **current state-of-play in the two project countries without active mines**. In Slovenia where economically viable deposits of critical raw materials (CRMs) are lacking and social opposition to mining is prevalent, the government focuses its efforts on research and development related to the recovery and recycling of CRMs from the supply chain. Similarly, Denmark is prioritising efforts towards the recovery and recycling of raw materials as a cornerstone of its raw materials and natural resource management strategy. Additionally, mining companies across all regions are required to submit comprehensive rehabilitation plans for mining areas when applying for a mining license.

Thematic Roundtable Discussion #3 – Reprocessing of TSF

The third and last thematic discussion evolved around the reprocessing of tailings already stored in tailings storage facilities. Participants were asked to provide their input on the environmental and economic aspects associated with reprocessing stored tailings waste and the existing financial incentives and government support programs to encourage investment in tailings reprocessing initiatives.

ⁱⁱ [Spanish Mining Law 22/1973](#)

Participants acknowledged that **processing of TSF entails complexities and risks**, encompassing both financial and environmental dimensions. Financially, the management and treatment of TSF can incur substantial costs, including expenses related to maintenance, monitoring, and potential liability for any environmental damages or accidents. From an environmental perspective, TSF processing poses numerous risks, primarily stemming from the potential for toxic contaminants to leach into surrounding soil and waterways. Improper management of TSF can result in environmental degradation, including soil and water pollution, habitat destruction, and harm to wildlife populations.

At the same time, **the regulatory frameworks governing TSF operations are frequently outdated**. Existing regulations may fail to adequately address risks associated with TSF processing or may lack sufficient enforcement mechanisms to ensure compliance. Additionally, participants noted the necessity for financial incentives to bolster business initiatives in TSF processing.

Lastly, discussing potential **EU-funds partner countries could use to support the mining sector's green transition**, the Spanish stakeholders highlighted the Spanish government's financial grants program aimed at promoting energy efficiency actions within SMEs and large companies in the industrial sector. This initiative, co-financed with contributions from the European Regional Development Fund (ERDF) for the period of 2014-2020, operates under the Spanish Multi-regional Operational Programme.

Both SMEs and large enterprises are eligible for receiving financial assistance, including those within the extractive industries, provided they are registered in Spain. Its primary objective is to support the implementation of measures aimed at reducing carbon dioxide emissions and final energy consumption through the enhancement of technology in industrial equipment and processes, as well as the adoption of energy management systems. Under this scheme, eligible entities can receive financial assistance up to a maximum of 30% of the initial investment for large companies, 40% for SMEs, and 50% for small enterprises, in relation to the total project cost.

C.1.4 - ROMANIAN GOOD PRACTICES

The last segment of the workshop was devoted to the presentation of current works in the field of valorising mining waste in Romania. Petre Badica from the National Institute of Materials Physics and Andrei-Lucian Timis DESTRO Slagcem SRL shared with participants current work in the field of repurposing and reprocessing mine waste.

Exploiting waste from metallurgy as secondary raw materials: complex characterization and subsequent processing towards new functionalities, Petre Badica, National Institute of Materials' Physics

Initially, Petre Badica a researcher in the National Institute of Materials Physics (INFIM) in Romania, discussed the significance of material characterization techniques in understanding mine tailings' properties and finding suitable applications for them. He referred to the use of red mud, a byproduct of aluminum industry, as an iron-rich raw material to obtain soft magnetic ceramic material, emphasising the use of characterisation techniques such as x-ray fluorescence (XRF) and differential scanning calorimetry (DSC) to assess the elemental composition of the surface and the phase transitions of iron oxide (Fe_2O_3), and magnetometry and Mössbauer spectroscopy to study the electromagnetic properties of red mud (Fe_2O_3).

Another example relevant to the workshop's thematic focused on the use of waste as raw material to obtain geopolymers as a substitute for Portland cements. Collaborating with the Politehnica University of Bucharest, INFIM explored the use of waste glass and red mud as aluminosilicate precursors for bottom ash-based geopolymers. Through techniques such as FTIR, MAS NMR, and SEM–EDX, they observed that incorporating up to 10% red mud in the synthesis led to enhanced geopolymerization and compressive strength, but exceeding this amount resulted in decreased strength.

During the Q&A session, discussions revolved around the challenges of implementing research findings such as the ones presented by Petre Badica in the business sector. Petre Badica highlighted the complexity of characterizing residuals like red mud, emphasizing the need for collaborative efforts across various research

fields to comprehensively address their properties (e.g., elemental composition, bioreactivity, toxicity, magnetisation) and potential applications. He also emphasized that the focus of research should align with the intended application of the derived materials.

Improved integrated solution for steel slag recycling – ZERO waste approach, Andrei-Lucian Timis, DESTRO Slagcem SRL

The next exemplary practice from Romania showcased the innovative approach of DESTRO Slagcem SRL, a company specialising in steel slag recycling. Andrei-Lucian Timis, CEO of DESTRO Romania, highlighted the company's zero waste strategy in handling the Calan slag dump to extract iron (Fe) and provide raw materials to various other industries. The Calan slag dump houses 1.3 million tonnes of slag from a steel mill in the Transylvanian town of Calan.

DESTRO employs a state-of-the-art hydraulic jaw crusher to break down the slag before subjecting it to magnetic separation to extract iron and other metals. The steel slag is crushed to suitable finesses depending on its intended use and the requirements of the application. For instance, particles ranging from 0-63 mm are incorporated into cement production to increase the strength and durability of concrete. Alternatively, particles sized 0-20 mm undergo further processing for integration into sintering or briquetting processes within steel plants. And steel slag within the 10-100 mm size range is used in blast furnaces.

During the Q&A session, Andrei Timis elaborated on the current state of metal extraction from slag, highlighting that presently only iron is being extracted due to several factors. Primarily, there's the high cost of the initial investment to establish the necessary infrastructure for metal extraction. Additionally, there's a significant consideration of the Romanian market's demand for raw materials. Presently, the recycled materials from DESTRO's process are primarily utilised by the country's cement and steel industries. Consequently, the focus remains on extracting iron, while the slag undergoes crushing to specific particle sizes.

C.2 - CONCLUSIONS & LESSONS LEARNT

The workshop, through its deliberative nature, provided a platform for participants, project partners, and regional stakeholders to engage in an interactive dialogue on waste valorisation. Participants exchanged ideas, territorial evidence, and experience, alongside the discussion of case studies, regarding policy barriers to mine reopening tailings processing, as well as the business challenges and research opportunities associated with valorising waste.

An early observation from the discussions was the potential for **green and energy efficient mining technologies to help address the social opposition to mining activities**. Public opposition stems from concerns about environmental degradation, including toxic tailings leakage and aquatic pollution, as well as the risk of accidents leading to human casualties. Proactive engagement with local communities and stakeholders is crucial in fostering understanding and support for greener mining practices. By transparently communicating the environmental and social benefits associated with green mining technologies, mining companies can build trust and credibility within the communities they operate in. Community outreach initiatives, such as public consultations and information days, can foster meaningful dialogue and collaboration, enabling stakeholders to voice their concerns and contribute to the development of sustainable mining solutions.

Furthermore, participants emphasised the **inadequacy of the regulatory framework** in supporting the advancement of green mining, especially concerning mine reopening and processing of tailings storage facilities. Regulatory processes are often convoluted and lengthy, and in some cases further complicated by the division of responsibilities among local, regional, and national authorities.

In addition, participants often referred to the **need for financial support mechanisms** such as incentives, tax breaks, and subsidies, in order to businesses to adopt greener practices, whether through infrastructure retrofitting for energy efficiency, integrating tailings processing into mining operations, or investing in waste processing and recycling. Similarly, participants highlighted the importance of **thorough exploration** to assess the extraction feasibility of a deposit from both environmental and economic perspectives. Proper **physicochemical**

characterization and understanding of tailings properties are also key to optimise processing methods and integrate them into end products effectively.

Lastly, the **Aguablanca case in the Extremadura Region of Spain** emerged as a good practice example of green mining practices and community involvement. Situated in Monesterio, Extremadura, the Aguablanca Project borders the provinces of Huelva and Seville, while being one of Spain's rare nickel deposits and among the scarce ones in Europeⁱⁱⁱ. Discovered in 1994, the Aguablanca mine operated as an open-pit mine from 2005 to 2015, extracting a total of 14 million tons of copper and nickel ore. In 2007, Lundin Mining acquired the project and transitioned it to underground operations by 2015. However, due to declining nickel and copper prices, Lundin ceased operations in early 2016.

Now, after an eight-year hiatus, the Extremadura government has given Rio Narcea Recursos, S.L. permission to reopen the Aguablanca Mine in July 2024. The mined nickel will feed into a battery factory for electric cars in Badajoz, to support the region's local economy. Adapting to new regional legislation, the mine will operate underground to mitigate environmental and visual impacts. Additionally, it will employ a closed-loop water circulation system and undertake a carbon footprint reduction initiative. Lastly, the company has developed a Corporate Social Responsibility (CSR) plan to safeguard the well being of local communities. The plan includes initiatives such as reskilling local miners, public outreach on the planned works, and community programs supporting education, diversity, and equality.

C.3 - POLICY RECOMMENDATIONS

The present section of the summary report outlines a set of policy recommendations on integrating the lessons learnt from the workshop into the territorial policies of RAW4RES partners.

Comprehensive Regulatory Framework

ⁱⁱⁱ <https://denariusmetals.com/project/spain/alto-minerals/aguablanca-project-overview/>

Regional and local authorities involved in mining permitting and regulation, are advised to establish streamlined, transparent permitting procedures for reopening mines. This reduces both time and costs involved in the process.

Public Engagement & Awareness

Territorial policies should prioritize meaningful stakeholder engagement to counteract negative community sentiments towards mining, often stemming from past fatal accidents in mining operations and toxic spills causing soil and water contamination. Regional policies should integrate provisions for public participation, consultation, and transparent access to information during all phases of mining operations. They could also implement themselves communication and outreach activities to inform citizens and address their concerns.

Repurposing of Closed Mines

Regional authorities are advised to explore alternative uses for closed mines that aren't suitable for further mining. Transforming these sites into museums showcasing the region's mining history can attract tourism, create local jobs, support SME growth, and generate community income.

Financial Support Mechanisms

Regional authorities can incentivize mining companies to invest in reopening low-grade ore deposits and repurposing mine tailings while ensuring environmental sustainability. Tax incentives, grants, subsidies, investment allowances, and import duty relief can offset costs associated with these business endeavours.


R&D Funding

Regional authorities are advised to allocate funding for research and development programs aimed at advancing innovative technologies for repurposing mine. Public funding to also encourage business investment in mining and processing technologies, facilitating a transition to a greener, more circular mining industry.

Cross-sector Collaboration

Regional authorities are advised to encourage collaboration between academia, industry, and research institutions to develop practical solutions for repurposing mine

waste. Interdisciplinary research efforts should aim to comprehensively address the properties of mine waste and identify suitable applications, strengthening regional secondary raw materials markets.

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CHAPTER D - REFERENCES

1. Dietrich, V. & Melcher, F. Mineral Raw Material Supply Chain Transparency and Traceability: Does Provenance Matter in the Supply Chain? *Berg Huettenmaenn Monatsh* **167**, 594–597 (2022).
2. European Commission. Proposal for a Regulation establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020. (2023).
3. Producing raw materials in Europe – is a domestic supply still possible? *Greek Mineral Wealth* <https://www.oryktosploutos.net/2022/01/25660/> (2022).

CHAPTER E - ANNEXES

ANNEX I - 2020 EU LIST OF CRITICAL RAW MATERIALS

Antimony	Hafnium	Phosphorus
Baryte	Heavy Rare Earth Elements	Scandium
Beryllium	Light Rare Earth Elements	Silicon Metal
Bismuth	Indium	Tantalum
Borate	Magnesium	Tungsten
Cobalt	Natural Graphite	Vanadium
Coking Coal	Natural Rubber	Bauxite
Fluorspar	Niobium	Lithium
Gallium	Platinum Metals	Titanium
Germanium	Phosphate Rock	Strontium

ANNEX II - 2023 PROPOSED LIST OF CRITICAL RAW MATERIALS

Antimony	Arsenic	Bauxite
Baryte	Beryllium	Bismuth
Boron	Cobalt	Coking Coal
Copper	Feldspar	Fluorspar
Gallium	Germanium	Hafnium
Helium	Heavy Rare Earth Elements	Light Rare Earth Elements
Lithium	Magnesium	Manganese
Natural Graphite	Nickel – battery grade	Niobium
Phosphate rock	Phosphorus	Platinum Group Metals
Scandium	Silicon metal	Strontium
Tantalum	Titanium metal	Tungsten
Vanadium		