

Raw Materials recovery from mining and metallurgical residues

Evidence review

Carlo Cormio



RESOURCE MANAGEMENT WEEK 2021

ENABLING SUSTAINABILITY PRINCIPLES IN RESOURCE MANAGEMENT



UNECE

Raw Materials recovery from mining and metallurgical residues

Evidence review



■ Outline

- Introduction
 - MINEA WG 2.1 objectives and achievements
 - Scope of the evidence review
- Evidence Review
 - Method description
 - Results & discussion
- Conclusions



■ MINEA WG 2.1 objectives and achievements

Objectives

- ✓ **Develop a common understanding and definitions** regarding material resources/reserves in mining residues deposits, both closed and in operation.
- ✓ **Establish a knowledge base** including technologies and data sources for Raw Materials recovery from mining residues.
- ✓ **Provide inputs to policy makers** on the resource potential in mining residues.



■ MINEA WG 2.1 objectives and achievements

Main achievements

- ✓ **Survey of national mine waste registries** from 7 European countries for their potential use as source of information aiming at the valorization of mine waste deposits *. Definition of 33 parameters for valuable materials recoverability assessment.
- ✓ Collection and **review of 66 case studies of Raw Materials recovery projects using mining and metallurgical residues as source of minerals or materials ****.
- ✓ Collaboration with WG4 in the assessment of the **classification and reporting of mining and metallurgical residues as resources/reserves**

* Žibret, G., et al. (2020). *National Mineral Waste Databases as an Information Source for Assessing Material Recovery Potential from Mine Waste, Tailings and Metallurgical Waste*. *Minerals* 2020, 10, 446. <https://doi.org/10.3390/min10050446>

** Blasenbauer, D., et al. (2020). *Knowledge base to facilitate anthropogenic resource assessment (MINEA Deliverable)*. COST Action Mining the European Anthroposphere (MINEA). online: <https://doi.org/10.5281/zenodo.3739164>



■ Scope of the evidence review

- ✓ **Assess current knowledge, knowledge gaps and action needed** to foster the production of RMs from mining / metallurgical residues
- ✓ **Analyse case studies providing SITE-SPECIFIC** characterization, evaluation and / or classification for minerals / materials recovery
- ✓ **Screen existing projects** dealing with exploration, characterization, evaluation, processing, impact assessment of mining / metallurgical residues.

Authors

T. Carvalho, M. Alonso, P. Cleall, C. Cormio, B. Lemière, D. Guglietta, D. Sinnett, K. Szabò

+ T. Werner (University of Melbourne) and the contribution of S. Heuss-Aßbichler and U. Kral

Evidence review

Method description



■ Data sources

- ✓ **Technical reports** for investors
- ✓ **Reports and databases of research projects** dealing with production of raw materials from mining/metallurgical residues
- ✓ **Reports from international organizations** and research centers
- ✓ **Scientific papers** published in international journals
- ✓ **PhD thesis**

Evidence review

Method description



■ Information collected

✓ References

- ✓ Document type (paper/book, presentation, deliverable, specifications, technical report, etc.)
- ✓ Document info (title, authors, geographic coverage, full reference, notes)

✓ Case studies

- ✓ **General data** (RM source, target materials, location, maturity level)
- ✓ **Resource assessment** (characterization, evaluation, classification)
- ✓ **Stakeholder perspective** (funding body, objectives, target audience)

Detailed guidelines prepared to add new case studies / update existing ones

Collaborative tools allowed experts from EU, UK, Australia to collect and review case studies

Evidence review

Method description



■ General data

Raw Material source	
Key	Type
WR	Waste rocks
LgS	Low grade stockpiles
T	Tailings
M	Metallurgical residues

Target materials	
Key	Type
PM	Previously mined minerals
NP	Non previously mined minerals
NM	New materials

Maturity level	
Key	Description
R	Research work
P	Prospect study
O	Operating

Evidence review

Method description



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Resource assessment

Characterization	
Key	Factor
L	Location
V	Volumes or masses
C	Chemical specification
P	Particle sizes / distribution
M	Material composition
W	Water content
Le	Leachates

Evaluation	
Key	Factor
F	Economic feasibility
E	Environmental impact
M	Market acceptance
S	Socio-political acceptance
A	Legal accessibility to resource
T	Technical recoverability
I	Infrastructure
L	Legal compliance

Classification	
Key	Description
-	no classification
NI 43-101	National Instrument 43-101
JORC	JORC reporting code (Australasia)
PERC	PERC reporting code (Europe)
SAMREC/SAMVAL	SAMCODES standards (South Africa)
SME	SME (United States)
CMC	Comisión Minera de Chile (Chile)
NAEN	Russian reporting code (Russia)
UNFC	UNFC (Europe)
UNFC-A	UNFC for Anthropogenic resources
UNFC + PERC	Both UNFC and PERC provided
other (specify)	Not listed standard reporting code



■ Stakeholder perspective

Funding Body	
Key	Description
PA	Public Agency
EU	European Union
NPO	Non-profit Organization
MC	Mining company
PC	Private company
U/R	University / Research center

Objectives	
Key	Description
MiR	Mineral recovery
MaR	Material recovery
LR	Land recovery
ER	Environmental remediation

Target audience	
Key	Description
R	Research
M	Market
PA	Public Administration

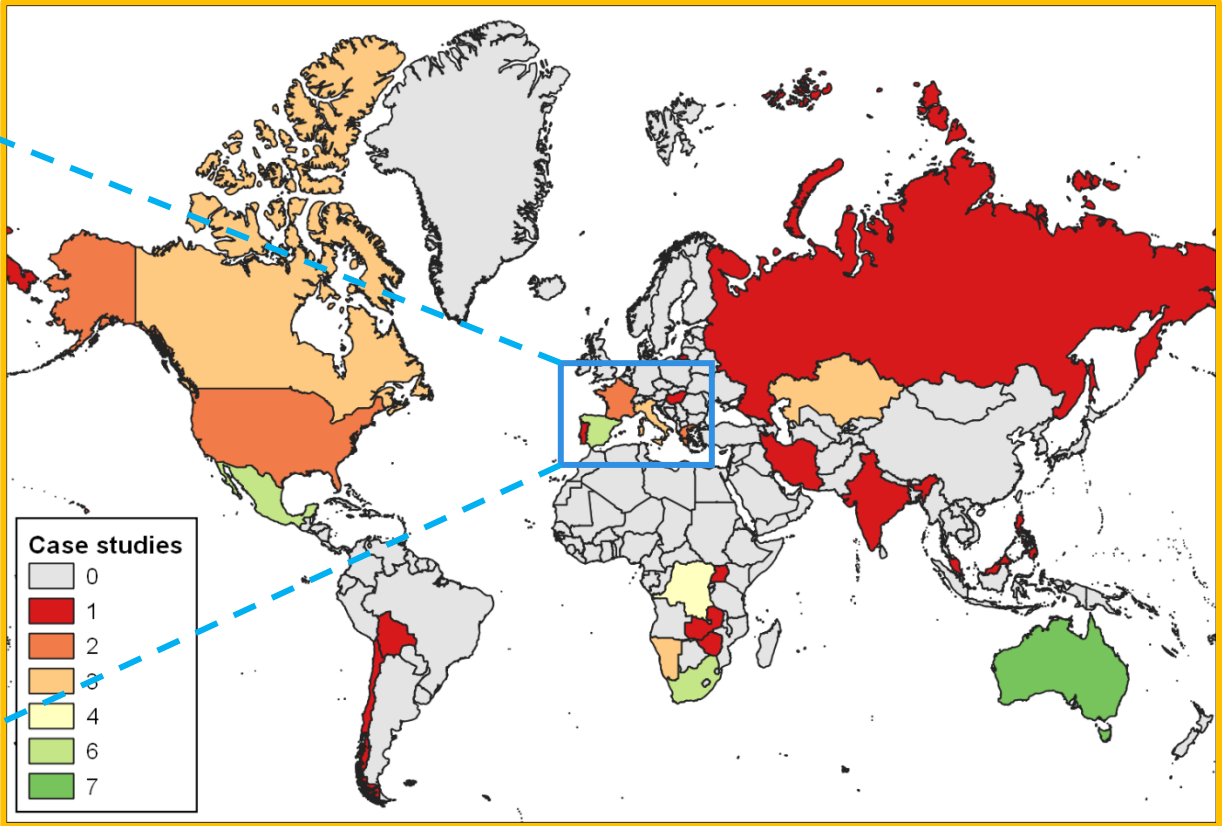
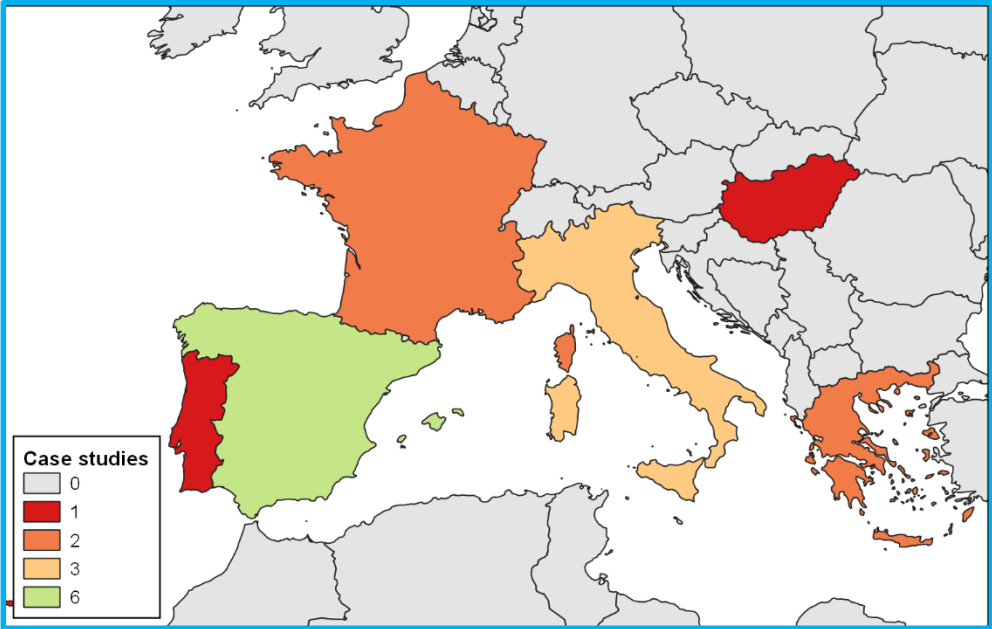
Evidence review

Results & discussion



■ Geographical distribution

- ✓ 66 case studies worldwide
- ✓ 14 in Europe (~ 20%)



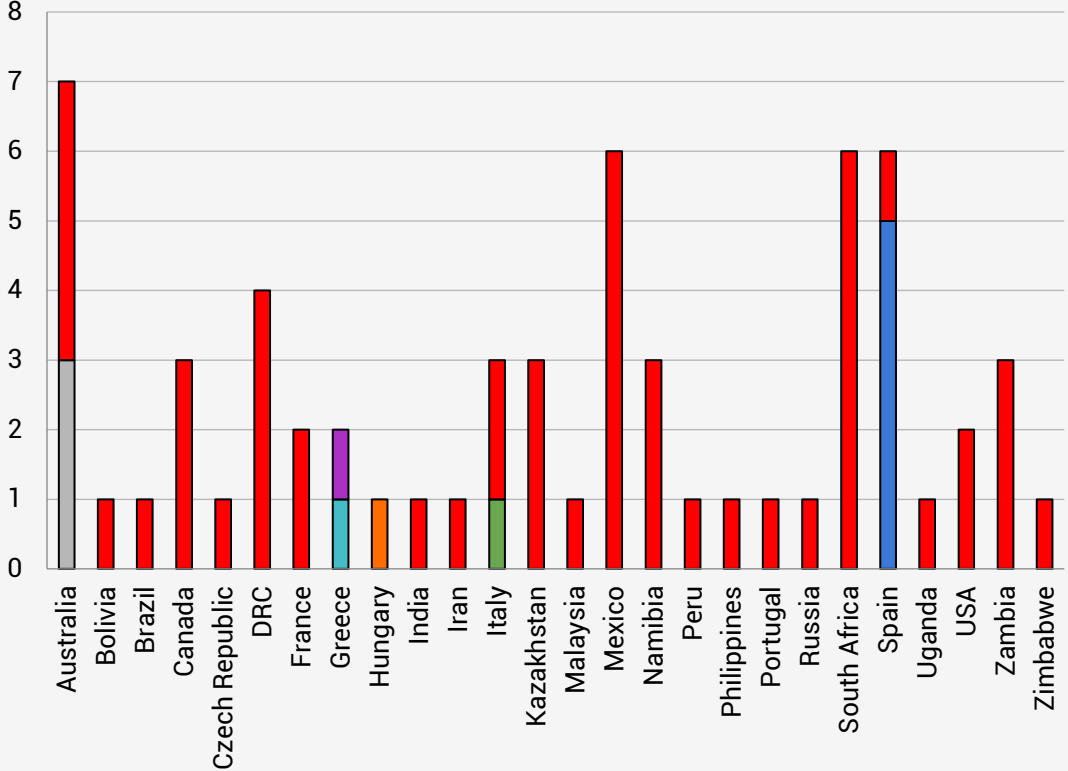
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Results & discussion

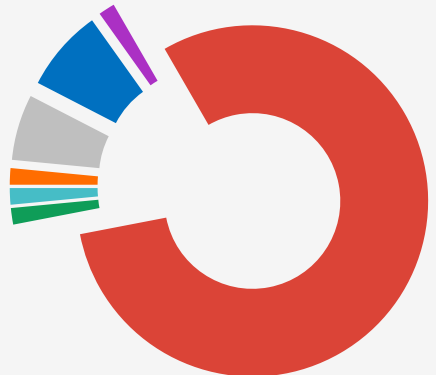


Stakeholder perspective

Objectives



- Mineral recovery, Material recovery, Land recovery, Environmental remediation
- Mineral recovery, Material recovery
- Mineral recovery, Land recovery
- Mineral recovery
- Mineral recovery, Environmental remediation
- Land recovery, Environmental remediation
- Material recovery



- ✓ 90% of case studies focus on mineral recovery. Among those:
 - ✓ 7.5 % linked to env. remediation
 - ✓ 3% linked to land recovery

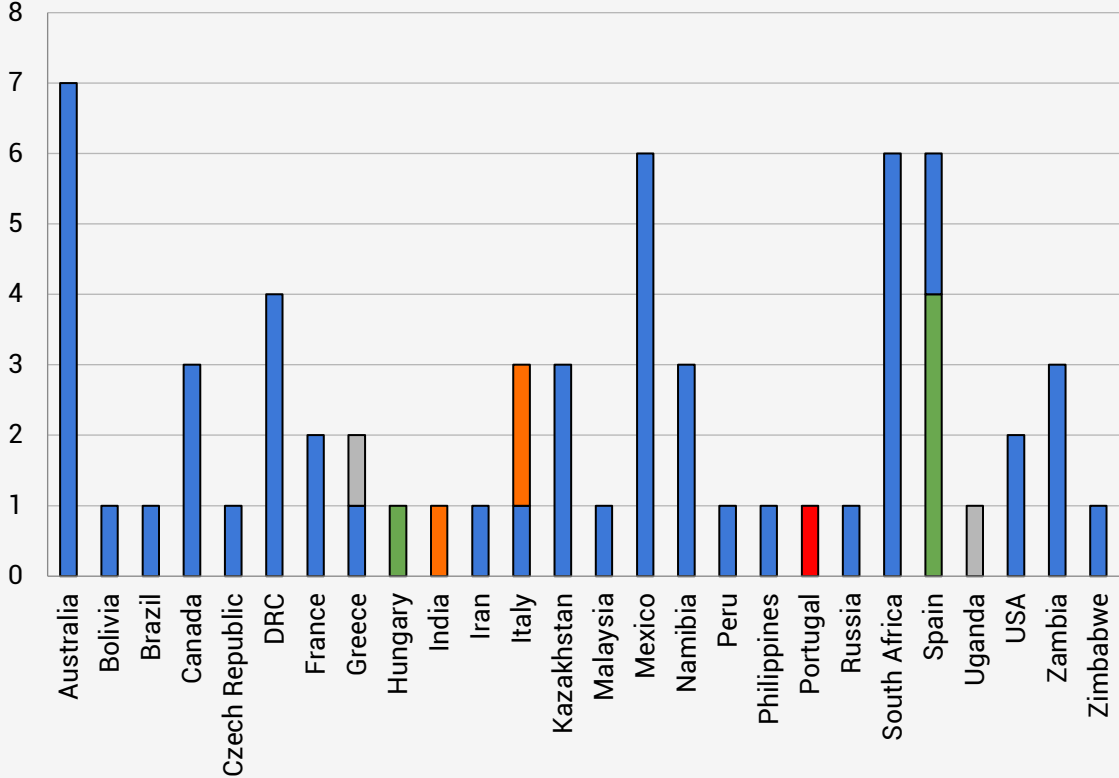
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Results & discussion

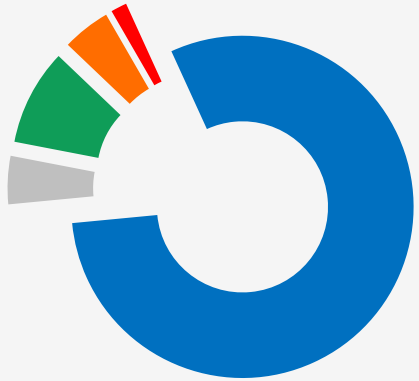


Stakeholder perspective

Target audience



- Researchers, Market, Public Administration
- Researchers
- Researchers, Market
- Market
- Market, Public Administration



- ✓ Market accounts for ~99 % of audience
- ✓ Public administrations account for 13.6 %

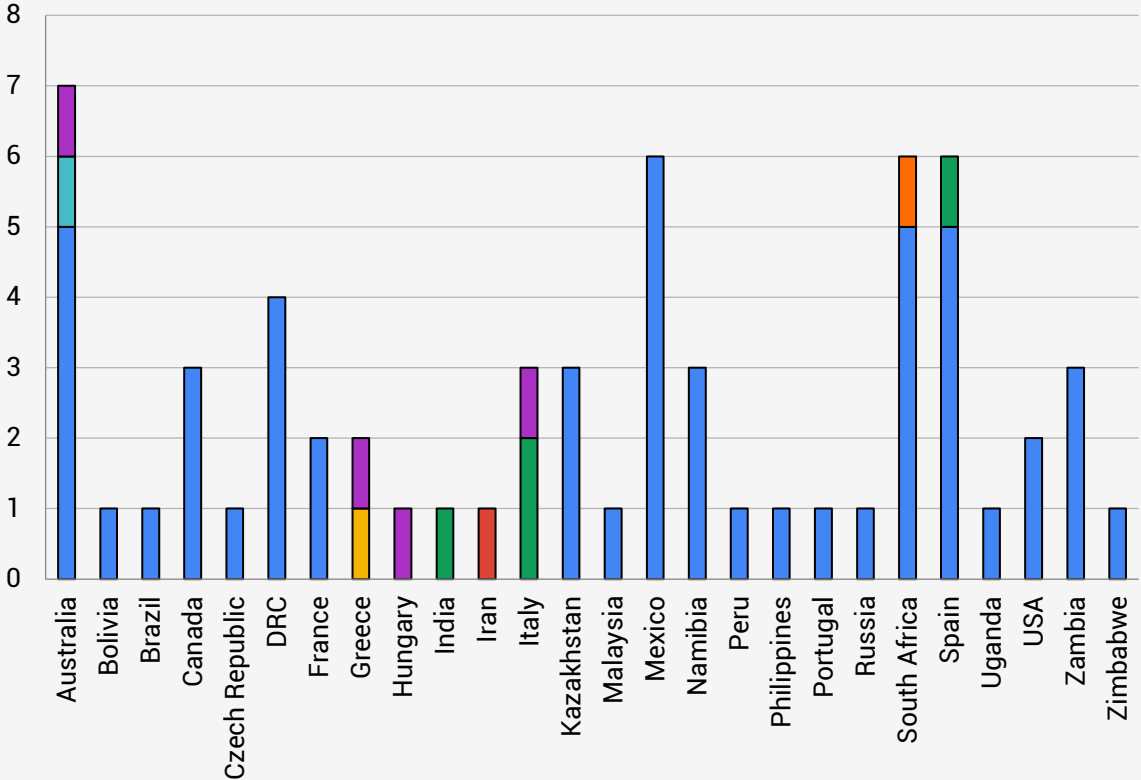
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Results & discussion

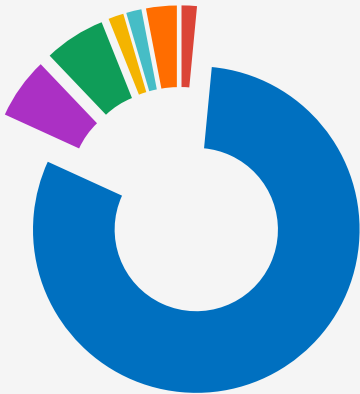


General data

Raw Materials Source



- Metallurgical residues
- Waste Rocks, Low Grade Stockpiles, Tailings
- Waste Rocks, Tailings, Met. Residues
- Waste Rocks, Tailings
- Low grade Stockpiles, Met. Residues
- Low grade Stockpiles
- Tailings



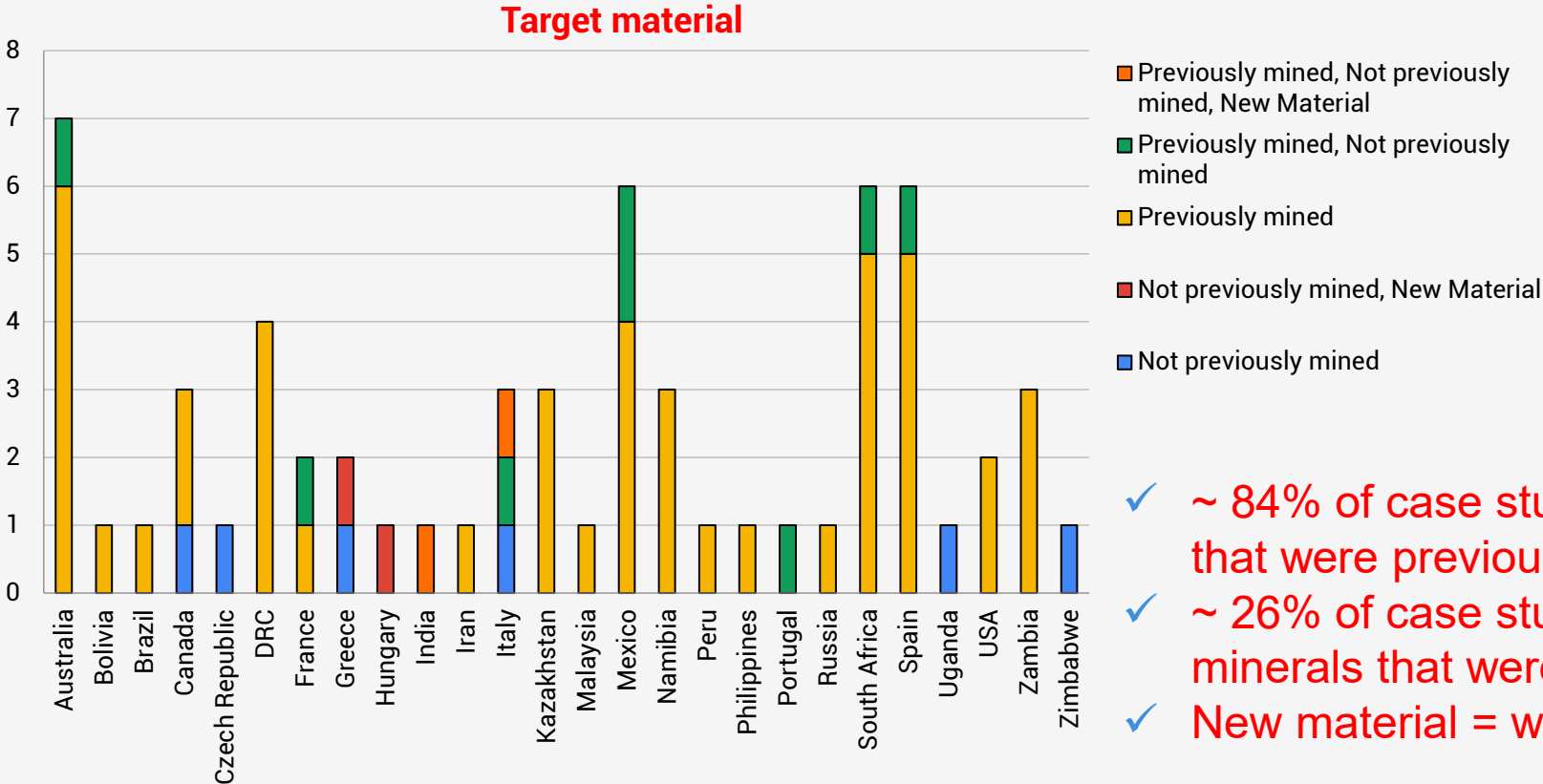
✓ ~ 80% of case studies deal with tailings valorization only

Evidence review

Results & discussion



General data

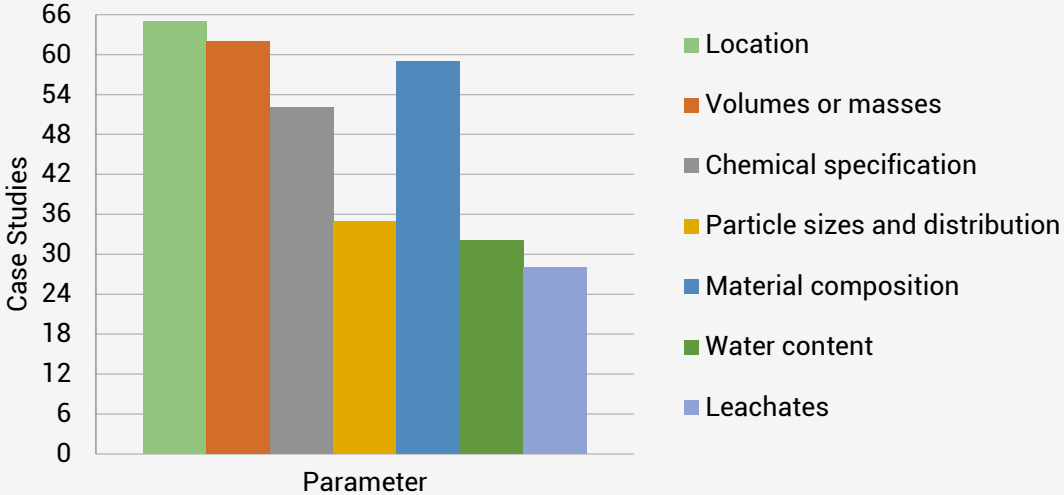
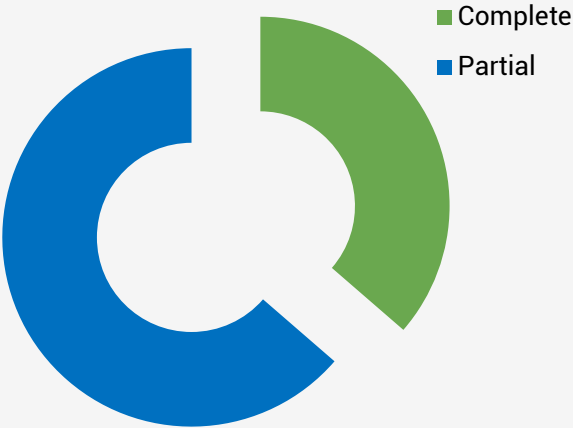


- ✓ ~ 84% of case studies addressing minerals that were previously mined
- ✓ ~ 26% of case studies addressing also minerals that weren't previously mined
- ✓ New material = waste valuable "as is"



Resource assessment

Characterisation



✓ Only 36% of case studies have a complete characterization (referred to the parameters considered)

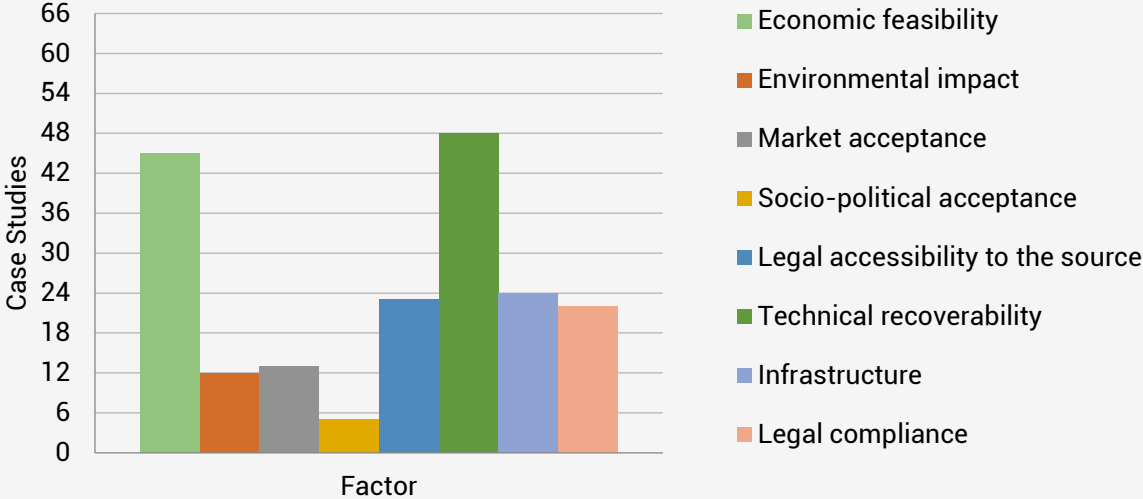
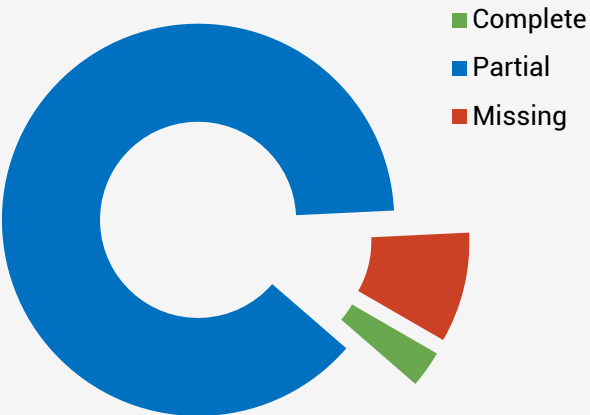
Evidence review

Results & discussion



Resource assessment

Evaluation



✓ Socio-political acceptance and environmental impact are mostly neglected

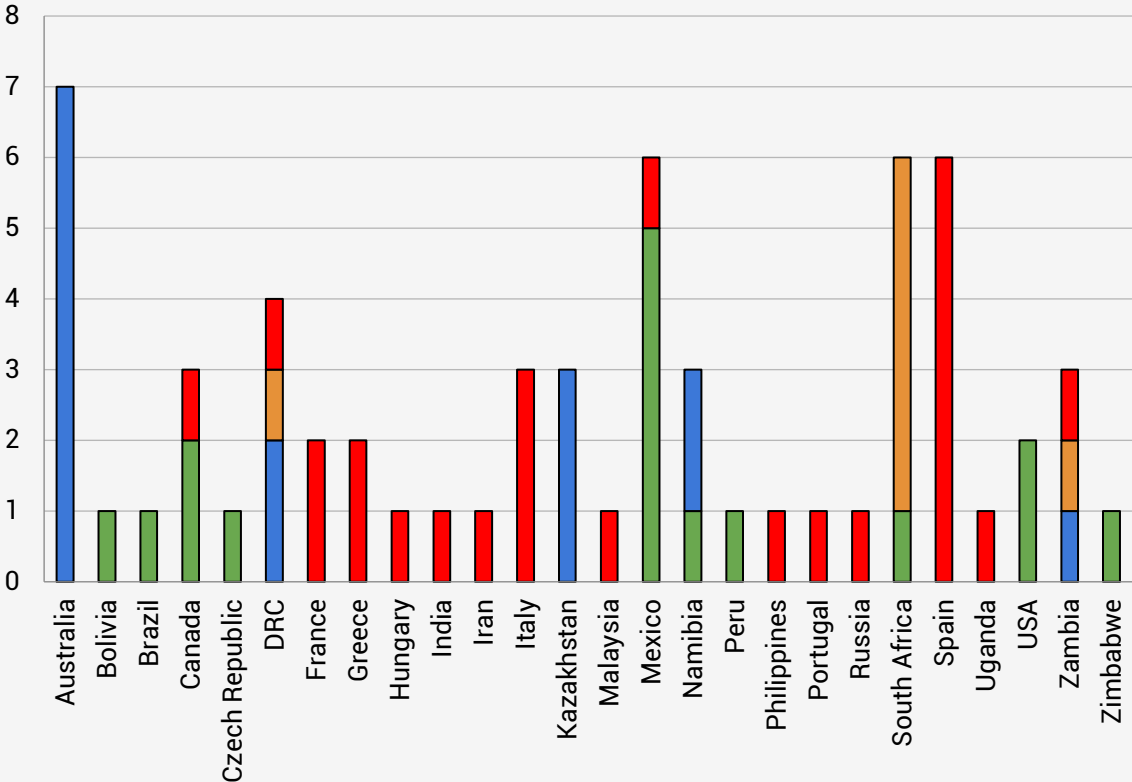
Evidence review

Results & discussion



Resource assessment

Classification



- ✓ No case studies classified using:
 - ✓ UNFC (but there are a few from research works, to be included)
 - ✓ PERC
- ✓ CRIRSCO-to-UNFC conversion has been tested on a selection of case studies (V. Correia and M. Neumann)

Evidence review

Conclusions



- ✓ **Lessons learned**
- ✓ Mining / metallurgical residues are still widely unexplored or not classified
- ✓ Social & Environmental impacts need to be more and better addressed
- ✓ The proposed systematic analysis may be the basis of a more effective decision support tool for RMs supply risk assessment

Evidence review

Conclusions



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- ✓ **Future works**
- ✓ **Complete the review of about 90 research projects/initiatives** dealing with primary/secondary resources exploration, characterization, evaluation, processing, impact assessment
- ✓ Publish the reviews in a scientific journal (manuscript writing ongoing)
- ✓ **Call for expression of interest**
 - ✓ Increase case studies list involving the wider experts community (e.g. building an online tool)
 - ✓ Convert CRIRSCO to UNFC numbers for collected case studies
 - ✓ Apply UNFC to case studies which have not been classified until now
 - ✓ **Benefits:** increased awareness on UNFC potential, challenges and benefits of UNFC highlighted, improved knowledge on domestic resources, ...

Thank you!

Ph.D. Eng. Carlo Cormio
SERENGEО Srl – c.cormio@serengeo.com

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