



Innovations in Exploration & Extraction – results from the Min-Guide project

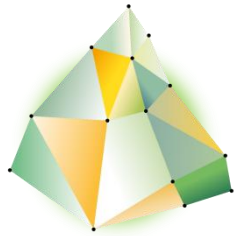
Michael Tost

Chair of Mining Engineering and Mineral Economics,
Montanuniversitaet Leoben
REMIX International Mining Conference, Wroclaw, 15 May
2019



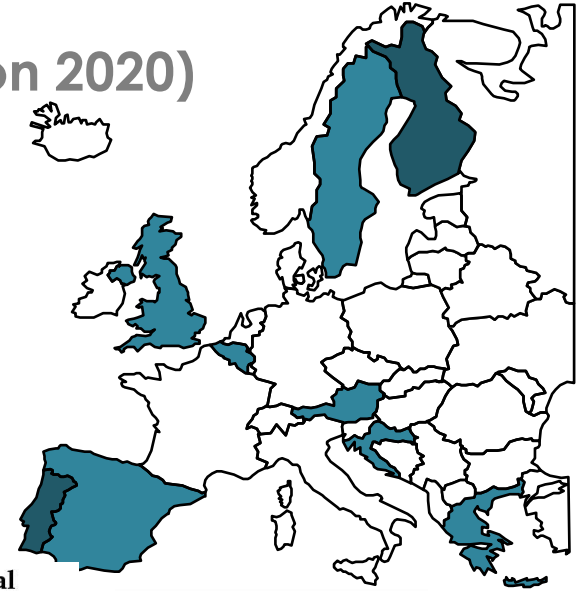
This project received funding from the European Union's Horizon
2020 research and innovation programme under grant agreement
No. 689527





What is MIN-Guide?

- Coordination and Support Action (Horizon 2020)
- 3-year project: Feb 2016 - Jan 2019
- Project Coordinator:



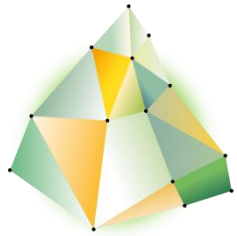
- 10 Partners
- 9 countries



GOAL



Contribute to an innovation-friendly policy framework for a secure and sustainable supply of minerals.



Innovation-friendly mineral policy

Industry innovation & policy frameworks



Exploration & Extraction

Identify industry innovation challenges and cases

Identify EU and EU MS mineral policy frameworks

Legislative framework



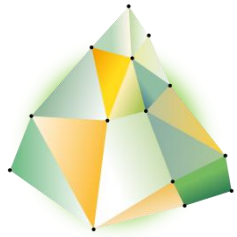
Mineral and metallurgical processing

Economic and financial instruments

Waste management & mine-closure

Information provision and awareness

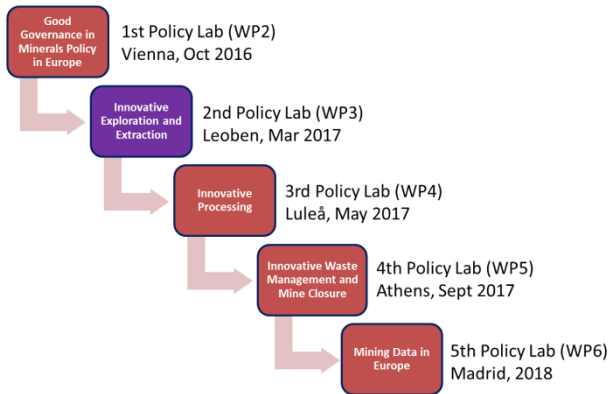




MIN-Guide activities

Events and information provision

5 Policy Laboratories



3 Annual Conferences (EU-Level)

The **Closing Conference** *'The future perspective of minerals production in the circular economy'*

The **Mid-term Conference**: *'Good practice minerals policy transitioning the minerals production value-chain'*

The **Opening Conference**: *'European minerals policy: Stock-taking and revealing the governance framework'*

Webpage and policy guide

Online Mineral Policy Guide



[About](#) [Annual Conferences](#) [Collaborative Spaces](#) [Minerals Policy Guide](#) [News & Events](#) [PR & Media](#) [Policy Laboratories](#)

MIN-GUIDE: an answer to the need of secure and sustainable supply of minerals in Europe

The MIN-GUIDE project addresses the need for a secure and sustainable supply of minerals in Europe by developing a 'Minerals Policy Guide'. The functioning of European economies and, consequently, the well-being of societies is highly dependent on the long-term supply of natural resources and raw materials for production and use. However, access to non-energy mineral raw materials that constitute the basis of industrial value-chains is not stable and secure. To secure minerals supply in Europe we would need a policy framework promoting innovative and sustainable approaches to tackle challenges in the mining value chain.

The MIN-GUIDE project has been designed to comprehensively tackle these challenges. The project will link to the European Innovation Partnership on Raw Materials (EIP) by feeding back its results into EU policy process, and supports outreach activities and community building.

MIN-GUIDE is a project that is funded by the European Commission in the Horizon 2020 programme. It is carried out by 10 organisations representing 9 European countries. The project runs from 1 February 2016 to 31 January 2019.

[Continue reading](#)



43
MINERAL POLICY PROFILES

478
PROJECTS

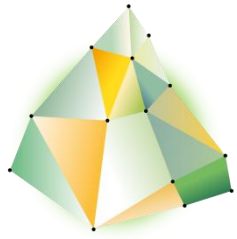
28
COUNTRY PROFILES

Latest News

[MIN-GUIDE: Guidance for innovation friendly](#)

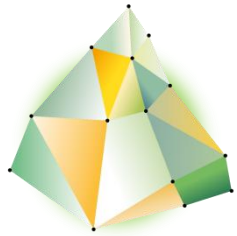
Event Calendar

[EU Advanced mining countries Raw Materials](#)



WP3 “Innovative exploration and extraction”

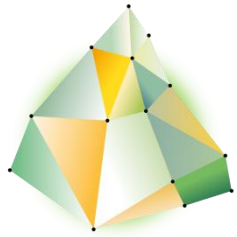
- Identification of EU MS mineral policies and legislation relevant to innovation in minerals exploration and extraction
- Identification of catalyzing and inhibiting elements for the implementation of innovative mineral exploration and extractive methods (non-technological as well as technological elements) and, following this, an identification of best practice cases
- *Assessment of needs and gaps analysis for aligning future policy developments/directions with inclusion of all relevant stakeholders*
- *Exploration of the feasibility of innovative mining legislation and legal framework for exploitation of sub-surface and deep sea resources.*



Innovations exploration

Exploration-innovations
New-geo-models, i.e. 3D-modelling-using-multiple-geological, geophysical-and-geochemical-datasets
Airborne-geophysical-methods Legende
Use-of-commercially-available-drones-and-other-small-aircraft-in-surveying-tenure-or-high-precision-mapping
In-situ-analysis-using-portable-XRF-analysers
In-situ-analysis-using-multispectral-core-logging
Trace-element-litho-geochemical-&-mineral-systems-mapping
Use-of-MMI-(mobile-metal-ion)-theory-in-geochemical-exploration
Advanced-field-work, including-better-sample-processing-and-analysis-techniques, data-analysis-and-processes-for-environment-friendlier-exploration
Advanced-geological-and-geophysical-data-processing-and-interpretation, e.g. SOM-(self-organising-maps)-method, prospectivity-analysis
Advanced-surficial-geochemical-and-biogeochemical-methods-based-on-weak-and-selective-leaching
Mobile-GIS/GNSS-applications-and-improved-field-mapping-workflows, plus-availability-of-cloud-based-server-storage
Deep-drilling-technologies, including-accurate-down-hole-surveying-and-directional-drilling, downhole-geophysical-and-structural-analysis-(but-NOT-yet-including-downhole-chemical-analyses)
Deep-penetrating-geophysical-technologies, in-particular-magneto-tellurics-and-electromagnetics-(including-SQUID-development)
New-drilling-technologies
Improved-online-access-to-existing-exploration-and-geological-data
All-geological-data-published
Faster-technology-to-scan-larger-areas
Overarching-mining-codes
Development-of-innovative-near-mine-and-deep-exploration-technologies

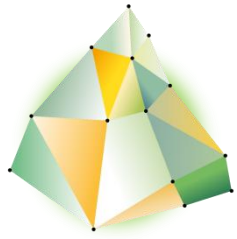
- No breakthrough innovations in exploration in the last 20 years
- “Skills of the geologist”
- Field vs. data



Innovations **extraction**

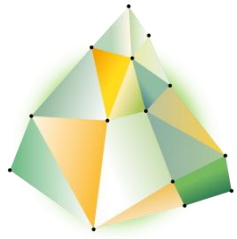
Extraction-innovations	
Autonomous equipment/operations including use of robotics, smart sensors and 3D printing	☒
Process control & (big) data management („real-time information and mass flows“)	☒
Continuous processes and automation	☒
Resource characterisation	☒
New models for financing of mining	☒
Lower environmental footprint (ie biodiversity, ore recovery, energy and CO2, water, waste)	☒
New-/Alternative mining methods (in-situ leaching, mechanical cutting to replace DLB, etc)	☒
Digitally enabled worker including remote operation centres, virtual and augmented reality, virtual collaboration	☒
Transparency and traceability including open platform databases, block chain usage	☒
Surveying methodology and mine design	☒
Scale-up of production equipment	☒
Resource characterisation for better structural control	☒
Integrated platforms, enterprise ecosystems incl. IT/OT convergence, asset cybersecurity	☒
Next-generation analytics and decision-making including Artificial Intelligence, simulation modelling	☒
Land-use planning governance (site-level vs. Cumulative impact at regional level) -- data will allow models/analysis as part of regional development plans	☒
New business models and customer relations (collaborative business models, customer responsibility)	☒
Dealing with extreme environments (deep-sea mining, extreme depths, arctic...)	☒
Various safety innovations including cultural changes	☒
Better skills base	☒
Better infrastructure, i.e. electricity and „mine-to-market“	☒

- First two considered key
- NGOs: more innovations needed concerning transparency, land use, environmental management



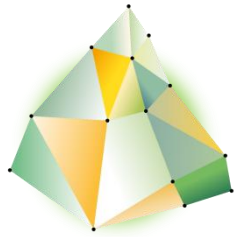
Narrative I **Impact of policy on exploration & extraction innovations**

- Innovations are mainly driven by business opportunity
- Policy is only playing a secondary role, except for areas where innovation can help with meeting legislative requirements
 - Health and safety (e.g. communication and warning systems in underground mines)
 - Environment (e.g. resource efficiency, energy, water, waste management)
- RMI seen as positive since it made minerals a political priority again
- Horizon 2020 and EIT RM programs seen as positive for innovations



Narrative II Innovations and their impact on the SDGs

- No one-size-fits-all single innovation concept that will resolve mining's challenges and contribute positively to all SDGs
- Quite on the contrary, almost all innovation concepts show repercussions on individual SDGs
- The “inside-out” economically driven technological innovations change the societal contract of mining
 - Promise of increased employment opportunities for the local community was always a strong driver for acquiring a social licence to operate
 - “Shared infrastructure” or “New business models and customer relations”
- Many of the innovation concepts analysed have positive impacts on the environmental SDGs
- Innovations do not contribute to SDG 5 on gender equality and empowerment
- The societal innovations are mainly positive for the SDGs, i.e. social and environmental, but often have negative implications on the direct



Conclusions

Is European Mining Smart and Green?

- Innovation is critical for exploration & extraction in the EU
- RMI, EIP, etc seen as positive – will minerals continue to be a political priority?
- National RDI programs (Sweden, Finland, Portugal) seen as positive
- Innovation is mainly driven by business opportunity
- Legislation based on societal challenges drives innovation
- No one-size-fits-all single innovation concept that will resolve mining's challenges and contribute positively to all SDGs



... not yet!



Thank you for your attention

Michael Tost
Chair of Mining Engineering and Mineral Economics,
Montanuniversitaet Leoben

www.min-guide.eu/