



Minerals Policy Guidance for
Europe

Innovative Exploration and Extraction

Deliverable 3.4.

*Guidelines and recommendations for future policy
and legislation*

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Author(s):

Darko Vrkljan, University of Zagreb

Mario Klanfar, University of Zagreb

With contributions by:

Michael Tost (Montanuniversitaet Leoben), Andreas Endl (Vienna University of Economics and Business)

With thanks to:

Luís Pinheiro, Filomena Cardoso Martins, Teresa Fidélis

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MIN-GUIDE Project partners



Vienna University of Economics and Business (Coordinator)

Vienna, Austria



University of Westminster

London, United Kingdom



Montanuniversität Leoben

Leoben, Austria



Luleå University of Technology, Department of Civil, Environmental and Natural Resources Engineering

Luleå, Sweden



National Technical University of Athens

Athens, Greece



Instituto Geológico y Minero de España

Madrid, Spain



University of Aveiro

Aveiro, Portugal



GOPA Com.

Brussels, Belgium



University of Zagreb – Faculty of Mining, Geology and Petroleum Engineering

Zagreb, Croatia



Ministry of the Employment and the Economy

Helsinki, Finland



Table of Contents

LIST OF TABLES	3
1. INTRODUCTION	4
2. SUMMARY OF OTHER DELIVERABLES IN THIS WORK PACKAGE	6
2.1. DELIVERABLE 3.1.	6
2.2. DELIVERABLE 3.2.	8
3. POLICY LABORATORY 2	10
3.1. NEEDS AND GAPS TO INTRODUCE INNOVATIONS IN EXPLORATION AND EXTRACTION.....	11
4. SITUATION IN EUROPEAN NATIONAL RAW MINERAL POLICIES AND GOVERNANCE	13
4.1. SUMMARIES FROM THE INTERVIEWS AND THE QUESTIONNAIRE	14
5. ANALYSIS OF NEEDS AND GAPS	27
5.1. SWOT ANALYSIS.....	30
6. CONCLUSIONS AND RECOMMENDATIONS	33
7. REFERENCES	35
8. ANNEX	37
LIST OF ABBREVIATIONS.....	37
QUESTIONNAIRE D 3.4.	39

List of Tables

Table 1.1: The MIN-GUIDE work packages	4
Table 5-1: SWOT Analysis.....	31



1. Introduction

MIN-GUIDE: a brief introduction

The Horizon 2020-funded MIN-GUIDE project aims to support the secure and sustainable supply of minerals in Europe through the development of a major new online repository outlining guidance and the latest in good practice for minerals policy decision makers. The project's key objectives are (1) to provide guidance for EU and EU Member States minerals policy, (2) to facilitate minerals policy decision making through knowledge co-production for transferability of best practice minerals policy, and (3) to foster community and network building for the co-management of an innovation-catalysing minerals policy framework. MIN-GUIDE will profile relevant policy in Europe, identifying innovation-friendly good practice through quantitative indicators, qualitative analysis of country-specific framework conditions, and the compilation of minerals statistics and reporting systems. These insights will form the basis for the project's key output, an online Minerals Policy Guide (referred to in this document as 'the Policy Guide').

The project is split across 8 work packages (WPs) (see Table 1.1 below). The content-rich work packages are WPs 2-6: WP2 will produce a comprehensive and well-structured knowledge repository of EU level and EU Member States' mineral policies and governance frameworks; WPs 3-5 will identify, benchmark, and elaborate good practice on policy innovation capacity according to the different activities along the whole mining value chain (permitting, exploration, extraction, cross-border exploitation, processing, waste management, recycling, remediation and mine closure); and WP6 will review the mineral data base and recommend standardisation and systematic reporting requirements for EU Member States.

Table 1.1: The MIN-GUIDE work packages

Common approach	WP1	Minerals policy guide development and conceptual basis
	WP2	Stock-taking of EU and EU MS mineral policy and legislation
	WP3	Innovative exploration and extraction
Core content	WP4	Innovative processing
	WP5	Innovative waste management and mine closure
	WP6	Raw materials knowledge and information base
Cross-cutting management and engagement	WP7	Stakeholder management, communication and dissemination
	WP8	Project management



The aim of WP3 “Innovative exploration and extraction” is to investigate how exploration and extraction innovations are taken up in different EU Member States, and how this is supported or inhibited by national and European policies. The main objectives of work package 3 are:

- Identification of EU MS mineral policies relevant to innovation in exploration and extraction of raw materials (Deliverable 3.1.),
- Identification of innovations in raw materials exploration and extraction and how they are taken up in EU MS (Deliverable 3.2.)
- Exploration of the feasibility of an innovative legal framework for exploitation of sub-surface and deep sea resources of raw materials (Deliverable 3.3.),
- **Investigation of how raw materials policies (European and national) influence the introduction of innovations in exploration and extraction of raw materials and needs and gaps of existing raw materials policies (elaborated in this deliverable),**

The objective of this deliverable is to make suggestions and recommendations for future development of non-energetic raw material policy and governance for exploration and extraction.

Due to the overall differences between conventional mining and deep sea mining, the latter is discussed in detail in deliverable 3.3. This deliverable only includes a short summary regarding deep sea mining.

The recommendations and suggestions for development of non-energetic raw material policies and governance in other parts of the mineral value chain are elaborated in Min-Guide’s work packages 4: Innovative processing and work package 5: Innovative waste management and mine closure.

Within the scope of this deliverable, the outcomes of deliverable **3.1 Policy and legislation framework for innovative exploration and extraction** and deliverable 3.2 **Innovation evaluation criteria and best case practise in exploration and extraction** were discussed with key stakeholders and neutral innovation experts from the field of exploration and extraction.

“Neutral” experts (from 17 EU MS) included experts from the academic community, geological surveys, and consultants (geological and mining).

The applied methods of investigation were through interviews (via skype) and questionnaires.

The results of the interviews and the questionnaire were then used for conducting a **SWOT analysis** as well as a **gaps and needs analysis**.



2. Summary of other deliverables in this work package

2.1. Deliverable 3.1.

The scope of Deliverable **3.1 Policy and legislation framework for innovative exploration and extraction** was (Tost 2017):

- summary of the key innovations in exploration and extraction (identified in deliverable 3.2.),
- identification of relevant public policies (raw materials policy and other generic policies relevant for exploration and extraction of raw materials)
- link and impact of relevant public policies of EU MS on innovations in exploration and extraction

Further on we identified relevant public policies (mineral policies and others) at the European level and national policies of member states.

Relevant raw materials policies at the European level are:

- Raw Material Initiative (RMI) (Raw Materials Initiative, 2008),
- Strategic Implementation Plan on Raw Materials (EIP SIP Raw Materials, Part I, 2013),
- National Mineral Policy Indicators – Framework conditions for sustainable supply of raw materials in the EU (2014)

The RMI points out the critical importance of raw materials for the European economy, with internal market access to raw materials, security of supply from abroad and resource management aspects as key issues. The RMI recommended (not obligatory) for member states to develop national mineral strategies, which so far only ten member states have done.

The relevant mineral policies at EU MS level are dispersed vertically (national and local level legislation and governance) and horizontally (between different authorities) (Endl, 2016).

The main impact of relevant public policies can be derived from broader societal challenges, related to resource efficiency, permitting procedures, emissions, handling of hazardous materials and waste, as well as health, safety and risk management. Other factors strongly affecting the mining industry are national taxation systems, land planning, national and EU funding schemes for research, development and implementation (RDI) programmes, coordination and support actions, government sponsored promotion campaigns for the public acceptance of mining, etc. (Sand, 2016).

The experts told us that innovations in exploration and extraction are mainly driven by business opportunity with public policy playing only a secondary role (e.g. to fulfil health and safety regulation demands or environmental protection demands) (Tost, 2017). They see the European raw material policies as positive since they made minerals and theirs supply a political priority. The RDI programmes Horizon 2020 and EIP Raw Materials were mentioned as positive examples supporting innovations in exploration and extraction. The national programmes in Sweden, Portugal and Finland were mentioned as positive examples supporting innovations in exploration and extraction at the EU MS level.



Table 4. in Deliverable 3.1. shows examples of policies (generic policies relevant in all of the EU MS and national policies of MS) linked to exploration and its perceived impact on innovations (21 innovations). The perceived impact of policies on these innovations in exploration is mainly positive (32 cases, 64%), or can have both a positive and a negative impact (12 cases, 24%). A negative impact is less expressed (4 cases, 8%) and neutral policies are mentioned in just 2 cases (4%). 51 policies are mentioned in the context of the top 10 ranked innovations in exploration (19 EU policies and 32 national member state policies). Among national policies most often mentioned are research and grants policies (8 times), tax policies (5 times), aviation regulations (4 times), policies concerning geological surveys (3 times), national mineral policies (3 times) and others (9 times - concerning water, radiation, waste, land use). A national mining law is mentioned in only one case (Finland).

Table 5. in Deliverable 3.1. shows examples of policies (generic policies relevant in all of the EU MS and national policies of MS) linked to extraction and its perceived impact on innovations (24 innovations). The perceived impact of policies on innovation in extraction is mainly positive (19 cases, 63,3%), or can have both a positive and a negative impact (9 cases, 30%). Once again, negative impacts are less mentioned (2 cases, 6,7%) and neutral impact policies are not mentioned at all (0%) . 31 policies are mentioned in the context of the top 10 ranked innovations in extraction (20 EU policies and 11 national member state policies). Among national policies most often mentioned are research and grants policies (3 times), tax policies (2 times), mineral policies (3 times), education policies (2) and land use policy. A National mining law is not mentioned at all.

To sum up, in exploration and extraction, in the context of the top 20 ranked innovations, 82 policy impacts are mentioned (European policies 39 times and national policies 43 times). Among European policies, the Raw Materials Initiative is most often mentioned (12 times). Among national policies most often mentioned are research and grants policies (11 times), tax policies (7 times) and mineral policies (6 times).

All in all, we can conclude that the perceived impact of innovation policies in this part of the mining value chain is mainly seen as positive (approximately in two thirds of cases), i.e. the policy spurs innovation, with weak negative perceived impact (<10%) that might hinder innovation.

Conclusions of Deliverable 3.1.:

- innovation will play a critical role in exploration and extraction (deep orebodies, exploitation of small and complex orebodies, exploitation in densely populated areas, dealing with strong land use competition, fulfilling rigorous environmental and nature protection demands and restrictions),



- current European mineral policies are generally positively recognized by interviewed experts to spur innovation,
- there is concern that a change of the economic situation could make raw material security and policy once again a lower political priority,
- innovations in exploration and extraction are mainly driven by business opportunity with public policy playing only a secondary role,
- policy does play a role through legislation facilitating innovations required to respond to societal challenges such as environmental issues,
- RDI related policies, tax (incentives) and education policies can also have an impact on innovation in this part of the mining value chain,
- decision makers should be aware of the innovations taking place in exploration and extraction and their links and influence from other public policy sectors (e.g. drones and aviation policies), and should be shaping these policies in a way that considers relevant mining aspects.

2.2. Deliverable 3.2.

The scope of Deliverable 3.2 ***Innovation evaluation criteria and best case practise in exploration and extraction*** was to (Tost 2016):

1. identify the key drivers/ challenges for innovation in exploration and extraction of raw materials
– desktop research: review of existing innovation related literature
2. identify a list of the most important innovations in exploration and extraction and their drivers –
through interviews and questionnaires

Geological potential and data, data availability and suitable mining policies were considered the most relevant direct drivers for innovation in exploration. Cost and productivity, orebody geology, legislation and health and safety of employees were considered the key drivers/challenges for innovation in extraction.

Responding to these challenges/drivers a number of innovation areas were identified: Better geological data, mapping and modelling, new exploration technologies were considered key innovation areas for exploration. All of these can be considered process innovations.

Autonomous, automated and continuous processes, safer and greener mining and remote operations were considered key innovation areas for extraction.

Lists of most important innovations in exploration (21) and extraction (24) were developed through interviews and questionnaires with stakeholders (30) from industry, academia, consultancy, government and NGOs.

Most exploration innovations mentioned by stakeholders were process innovations. Some of these innovations include elements of organisational and system innovations. Only one innovation was considered to be a system innovation.

Most extraction innovations mentioned by stakeholders were also process innovations, with some of them including some organisational elements. In addition one system innovation and one organisational innovation was mentioned.



The stakeholders also identified a list of drivers for innovation in exploration (10) and extraction (19) through interviews and questionnaires. Geological potential data was the most mentioned driver for inducing innovation in exploration. Productivity improvements, health & safety improvements and cost reduction were the most often mentioned drivers for extraction. These drivers correspondent with the results of the desktop research.

The top five innovations (see Table 12 of Deliverable 3.2) for both exploration and extraction were chosen for further case study development.



3. Policy Laboratory 2

The second MIN-GUIDE Policy Laboratory entitled “***Innovations and Supporting Policies for Mineral Exploration and Extraction***” took place on 21-22 March 2017 at Montanuniversitaet Leoben, Austria. The aim of the workshop was to provide an overview of and reflect upon innovation examples in exploration and extraction, including deep-sea mining, and how they link to national mineral policies in EU MS. The Policy Laboratory format engaged key stakeholders from politics, industry, geological services and research in an intensive and interactive exchange. Five good practice cases on innovation in exploration and extraction and three cases from deep sea mining were presented and discussed. This allowed the participants to learn from good practice cases hands-on, to explore transferability in different contexts and to reflect upon future needs and gaps. For detailed descriptions of the good practice cases discussed please see <http://min-guide.eu/content/policy-laboratories>.

Policy and non-policy enabling and hindering factors

The following policy and non-policy enabling and hindering factors for implementing innovations in exploration and extraction were established through an intensive and interactive exchange in the policy laboratory sessions.

Policy enabling factors

In cases of hard rock continuous mining and big data management no direct link between policies and innovations was established and no policy enabling factors were identified.

Policies that affect innovation in airborne geophysics are EU Aviation Strategies and Laws, National Tax Policies and EU Habitats Directive 92/43/EWG.

Differences in obtaining permits for exploration between northern and southern members of the EU were noticed as well as the relative ease of obtaining licenses in Scandinavia vs. challenges in central Europe (e.g. German federalism).

Tax benefits for explorers were also regarded as additional encouragement.

Non - Policy enabling factors

Technical advancement: Software Improvements and interface, mine equipment extraction and processing technology

Competition: Optimize Mine design, Mining and Extraction/effective budgeting/minimization of unforeseen costs

Market Demands: Specification of the products and Market agreements

Currently R&D is the main technical driver behind developments in airborne geophysics (EU Raw Materials Initiative 2008, Horizon 2020, etc). Innovations will largely be based on the development of sensor devices and new airborne technology (drones, 4D, analytics, IT).

Provision of high quality, national/regional geoscientific datasets free of charge and easily accessible for the explorers. Great examples: Scandinavia, Ireland, UK, Spain. Central and Eastern Europe are way behind and will have to catch up soon.

Policy and financial support of EU and national governments.



Hindering factors

- Upfront costs (drilling, analytics, software, people) and investments
- Permitting
- Some opposition to change ("we always did it this way")
- Short term cost reduction
- Time/Push for production

3.1. Needs and gaps to introduce innovations in exploration and extraction

To improve the legal utilization of UAVs (an ***unmanned aerial vehicle***, commonly known as a ***drone***, is an aircraft without a human pilot aboard), EU countries need to catch up with Aviation Laws and standardise them. The B-VLOS operations are a must for effective drone operations and should be allowed in rural areas. The development of coherent regulations and comprehensive operational procedures for UAV operations (geofence, redundant safety systems, emergency options, etc.) as well as UAV pilot certification system for all European countries are needed.

For better ***resource characterisation*** integration of European or International Reporting Codes and establishing geoscientific databases as a part of the National or European Database/archive are needed. The obligatory execution of a digital 3D Model of the orebody and a geological model of the underground as well as definition of a required minimum orebody quantity and quality information is recommended.

Governmental or EU funds and initiatives (Horizon 2020 et al.) are needed for applied research.

Policies should aim to simplify and speed up the tenure application and management process throughout Europe.

Provision of hands-on geologists and geophysicists capable of running, processing and interpreting geophysical surveys with increased focus on non-seismic research and teaching are the education issues noticed.

Needs and gaps for deep sea mining

With the actual knowledge, a precautionary approach and adaptive management are crucial.

There is a need to set aside areas from the mining zones.

Determine the protected areas by capturing the local and regional heterogeneity/diversity.

Work with the industry to minimize the impacts based on scientific knowledge and through technological advances

The findings from policy laboratory 2 are consistent with the findings from the interviews and questionnaire in some points of view as better resource characterisation, needs for RDI activity and financing and needs to simplify/speed up the permitting procedure. The link between mineral policy and innovations is not established and no mineral policy enabling factors were identified in both



investigations. Some issues were not touched at all in the policy laboratory, such as social issues, mineral strategy and access to mineral resources.



4. Situation in European national raw mineral policies and governance

The aim of this task is to make suggestions and recommendations for future raw materials policy development for exploration and extraction. Within the task, the outcomes of Deliverables 3.1 and 3.2 are discussed with key stakeholders through **interviews and questionnaires** to be used as an input for a **gaps and needs analysis**.

Within the scope of this task we investigate:

- how existing national raw materials policies of EU MS influence the introduction of innovations in exploration and extraction in general,
- how existing national raw materials policies of EU MS influence the introduction of the top 10 innovations in exploration and extraction that have previously been identified as key innovations,
- if the governance authority responsible for mining activities is well-structured and efficient,
- if the national mineral policy is stimulating/hindering innovation in exploration and extraction as well as for mining activities in general,
- if the national mineral policy can be improved in a way to facilitate the implementation of innovation in exploration and extraction as well as for mining activities in general,
- identify possible changes in national mining regulations/governance (and other regulations affecting mining) which could promote mining activities in general,
- identify needs and gaps of existing raw materials policies.

In order to answer these questions we developed a questionnaire and sent it via e-mail to “neutral” experts in all MS in the fields of geology and mining, particularly specialists for the part of the mining value chain related to exploration and extraction. The list of questions is attached in the Annex. The term “neutral” implies experts from the academic community, geological surveys or consultancy. We carried out interviews with experts who responded via Skype, or they answered the questionnaire directly in written form. The duration of interviews ranged from 30 to 90 minutes. 26 people from 17 different EU member countries were interviewed (audio notes or written notes), the experts names, professional skills and their positions are in the archives of the task leader of Deliverable 3.4. The following section lists the summary transcripts of the interviews.



4.1. Summaries from the interviews and the questionnaire

Austria

The Austrian Mining Law (MinRoG) is considered the core legislation. According to Austrian Mining Law mineral resources related to ownership of land are divided in three categories: state owned, land owned and finders owned. The mining rights for exploration and extraction of minerals depends on owners of land. The expert finds this critical, or negative, which means in case of land owned minerals, mining authorities are not in charge. There is no knowledge of who is doing what since this is not covered anymore through mining authorities and there is no data available about mining activities in extraction/exploitation field.

Once an operational plan (Gewinnungsbetriebsplan) for mining operations (activities) is approved, any further improvements (innovations) against this plan don't need approval of mining authority, just a notice to authority.

The Environmental Impact Assessment is needed only for exploitation field of certain size. The size of exploitation field could be extended using certain good practice in environmental protection and technology applied (using certain mine planning aspects to "hide" the mine, using conveyors instead trucks, low grade environmental footprint). Also, there is subsidies for train transport system.

The spatial law, nature protection law and law concerning some taxes ("Schotterschilling") are on the state level, the other legislations is on local level (Austria is an administrative split in 9 provinces - 9 different regulations solutions).

There are some subsidies for certain environmental innovations available, e.g. CO₂ reduction measures.

Exploration of raw materials is not considered RDI in Austria. Austria has a very strict aviation law hindering the uptake of drones in exploration (safety concerns are the main driver).

Austrian Safety Law (ASCHG) for some issues (e.g. for human-machine interaction) is not up to date anymore and rather limiting for innovation. On the other hand, limitation not to enter the mining face is stimulating for the development of autonomous equipment. Limitations on human surveillance in data protection is hindering for innovation. There are no special financial considerations for mining activities; special subsidies were stopped some years ago.

Croatia

Mining is an important industry for the Croatian economy; however, it lacks a feasible legal and procedural framework as an important prerequisite for the development of the mining sector. The Mining law is a state law applicable to the entire Croatian territory. The new mining act was passed in Croatia in 2013 (Official Gazette 56/13 and 14/14.), which, with its unique 4-step procedure, greatly simplifies the permitting procedure and is therefore stimulating for mining activities. In the case of investigation, national related policies do not affect innovation in exploration.

There is no National mineral policy at the strategic level except for hydrocarbons exploration or exploitation activities. However, it is no longer regulated under the Mining Act, but under the new Act on Hydrocarbons. Therefore, the general answer is: The national mineral policy is not stimulating the introduction of innovations in mining. The national mineral policy is stimulating mining activities in general.



The governance authority for mining in Croatia is dual (two Ministries). The jurisdiction over minerals is currently shared by two government bodies: Ministry of Economy, Entrepreneurship and Crafts deals with all issues related to solid mineral raw materials, while Ministry of Environmental Protection and Energy is in charge of permitting processes for energy mineral raw materials. The governance authority responsible for solid mineral raw materials is adequately structured and moderately efficient. The governance authority responsible for hydrocarbons (new body, recently separated from the aforementioned ministry) is still under construction. Therefore, it is not fully operational yet.

It is recommended that some potential critical raw materials are explored using modern and innovative technologies.

Gaps and Needs

- It is necessary to incorporate provisions on stimulation of innovation into acts and ordinances related to mining activities, and provisions on exploration and extraction suitable areas into the Physical Planning Act and Building Act.
- Currently no innovations are mentioned in the legislation, but in the future, it could be possible, through new ordinances, to encourage innovation for the purpose of better and efficient exploration and extraction of raw materials.
- As mining activities are also dependant on legislation other than the Mining Act (Physical Planning and Building Act), it is prerequisite to determine areas suitable for exploration and extraction and incorporate them in state and counties' spatial plans.
- However, implementation of new technologies (infrastructure and IT services to achieve service delivery, GIS-based system that promotes efficient administration) is needed.
- A new regulation for classification and accompanying regulations on resources/reserves of solid raw materials is in the making.
- Innovations are not in any way mentioned in the national mining related policies, though we feel that innovations would be welcome. Other policies do not mention innovations either. The implementation of new technologies (infrastructure and IT services to achieve service delivery, GIS-based system that promotes efficient governance administration) is needed.
- A new strategy for mineral resources in Croatia should be developed.
- The mining law must protect raw material resources (from other land users).
- Overarching there is a social unacceptance of mining activities (NYMBY syndrome) and there is a public perception of mining activities as nature and environmental devastators.
- Streamline and speed up the permitting procedure, especially the EIA procedure.
- Better coordination of state authority involved in procedure of permitting (mining governance body, physical planning governance body, environmental and nature protection governance body).

Czech Republic

Raw materials in the Czech Republic are divided into two categories: state-owned or 'reserved' minerals, and land owned or 'non-reserved' minerals (or deposits). In fact, all raw materials are 'reserved' minerals, with the exception of building stone, gravel, and clays.



The fundamental law for mineral extraction is the Mining Act and for prospecting and exploration of reserved mineral deposits the most relevant law is the Geological Act. Other important national Acts relevant for mining are the Act on EIA, Forest Act, Act on Land and Soil, Act on Nature and Landscape,.

The Ministry of Environment is the authority responsible for approval of exploration areas. The central mining authority is based in the Czech Mining Office in Prague, the part of the State Mining Administration. The District Mining Authorities (eight in total) act on a regional level.

For prospecting and exploration, an application for 'reserved' minerals is considered by the Ministry of Industry and Trade with the approval of the Ministry of Environment.

In the permitting procedure the responsible authority must consider the conditions and interests protected by special regulations, which primarily refers to the laws related to the protection of landscape and nature, agricultural and forest land, the Water and Mining Acts, etc. Prospecting and exploring of 'non-reserved' minerals is allowed only with the agreement of the landowner.

The Ministry of Environment issues the certificate on the deposit of reserved minerals and lays down a deposit protection area.

The 'permission for mining activity' (opening, preparation and extraction) is issued by the District Mining Authorities.

The authorisation of mining activities in the case of 'non-reserved' minerals is needed. A zoning decision, issued by a building office, and permission for exploitation of a deposit, issued by a District Mining Authority, are needed as well.

The issuing of a mining permit is also contingent on fulfilling the demands of special acts (the Act on EIA, Forest Act, Act on Land and Soil, Act on Nature and Landscape, etc.).

Expert opinion is that the national mineral policy stimulates the introduction of innovation in mining (the support of research projects – grants, geological surveys etc.). In theory, the mineral policy stimulates mining activities, but in practice there are many problems with opening new mines or reopening old ones due to difficult environmental legislation and public aversion. The governance authority responsible for mining activities is well structured and effective. To improve the implementation of innovation in the exploration and extraction of raw materials, the existing Mining law (CBU 44/1988) needs updating. There is no need to change the national mining regulations/governance (and other regulations affecting mining) because in the new national mineral policy the EU strategies (Raw Materials Initiative) have already been considered.

Cyprus

The main focus in Cyprus is on old, mainly abandoned, exploration and mine sites (some are centuries old). Because of these abandoned sites there is a negative public perception about mining. Mining is not a priority. There are some limestone quarries and only one active metal "mine" (Hellenic Copper). They are recovering metals (incl. copper by-products) from tailings, for which they are using modern technology and are also innovative. There was some exploration in recent years (for Au and Pt group metals), but no significant orebodies were found. Airborne geophysics was used, but when following up, drilling didn't verify the results, so this was seen as a failure. Mining law in Cyprus is seen as neutral



for innovation in exploration and extraction. There is no RDI programme in Cyprus itself, e.g. Hellenic Copper works with foreign universities. SLO (social license to operate) issues and environmental legislation (often based on EU requirements) was a key driver for Hellenic Copper to do R&D and improve their technologies.

The mineral policy is neutral for the top 5 ranked exploration innovations; it is mainly a business decision to use them. The top 5 ranked extraction innovations are not yet used in Cyprus.

Gaps/needs in Cyprus exploration and extraction:

- Mining is not a political priority.
- Clean-up of abandoned sites is needed (incl. old asbestos mine).
- An exploration program for deep deposits would be needed, but the government has no money.
- Support for Hellenic Copper to find/use further processing innovations for their recovery of metals from tailings/old waste sites.

Finland

The Finnish national mining related policies are supportive to innovation in exploration and extraction in general. Finland established the Green mining program in 2011. The main objective of the Green Mining Programme was to make Finland a global leader of a sustainable mineral industry by 2020. The programme fostered exports from Finland, developed Mining Finland Programme, included investment in Finland and stimulated the internationalisation of small and medium technology companies.

The top 5 ranked exploration innovations that have previously been identified as key are broadly used in Finland.

3D modelling using multiple geological, geophysical and geochemical datasets is applied at several locations (e.g. Central Lapland 3D model, Enontekiö 3D model). Airborne geophysical methods are used for example at Inari for airborne gravity studies this year.

A drone project was established (2015-2017) to set legal and practical guidelines for use of drones in geological and geophysical investigations. Finland is using four pXRF and just acquired one pXRD.

In-situ analysis using multispectral core logging is developed through several projects (programmes EUROCORE, INSPECTOR – Germany spectral methods, on line data collection from drill ore). Just starting XRF scanning and hyperspectral spot measurements project proposals are in development for scanning. The interviewed expert has no knowledge about the use of autonomous equipment for extraction operations including use of robotics, smart sensors and 3D printing. The Finnish company GTK MINTEC (mineral processing on gold deposit, joint project with industry) operates continuous processes and automation.

UNFC code and Nordic guidelines project are applied for resource characterisation. The application for peat resources characterisation is under development.

The national mineral policy is stimulating for mining activities in general. Finland established a Mineral policy and strategy that is pro-mining. The environmental interpretations are making the permitting procedure for exploration and extraction more complex and time-consuming.



The governance authority responsible for mining activities is well-structured and considered efficient. Although the mineral permitting procedure for exploration and extraction has been in accordance with the new mining law since 2013, in some special cases permitting is still time-consuming (six months for exploration, two years for extraction) and not all processes are tested in practice. According to mining regulations, permitting procedure must prove that deposit is commercially feasible for extraction.

Gaps and needs

- Change the national mining regulations in such a way that government royalties are directed into stimulating exploration related research.
- Only a political decision could probably improve the situation in national mineral policies.
- Permitting in one permit - one stop shop (approximately 40 permits are needed on the county level today).

France

The mining law in France has recently changed and environmental issues have become much more important, as is the consideration of local communities. The mining law is valid for all of France. The national mining and other policies give preference to environmental and nature protection. The mining legislative doesn't consider innovative tools, and introduction of innovations is only through mining companies. The geological data is public and the geological survey puts the data on its websites. The geological report for deposit (resource) characterization is only for investors. The international report code is used for developing geological reports for deposit characterisation. The issuing concession for exploration and extraction of raw materials is in procedure of public competition and there is no issuing of concession on demand. Metallic and industrial minerals are state-owned minerals, and quarried minerals are land-owned (belong to the landowner). Exploitation is subject to authorisation granted by the Prefect after issuing of a concession for exploitation. The estimated time for an authorisation permit process is three years, including environmental and public information considerations.

If a company is considered not strong enough (in a professional or financial way) the mining authority could reject their proposal in public competition.

The national mineral policy is stimulating innovation in exploration and extraction (tax credit). The national mineral policy is quite friendly for mining activities in general.

The governance authority responsible for mining activities in France is not yet well structured and not sufficiently efficient. The permitting procedure for issuing concession for exploration and extraction of raw materials is time-consuming and long-lasting (approximately two years).

There is a lot of opposition to mining activities, especially on the local level, but not at all parts of France.

Gaps and needs

- The mining governance authority and mining company must improve transparency and communication to local public.
- Improving the procedure of permitting for exploration and extraction of raw materials.



Germany

The legislative competencies in Germany are held by the Federation (Bund), whereas the execution of the laws is regularly conducted by the Federal States (Länder). The Federal Mining Act (“Bundesberggesetz”) distinguishes between the ‘freehold’ (“grundeigenen”) and ‘free for mining’ (or ‘freely mineable’) (“bergfreien”) minerals. Freehold minerals are land-owned (belongs to the landowner).

The ‘free for mining’ minerals (including some industrial and construction minerals) can be explored and extracted by holder of the permission. The ‘old rights and agreements’ prior to the enactment of the Federal Mining Law may stipulate exceptions.

If the public interest is endangered, the mining authority could restrict or deny the permit for exploration and extraction.

The national mineral policy is currently not an issue as such. The main hurdle is the social acceptance and the level of knowledge about that topic/issue in society.

In Germany, the responsible governance authorities for mining activities are organised at the level of the Federal States (Länder). Mining is well-structured and efficient when it is in the social and political interest of that State (typically under the Ministry of Economy). Some of the States organise the mining authorities under the Ministry of Environment – often less interested in mining and very tight in personnel. For sand and gravel, the competence is on municipal level.

Possible changes and improvements in national mineral policy to improve the uptake of innovation in exploration and extraction should address education of society from an early age.

Gaps/needs

- Actions to improve the knowledge base and level of trust of society in mining (companies, regulators, authorities).

Greece

There is still high opposition to new mines in Greece. The state permitting agency tries to help by asking for innovations (BAT) from companies. The overall economic situation in Greece is very difficult, which also makes it hard for mining activities. However, focus on mining has increased with the crisis. The largest mines are now owned by European and Canadian companies. The RDI programmes are supported generically (tax incentives), but mining in Greece is not innovative. The drivers for introduction of innovations in exploration and extraction of raw materials are mainly business decisions. The environmental and cultural legislations encourage innovations. The private exploration data stays private, there is no requirement to make it public or hand over to IGME, only environmental data related to permit is public. There are no incentives for financing new mines and some companies shifted HQs from Greece concerning tax and financial (country) reasons. There are some generic financial incentives for creating new jobs. There are some exploration or extraction start-ups emerging, related to the economic situation, which could be innovative. Experts find that mining law is neutral for innovations. The environmental and H&S legislation are seen as more stimulative for innovations. The top 10 ranged innovations are mainly driven by business opportunity, not by policy. The Greek mines are rather small and have a little potential to gain from the top 10 listed innovations. Some of top 10 ranged innovations in exploration and extraction of raw materials are now used in



Greece. The 3D modelling is used by some of the largest mining companies (e.g. Hellas Gold). The environmental law requires fewer permits for airborne geophysics than for drilling. The aviation policies are limiting for drone application and are now changing with EU legislation. The Greek companies are considered as followers rather than leaders with regards to these innovations. The current EU raw materials and other policies are supportive for introducing innovations in Greek mining. “Strategy for sustainable exploitation of minerals” (2012) also includes requirements for innovative technologies (BAT- Best Available Technology), regulations for lower environmental impact and energy efficiency. There are some funding programmes (generic) to reduce environmental footprint. There are no specific policies driving encouraging innovations in mining. The overall Greece Mining Law is quite old, not friendly for introducing innovations in mining. Innovations are mainly driven by H&S and environmental legislation, potentially by other land user (e.g. touristic).

There are no policies for national and specific Greek RDI programme similar to Horizon 2020 or EIT programmes.

Hungary

The raw materials are state-owned. The Mining Law defines areas ‘open’ or ‘closed’ for exploration. In the ‘open’ area, exploration is permitted by the regional authorities. In the “closed” area, exploration is permitted by state authority (ministry) through a mineral concession. The regional mining authorities and some other authorities formed ‘Government Offices’ (in April 2015), and now the permitting procedure is considered a ‘one-stop-shop’ (for “open” area). These are one-stop-shop offices, incorporating mining, environment, nature conservation, soil protection, and cultural heritage inspectorates.

The permitting procedure (exploration and extraction) for aggregates and industrial minerals may last 1-1.5 years, whereas another 1.5-2 years is needed for metallic ores for the concession procedure or a minimum of 4 years in total).

Airborne geophysical methods at small firms and in-situ analysis (oil company, computer tomography) are used from the top 5 ranked innovations in exploration. The national mineral policy is not stimulating for the introduction of innovations in exploration and extraction. The national mineral legislation is too complex and, with that in mind, not stimulating for mining activities in general. There are more and more requirements regarding the EIA procedure.

The governance authority responsible for mining activities has too many levels. The permitting procedure for issuing a concession for exploration and extraction of raw materials is time-consuming and long-lasting. There are no national regulations for execution of exploration and developing geological report for deposit characterisation. The national mining regulations/governance (and other regulations affecting mining) should be changed in a way to foster the permitting procedure for issuing concession for exploration and extraction of raw materials. The procedure is currently time-consuming and long-lasting (approximately two years).

Gaps and needs

- The local community has too many tools to stop mining operations.
- There is no experienced staff in mining and other governance bodies.
- The governance authorities (mining and others) are not ready to listen to the academic community.



- Streamline and speed up the procedure of permitting for exploration and extraction of raw materials.
- The re-evaluation of critical mineral resources is needed.
- The execution of national mineral strategy.
- Reconstruction / reorganisation of mineral governance bodies.
- The integration of the national and local spatial planning systems.

Ireland

Mineral exploration and mining in Ireland is governed by the Mineral Development Acts (1940-1999). A new Minerals Development Bill is currently being introduced to consolidate previous legislation and to bring the law in line with EU legislation, i.e. water, waste, environmental issues and international best practice.

Mineral exploration and extraction in Ireland are governed by the Exploration & Mining Division (EMD) of the Department of Communications, Climate Action and the Environment, on behalf of the Minister. Ireland has a well-established, modern exploration and mining industry (with a record of accomplishment of good community relations), which re-ignited in the 1960s and which has produced good results, i.e. for Zn, Pb, Au, and industrial minerals. However, no new mine has opened in Ireland since 1998 (Lisheen Zn-Pb Mine). Two mines have closed since 2014 (Lisheen and Galmoy) and thus a single world class Zn mine remains (Navan). Exploration is however buoyant in 2017 for Zn-Pb, Cu, Li, Au, Mo and other metals.

The industry is valuable within the economy (mineral exploration and mining worth approximately €810 million in 2012, where geoscience activity is in total worth around 3% of GDP in 2006), but this is not realised by the public as the industry has a low profile.

Within Ireland, the positive results of the Fraser Institute Ranking (perception of policy) are well received by EMD; which does not stimulate a need to develop new policy. Ireland does not have a single mining policy per se; rather it has a series of short guidance documents.

Mining is taxed at 25% (relative to the general corporation tax of 12.5%), with tax breaks for exploration and capital allowances. There are no tax breaks for mining innovation.

There is significant collaborative research being conducted in applied geosciences and minerals, with R&D funded through iCrag and SFI, as well as EU (H2020) programmes, e.g. Irish researchers are members of the EU northwest KIC.

Irish Centre for Research in Applied Geosciences is a public-private collaboration of Government (via SFI – see below) and industry partners for research in applied geosciences. It is an inter-disciplinary and inter-iversity centre of geoscience excellence hosted at University College Dublin (UCD), Ireland's largest university. Science Foundation Ireland is a core funder of pillar multi-disciplinary research in Ireland. The Tellus state driven geophysical/ geochemistry study is being rolled out across Ireland (about 50% done), results are publicly available – encourages exploration and innovation.

This is a major public stimulant of exploration and testing of new ideas/terrain.

Mineral rights are owned by the State (with some exceptions), while the landowner retains surface rights. Access for exploration drilling generally proceeds without incident, but is becoming more challenging. There is no mechanism for dispute resolution between holders of mineral licences and landowners within the licensing regime.



The EMD does not get involved with social/ access issues directly, but under Aarhus Convention and related legislation requires industry to consult directly with landowner and community stakeholders. Ireland has an open sky policy for acquisition of airborne geophysical data. For drones / airborne geophysical surveys, a civil aviation license is required, and permission for low flying must be negotiated with landowners (intensive land use with agriculture/livestock). This is generally not an issue so long as sufficient fore-warning is given.

The current and planned mining legislation has no link to exploration innovations, industry requirements mainly drive these. However, collaborative research at iCrag involves government, industry and academia and is driving innovation. Only safety and environmental legislation has link and impact to exploration innovations. The introduction of innovations in exploration and extraction is a mainly business decision.

Resource characterisation and estimation is carried out to internationally accepted, professional codes of practice. Legislation is not relevant for this, but is important in terms of issues of water, mine waste characterisation, legacy issues etc. The EMD seeks that all reports to it are signed off by an accredited Professional Geologist.

Financing: State plays no role in this; industry sources its own finance privately. The role of the state is clearly defined as facilitator and regulator.

Gaps and needs:

- Clear statement of mining policy in definitive document, with updated Codes of Practice for exploration and mining to reflect policy and legislative changes.
- There is no definitive policy for mine closure, which has caused delays from the industry side. May cause issues for future mine closures?
- There is no single Mining Authority, there may be 3-4 different authorities involved in establishing and closing a mine, incl. EMD, EPA and local planning authorities.
- Innovations in social engagement may be required for future mine developments; industry is willing to participate.
- The mining industry has a good record of accomplishment, with no major mining accidents in Ireland in the modern 40 year period. However, the public is quite unaware of Ireland's mining industry, but in principle supports exploration and mining of our own resources based on a recent survey.

Poland

The Polish Mining Law was changed (3 years ago) to streamline and bring more in line with EU legislation. The changes of mining law affected geological documentation, design of mining project, procedure of permitting and H&S regulations. Getting the concession for exploration and extraction is very difficult. The procedure of land ownership and environmental permitting is very complicated. Mining is a hot topic in Poland, mainly because of coal and underground mining safety issues, which impacts all other mining too. There is no active policy support for mining and no real exploration happening at the moment. Plans for open mines have been stopped and lot of geological work has stopped as well. The top 10 ranked innovations in exploration and extraction are mainly driven by business decision. The introduction of any innovation needs approval of the authorised mining plan, H&S considerations play a big role in updates, i.e. improvements should be positive. Drones are used



in active mines for surveying. The aviation law requires special license for implementation of drones. The Polish mining company KGHM is doing some testing of autonomous equipment. The introduction of autonomous equipment in extraction needs mining authority approval. The simplification of permitting and concession procedures would be helpful (expert sees Slovakia or Belgium as positive examples). Future policies must make mining more attractive.

There is no national mineral policy (strategy) in Poland. The governance authority responsible for mining activities in Poland is not well-structured and efficient because responsibility is divided between too many institutions. The biggest problem regarding extraction and processing activity concerns waste management. The national mining regulations/governance (and other regulations affecting mining) must make better access to mineral deposits possible. There is spatial conflict in many places with deposits, as well as no social acceptance. There is lack of mineral policy concerning mineral protection in Poland.

Portugal

Portuguese Mining Law is not relevant for applying innovations in exploitation and extraction in general. Innovations are mainly driven by business decisions. Portugal has a Mineral Resource Strategy (2012-2020) which also includes innovation elements, e.g. tools and financing geosurvey for exploration. A new cluster is developed by using EU structural fund. The implementation of the Strategy in practice has been poor until now. The mining authorities are incentivised to drive innovation and give tools for academia to work more and better with companies. There are no tax incentives for RDI programmes for innovations in exploration and extraction. The environmental and H&S legislations are driving innovation, but mainly to the level of legal compliance. The top 10 ranked innovations are mainly driven by business decision, mostly without link to policy. Some of these innovations have a link to environmental and H&S legislations. The new cluster should help to uptake many of them. Airborne geophysics and 3D modelling could be very useful for further exploration in the south of Portugal (Iberian Pyrite Belt). Drones are not really used. Resource characterisation is very important for Portugal, as many companies don't do this the right way. By-products such as indium and germanium are therefore not considered in decision making. The new cluster wants to use a new financing PPP model (structural fund and private bank financing). The experts expect that the new cluster will help to close existing gaps.

Spain

Spain has a long mining tradition, particularly in the production of gold and other metals, and has large mineral potential. Mining operations are governed by the Spanish Mining Law and Law on Environmental Assessment. These laws are applicable to the whole territory. The permitting or concession procedure and the number of permits required for exploration and extraction depends on the type of raw materials. The responsibility for governing minerals is divided between several Ministries. The average time to get the permits/licences is one year for exploration and 2-5 years for extraction. The permitting procedures are governed by a multi-authorisation system, which is not well integrated and coordinated. The system has been reported to be neither efficient nor effective. The delays in permitting procedure are derived from the fact that the mining, environment, culture, land planning, and other permissions are requested to different administrations with various timeframes and schedules.



Another challenging issue is the environmental permit, which depends on the environmental authorities of each Autonomous Community. Although the law establishes clear deadlines for the environmental procedure, authorities rarely seem to meet them, with no administrative consequences.

Another problem is the banning of mining operations by Autonomous Governments and Municipalities. According to the country expert: 'Some Autonomous Governments and Municipalities have used land use planning under their direct control and without clear limits (this competence is constitutionally in their hands) to ban mining from their regions'. The Supreme Court established in its decision that restrictive planning would violate the Mining Law, but this doctrine has yet to be confirmed by legislation to provide juridical security to mining rights and to the access to mineral resources.

Gaps and Needs

- There is a gap between the legal and the real time frame in permitting of 5-10 years for the extraction of metals and 2-3 years for the extraction of industrial/construction minerals.
- The creation of a single permitting procedure depending on the mining governance authority. Conflicts among governance authorities should be resolved internally.
- Respecting the deadlines for the environmental and other governance procedures.
- The establishment of consequences for mining and other governance authorities in case of not respecting deadlines for different governance procedures.
- Change legislation to provide juridical security for mining rights and for the access to mineral resources.

Slovakia

Currently metal excavation takes place only in one ore deposit (gold and silver). The extraction of non-metallic deposits encompasses 231 deposits.

The Mining and Geological Law is the main legal framework relevant for permitting procedures. Responsible mining authorities are the Ministry of Environment, Ministry of Economy, Main Mining Office and the Regional Mining Offices.

Mineral resources in Slovakia are divided in two categories: reserved minerals (state owned, mainly metal and industrial minerals) and non-reserved minerals (land owned, mainly constructions minerals). There are great differences (in duration and number of permits) in the permitting procedure depending on the kind of mineral resources. For non-reserved minerals only one permit is needed and for reserved minerals over 20.

The granting of the Mining Activity Permission is often delayed (regarding the EIA studies) and can last several months or even years. Prolongation of the approval procedures for exploration and mining is often caused by negative public opinions. This negative standpoint is reflected in decisions of local authorities (at the level of municipalities), arguing that the land use of the property concerned is intended for other uses and that such justification is based on public interest.

Slovenia



The mining economy in Slovenia has a very specific layout, because only one coal mine is still active. All other underground metal and coal mines were closed. In the last ten years, two marble quarries developed underground production stopes with minimal influence on the environment. Innovation plays only a small part in mining activities. The mining activities have very small synergies with national mineral policy. In practice, most of the mining companies are under free market economy rules, which in general do not give many financial possibilities regarding research and innovation. The mining legislation and mining governance authority has a positive influence on mining activities. All government institutions, including mining inspection, are connected to mining companies. The Mining Law is relatively new and harmonized with EU legislation.

The Mining Law is a state law applicable to all of Slovenia. The mining companies have an annual production of about 24 million tons of mineral resources, which means that about 24 tons of mineral resources belong to each resident. One possibility is that government pushes more new infrastructure and other construction projects to increase the consumption of mineral resources.

Sweden

Mining has priority in Sweden regarding the land use. The Mining Act is the key act and sets priorities, e.g. environmental law can set conditions and restrictions for mining, but can't stop mining. Sweden has very low mining tax and royalties, which is seen as an incentive for mining activities. Sweden is very innovation friendly and requires the best possible technology. The environmental and H&S legislation are driving innovation. Mining companies are more concerned about uncertainties (e.g. SLO is seen as an uncertainty) than strict requirements. The experts don't see national mineral policy as an innovation driver and don't see gaps in the national mineral policy. There is funding available for RDI programmes (VINOVA, SIPSTRIM programme). Sweden is a unitary state and all laws are state laws applicable to the entire Swedish territory.

The Mining Act regulates exploration and exploitation of so called concession minerals. The act is not applicable to other natural resources or activities. The Mining Inspectorate of Sweden is responsible for licensing under the mining act, i.e. exploration and exploitation. The environmental permit is handled by the land and environmental court. The Mining Inspectorate is a state authority among other state authorities involved in the licencing process for mining activities. The operator must first apply for and be granted an exploration permit and if/when minerals are found, a mining concession can be applied for. Additional permits are required after that, e.g. environmental permits and building permits etc. There is no bidding or tendering procedure. Exploration permits are usually granted generously, whereas a mining concession requires an EIA which has to be approved by another state authority (regional administrative board). It is always the operator that applies for a permit.

A so called mineral remuneration is paid for mining rights. The remuneration amounts to two per mille of the estimated value of the minerals taken out of the ground each year. The money is divided between the landowner (3/4) and the state (1/4). The exploration and exploitation of mineral resources are not necessarily forbidden in areas of nature reserves (except for National Parks), it depends on the circumstances; the characteristics of the area, what it is protected for, etc. All competing land-uses are dealt with in the concession process. The areas that contain valuable minerals can be designated as national interests (national level), which must be taken into account in the municipal planning.

United Kingdom



The UK consists of [four countries](#), [England](#), [Scotland](#), [Wales](#) and [Northern Ireland](#). For minerals law and regulations operate in parallel under broadly the same powers. The UK mainly extracts construction minerals (about 86% of total extraction).

Non energy raw materials are land-owned (exceptions are gold and silver owned by the Crown) as well as offshore minerals, and minerals extracted in Northern Ireland owned by the provincial Government of Northern Ireland (except for gold and silver).

The Town and Country Planning Acts are the most relevant acts for permitting procedures. The UK has no specific Mining Authority; it has a decentralised permitting regime to the local administration.

An average of approximately 3 years is needed to obtain permission for extraction (inclusive the EIA procedure).



5. Analysis of needs and gaps

This chapter analyses and summarizes the results of the investigation that has been carried out through interviews and questionnaires, as well as policy laboratory 2 presented in previous chapters. The main topics of the investigation are:

1. how raw materials policy (European and national) influences innovation in exploration and extraction
2. identifying the gaps of existing raw materials policy and governance
3. specifying the needs for future development of raw material policy and governance

According to the results of the interviews and the questionnaire the overall influence of national mineral policies, mining regulations, and regulations influencing mining on stimulating innovation in exploration and extraction is estimated to be mainly neutral (i.e. not stimulating and not hindering) by neutral experts. Only for a few EU MS (Finland, France and Slovenia) the experts said that national mineral policy and other policies have a positive influence on innovation in exploration and extraction. H&S legislation, environmental and nature protection legislation are mentioned to encourage innovation to the certain degree. Current EU raw materials policies are seen as supportive for innovation in exploration and extraction.

The key driver for introducing innovations in exploration and extraction is mainly a business decision based on opportunity.

Only in a few MS (Sweden, Finland, Ireland, Slovenia) the atmosphere in mining regulation and public opinion is friendly regarding developing mining activities. For example, Slovakia was known for its metal mining tradition, currently metal mining activities are reduced to only one ore deposit (gold and silver). In Spain, some regional governments and municipalities have used land use planning to practically ban mining from their regions.

The prolongation of the approval procedures for exploration and extraction is often caused by negative public opinions. Mainly, there are no existing financial incentives for mining companies to fostering new exploration or the opening of new mines.

Regarding questioned experts the structure and efficiency of the governance authority responsible for mining activities in EU MS is estimated as not sufficient or not sufficient enough in general. The structure and efficiency of the governance authority responsible for mining activities is estimated as sufficient just in a few countries of the EU (Slovenia, France, Sweden).

There were a lot and very different suggestions for possible changes and improvements in national mineral policy (and other regulations affecting mining) and governance to improve the implementation of innovations in exploration and extraction.

The identified needs and gaps in existing mining policy, mining and other relevant legislation and governance of solid non-energetic raw materials according to the results of our interviews and the questionnaire can be summarized in these main key points:



Develop a strategy for the management of solid non-energetic raw materials for every EU MS

The need to develop a strategy is mentioned by many of the interviewed experts from different countries (Croatia, Hungary, Ireland, Poland) as a pre-requisite for progress of the mining industry. Currently, only 10 EU MS have adopted a national Mineral Strategy.

Simplify the permitting procedure for exploration and extraction of raw materials

Simplification of the permitting procedure for exploration and extraction was one of the most mentioned needs. The governance system for issuing permitting licence/concession for exploration and extraction has been mentioned as not efficient enough. There is a gap regarding the legal and the real time it takes for getting permits for exploration and extraction. The long-lasting and time-consuming permitting procedures - with uncertain outcomes - are addressed by different, often not well integrated and coordinated, governance bodies. In the scope of this matter the experts also identify needs/gaps as:

- reconstruction and reorganisation of minerals governance bodies,
- better coordination between state authorities (different ministries) involved in the process of permitting,
- the staff in mining and others governance bodies is not experienced and skilled enough,
- establish single Mining authorities responsible for mining governance and permitting procedures (one stop shop),
- the conflicts among governance authorities should be resolved internally,
- respect the deadlines for the permitting, environmental, spatial planning and other governance procedures,
- the establishment of responsibility and consequences for mining and other governance authorities in the case of not respecting deadlines for different governance procedures.

Provide accessibility and secure supply of solid non-energetic raw materials

To ensure this many experts stated that the supply of solid non-energetic raw materials should be a political and policy priority. The national mining regulations/governance (and other regulations affecting mining) should be updated in such a way to make better access to mineral deposits possible. A gap in mineral policy concerning mineral deposit protection is noted. Experts also identify needs/gaps as:

- Mining is not a political priority,
- only a political decision could probably improve the situation in national mineral policies,
- integration of the state and regional (county and municipality) physical planning system,
- protection of solid non-energetic raw material resources (from other land uses),
- determine the areas suitable for exploration and extraction in spatial plans,
- often there is no legislative mechanism for dispute resolution between holders of mineral licences and landowners within the licensing regime,
- mining and other relevant legislations should provide juridical security to mining rights and to access to mineral resources,



- local communities have too many tools to stop mining – often there is no legislative mechanism for dispute resolution
- the banning of mining operations by regional governance authority (autonomic county and municipalities)

The social unacceptance of mining activities and public perception of mining One of the main tasks for future mineral policy and legislative observed in this investigation is to find a way to achieve a better public perception and better social acceptance of mining activity. Experts observe and suggest the following needs:

- Prolongation of approval procedures for exploration and extraction is often caused by negative public opinion,
- Negative standpoint is reflected through arguing of local authorities that land use of the property concerned is intended for other uses and that such justification is grounded on public interest,
- Social unacceptance of mining activities (NYMBY syndrome),
- Public perception of mining activities as nature and environmental devastators,
- Mining governance authorities and mining companies should improve transparency and engagement with the local public,
- Possible changes and improvements in national mineral policy to improve implementation of innovations in exploration and extraction should also address education of the society since the early age,
- promotive actions to improve the knowledge base and level of trust of society in mining (companies, regulators, authorities),
- innovations in social engagement may be required for future mine developments,
- the public is quite unaware of the mining industry,
- Future mineral policies must make mining more attractive to public

Resource characterisation

Gaps and needs for better qualitative and quantitative resource characterisation are also mentioned.

- resource characterisation is important, as many companies don't do this the right way
- the (re-)evaluation of critical mineral resources is needed,
- by-products are therefore often not considered in decision making,
- currently no existing national regulations for executing exploration works on deposit of solid raw materials (for example the density of investigation boreholes, number of sample for quality analysis, etc.) and no national regulations for reporting of exploration results,
- new regulations for classification and accompanying regulations on resources/reserves of solid raw materials are needed

Research activity/financing

Gaps and needs to develop mechanisms in national mineral policy and legislation for fostering RDI activity and financing of research for exploration and extraction are observed by the experts:



- mining authorities are incentivised to drive innovation and provide tools for academia to work more and better with companies
- there are no specific tax incentives for RDI programmes for innovation in exploration and extraction,
- collaboration between government institutions, research companies and the mining industry on international research projects with the goal of improving mining technologies,
- state owned mining companies should be obliged to contribute to research, with a kind of percentage of their expenditures

Application of findings for other parts of the mineral value chain

The above mentioned gaps and needs are, except for permitting, equally relevant for the following parts of the mineral value chain, however these gaps and needs will be discussed in details in Deliverables 4.3 (for mineral processing and metallurgy) and 5.3 (for waste management and mine closure).

5.1. SWOT analysis

The Strategic Implementation Plan for Raw materials (EC, 2013) has been developed to contribute to the 2020 objectives of the EU's Industrial Policy 6 (increasing the share of industry to 20% of GDP) and the objectives of the flagship initiatives 'Innovation Union' 7 and 'Resource Efficient Europe' 8 by ensuring the sustainable supply of raw materials to the European economy whilst increasing benefits for society as a whole.

With that goal in mind, the Strategic Plan tends to promote the production and export of raw materials from Europe by improving supply conditions, diversifying raw materials sourcing and improving resource efficiency (including recycling). Another goal is to put Europe at the forefront of the raw materials sector and mitigate the related negative environmental, social and health impacts.

One of the priority tasks in the non-technology pillar of the Strategic Plan is improving Europe's raw materials framework conditions considering three action areas: Minerals Policy Framework, Access to Mineral Potential in the EU and Public Awareness, Acceptance and Trust.

This SWOT analysis is conducted on the basis of the results from interviews, as well as the outcome/results of policy laboratory 2, as presented above and put into the context of the Strategic Plan, i.e. the aim of this SWOT analysis is to analyse the possibilities for future strategic development of exploration and extraction activities .



Table 5-1: SWOT Analysis

	Helpful	Harmful
Internal Origin	<p>STRENGTHS</p> <ul style="list-style-type: none"> ▪ high level of technological development in EU MS ▪ necessity for raw materials in EU MS ▪ existing EU mineral policy, strategic and action plan ▪ currently, mineral policy is a political priority ▪ existing national mineral strategy in some EU MS (10 countries) ▪ EU R&D programmes ▪ tax incentives for introduction of innovations in exploration and extraction (only in some EU MS) 	<p>WEAKNESSES</p> <ul style="list-style-type: none"> ▪ differences among EU MS concerning mining legislation and governance ▪ lack of national mineral strategy in majority of EU MS ▪ long-lasting and time-consuming permitting procedures for exploration and extraction ▪ deep, remote, complicated deposits (with low ore concentrations) ▪ national mineral legislation not fostering innovation in exploration and extraction, ▪ no financial incentives to stimulate new exploration and extraction ▪ governance authorities responsible for mining activity are often not well-structured and efficient
External origin	<p>OPPORTUNITIES</p> <ul style="list-style-type: none"> ▪ introduction of all sorts of innovations in exploration and extraction: product, process, organisational, marketing and system innovations (Bicket 2016) ▪ development of national mineral strategy for all EU MS ▪ standardization and harmonization of national mineral legislation ▪ setting up funds and grants for R&D programmes ▪ setting up tax incentives for introduction of innovations in all EU MS ▪ establishing an educational and promotive programme for raising public awareness about raw materials ▪ improvement of national mineral policies and governance to stimulate innovation, ▪ simplification of the permitting procedure for exploration and extraction ▪ establishing single mining authorities responsible for mining governance and permitting ▪ integration of the state and regional (county and municipality) physical planning system ▪ protection of solid non-energetic raw materials resources, ▪ determination of areas suitable for exploration and extraction in spatial plans ▪ providing juridical security to mining rights and to the access to mineral resources ▪ improving transparency and communication with the local public ▪ innovation in social engagement for future mine developments ▪ better qualitative and quantitative resource characterisation ▪ developing mechanisms in national mineral policy and legislation for fostering RDI activity and financing of research for exploration and extraction 	<p>THREATS</p> <ul style="list-style-type: none"> ▪ land use competition ▪ restriction and demands of environmental and nature protection authorities ▪ social non-acceptance of mining activities ▪ negative public perception of mining activities ▪ low prices and big global market supply ▪ mining is not a political priority ▪ areas of solid non-energetic raw materials resources are not protected (from other land uses)



The main strength for the future development of the mining industry is the existing strategic plan for raw materials at the EU level, as well as the political will and awareness of the importance of raw materials for the economic development of the EU. On the other hand, the weaknesses are numerous: national mineral policies are developed only in 10 EU MS, permitting procedures for exploration and extraction are long-lasting, mineral resources are not protected from other land uses, etc. A key threat for the development of the mining sector is that areas with raw materials are not protected (from other land uses) in spatial plans nor in mining or other relevant legislations. The opportunities to foster development of mining activities are also numerous: The development of national mineral strategy in all EU MS, simplification of the permitting procedures for exploration and extraction, standardisation and harmonization of national mineral legislation, establishment of single mining authorities responsible for mining governance and permitting procedure, protection of solid non-energetic resources of raw materials and introduction of all categories of innovations in exploration and extraction.

Needs and gaps for deep sea mining

Deliverable 3.3 recommends developing a harmonized EIA procedure for deep sea mining at the EU level regarding Code for Environmental Management of Maritime Mining and initiatives promoted for Pacific State.

In that sense the revisiting of existing Directive 2011/92/EU and Directive 2014/52/EU is suggested.

The revisiting of Directive 2014/89/EU is suggested for establishing a framework for maritime spatial planning and EIA procedure for activities conducted in the maritime area, including the continental shelf of EU MS.



6. Conclusions and recommendations

The feedback from the experts we were talking to regarding the influence of national mineral policies, mining legislative, and legislative concerning innovation in exploration and extraction is mainly neutral. At first sight it may seem that this is contrary to the conclusion in deliverable 3.1 where we state that the perceived impact of policies on innovation in this part of the mining value chain is mainly seen as positive (in approximately two thirds of cases);. However, in deliverable 3.1 we discuss mineral and other European policies impacting mining (only 7.3 % are mineral policies). In this report, experts mainly refer to national mineral policies and mining legislation. Therefore, we can come to the final conclusion:

1. Mineral policy and other European policies concerning mining activities have a positive effect when it comes to introducing innovation in exploration and extraction (according to an investigation in report 3.1., policy laboratory 2 and this report).
2. National mineral policies and mining legislation have predominately a neutral effect when it comes to introducing innovation in exploration and extraction (according to the investigation of policy laboratory 2 and this report).
3. Other national policies and legislation have a stimulating effect when it comes to introducing innovation to some degree (see below).
4. Other national policies and legislatives (research, H&S, tax, environmental and nature protection, waste management, land use and others) have a more stimulating effect than mining policies and legislation

H&S legislation, environmental and nature protection legislation encourage to the certain degree innovation. The current existing EU raw materials policy is considered supportive of introducing innovation in exploration and extraction. The key drivers for introducing innovation in the are mainly business decisions.

The structure and efficiency of the governance authority responsible for mining activities in EU MS is estimated not well or not enough well in general.

Suggestions and recommendations for overarching existing gaps in current national mineral policies in EU MS and needs for future developments are:

1. Develop a strategy for the management of solid non-energetic raw materials for every EU MS.

The need to develop national mineral strategy is the prerequisite for progress of the mining industry. Currently, just 10 of EU MS have adopted a Mineral Strategy.

2. Foster and simplify permitting procedures for exploration and extraction of raw materials.

The governance system for issuing permitting licence/concession for exploration and extraction is not efficient enough and often . long-lasting and time-consuming with uncertain outcomes. The establishment of single mining authorities responsible for mining governance and permitting procedures (one stop shop) is suggested. The deadlines in the permitting procedures should be respected and the responsibility and consequences for permitting authorities in case of not respecting the timelines should be established. The staff in mining and others governance bodies must be experienced and skilled in matter of exploration and extraction of solid raw materials.



3. Provide accessibility and safe supply of solid non-energetic raw materials. The supply of solid non-energetic raw materials should be a political and policy priority. The national mining regulations/governance (and other regulations affecting mining) must be innovated to make better access to mineral deposits possible. The raw material resources should be protected by mining and land planning legislation (from other land uses). The land areas suitable for exploration and extraction should be designated in spatial plans. The legislative mechanism for dispute resolution between holders of mining rights and landowners within the licensing regime should be developed. The mining and other relevant legislation should provide juridical security to mining rights and to the access to mineral resources.

4. Improve the social acceptance and the public perceptions of mining. The mining governance authorities and mining companies must improve transparency and engagement with the public. Innovations in social engagement may be required for future mine developments. The public is quite unaware of the mining industry's importance and education as well as promotive actions (including of what best practices are and what innovations, as described in deliverable 3.2, can do) to improve the knowledge base and level of trust of society in mining is needed.

5. Resource characterisation

Better qualitative and quantitative resource characterisation is needed. Many exploration companies don't do this the right way and a re-evaluation of mineral resources is often needed. Harmonized regulations at EU level for executing exploration works and for reporting of exploration results should be established.

6. Research activity/financing

Mechanisms in national mineral policies and legislation for fostering RDI activity and financing of research should be developed. Tax incentives for RDI programmes for innovations in exploration and extraction should be adopted in national mineral legislation. Collaboration between government institutions, research companies and the mining industry in (international) research projects should be encouraged by national mineral policy.



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8. Annex

List of Abbreviations

BAT	Best Available Technology
CE	Conformité Européenne
B-VLOS	Beyond Visual Line of Sight
EC	European commission
EIA	Environmental Impact Assessment
EIP	European Innovation Partnership
EIT	European Institute of Innovation&Technology
EPA	Environmental Protection Agency
ETS	Emission Trading System in the European Union (EU ETS)
EU	European Union
GHG	Greenhouse Gases
GIS	Geographic information system
H&S	Health and Safety
iCRAG	Irish Centre for Research
IT	Information technology
MIDAS	Managing Impacts of Deep Sea Resources Exploitation
MS	Member states (of the EU)
NGOs	Non-governmental organizations
NYMBY	Not In My Back Yard
PPP	public and private partnership
pXRF	portable X-ray fluorescence
pXRD	powder X-ray diffraction



R&D	Research and development
RDI	Research, development and innovation
RMI	Raw Materials Initiative
SIP	Strategic implementation plan
SIP STRIM	Strategic Innovation program for the Sweden Mining and Metal-producing Industry
SLO	Social licence to operate
TELLUS	Irish ground and airborne geoscience mapping programme
TEXES	the Finish funding agency for innovations
VINNOVA	Sweden's Innovation Agency
UAVs	Unmanned Aerial Vehicle
UNEXMIN	Underwater Explorer for Flooded Mines
WP	Work package
XRF	X-Ray Fluorescence



Questionnaire D 3.4.

MIN-GUIDE (Minerals Policy Guidance for Europe) is a project funded under Horizon 2020, the EU Framework Programme for Research and Innovation. The project, coordinated by the Institute for Managing Sustainability at the Vienna University of Economics and Business, has started in February 2016 and will run until January 2019. MIN-GUIDE's activities are targeted to foster a minerals policy framework which enables public as well as private sector decision-makers to implement innovative and sustainable approaches to tackle challenges in the mining value chain. It will do so by developing a Minerals Policy Guide, while fostering network-building for co-management and knowledge co-creation which will support the implementation of the EU Raw Materials Initiative, including the Strategic Implementation Plan of the European Innovation Partnership on Raw Materials. Please find attached the MIN-GUIDE project flyer. For further information, please also visit the project's website at <http://www.min-guide.eu/>.

We are looking at the situation in the EU Member States regarding raw materials policies and their link to mining innovation generally, i.e. how national mining related policies affect innovation.

How do national mining related policies affect innovation in exploration and extraction in general?

As well as, for the 10 below-mentioned innovations that have previously been identified as key:

Innovation cases

New geo-models, i.e. 3D modelling using multiple geological, geophysical and geochemical datasets

Airborne geophysical methods

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

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

Is the national mineral policy stimulating or not stimulating/hindering the introduction of innovations in mining?

What is your opinion: is the national mineral policy stimulating or hindering for mining activities in general?

Is the governance authority responsible for mining activities in your country well structured and efficient?



Could you suggest some possible changes and improvements in national mineral policy (and other regulations affecting mining) to improve implementation of innovations in exploration and extraction of raw materials?

Could you specify some possible changes in national mining regulations/governance (and other regulations affecting mining) stimulative for mining activities in general?

Are there any gaps or needs in national policies that could improve the situation?