Study supporting the development of general guidance on the implementation of the Extractive Waste Directive

Final Report

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Study supporting the development of general guidance on the implementation of the Extractive Waste Directive (ENV.B.3/ETU/2017/0039)

Final report

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SUMMARY

The tender "ENV.B.3/ETU/2017/0039 - Study supporting the development of general guidance on the implementation of the Extractive Waste Directive (EWD)" has been launched in response to the findings of the EWD implementation report of 2016.

While the previous published report on the implementation of the EWD concluded that the majority of Member States (MS) have adopted the measures needed to implement the EWD, the European Commission found a number of obstacles in assessing the implementation of the EWD. The EWD implementation report identifies that 1) the incomplete and inconsistent set of data is a major obstacle to the European Commission assessing the implementation of the EWD, and 2) diverging interpretations of the EWD are a likely source of inconsistencies in the data reported by MS.

This project focusses on a reliable description of the material streams resulting from the extractive sector and their management, which might lead to an exchange with MS towards a uniform understanding and application of the EWD.

The main objective of this study was to initiate a dialogue with authorities and stakeholders on key concepts of the EWD to develop a wider picture of the entire sector.
More specifically, the project broadened the discussion to all material flows in the extractive sector to obtain a better understanding of 1) how the relevant definitions of the EWD are applied, 2) the number of extractive operations per MS (i.e. a comprehensive list of all metal mines and an aggregated overview at MS level with respect to the other commodities), 3) the volumes of the different commodities together with the metal mines' and the non-metallic material flows and the route they are designated to (waste, or other), and 4) the precautions taken with respect to human health and the environment when managing "non-waste" material streams.

Individual objectives were:

- To develop a coherent description of the metal mines in EU-27 with plausible and matching figures for the amounts of extractive waste generated and corresponding numbers of extractive waste facilities.
- To collect, determine and present aggregated figures for each Member State of the production streams of industrial minerals, construction minerals and aggregates, subdivided into commodities, such as kaolin, perlite. feldspar, etc., per Member State, as well as to collect information on the amounts of associated extractive waste and their category per main waste streams.
- To estimate the number of operating EWFs, based on the assumption, that a given waste facility receives waste from only one mine.
- To collect data and estimate the amounts of tailings that are not deposited into EWFs, but are used as material for filling excavation voids.
- To list the number of EWF that were initially included in the inventories of closed and abandoned EWF, but that have been rehabilitated since.
- To prepare Country Fact Sheets that provide an overview of the national mining sectors, related waste management information, and the implementation of the EWD.
- To assess the potential environmental impact of chemicals (substances or substance groups) used for the concentration of metals from crushed ores (flotation) per mining sector and intended use.

To reach the above objectives, three main avenues were followed a) data gathering for the description of the extractive sector (including the estimation on the amounts and category of main waste streams, as well as the classification of the extractive waste facilities), (b) a dialogue with the Member States, and (c) enrichment of the study with information related to the substances used for flotation, as well as an inventory and rehabilitation of closed and abandoned waste facilities.

The first phase of the study was limited and only included publicly available data and reliable databases. The objective was to develop an overview of the mineral resources extraction activities in the EU and to estimate the overall material flows for the reference period 2015-2017. The volumes of the material flows are mainly based on calculations and estimations according to literature references or other available sources (e.g. communication with extractive industries, published operator's reports, published EWMPs and published decisions for EIA). In cases where there were not data available some assumptions were implemented based on data from same commodity or same extraction method (open pit or surface mining), which may not always reflect / align to reality, but their purpose is to show the overall flows of material.

The second phase of the study, the dialogue with the MSs, relied heavily on the goodwill of the MSs to provide information. Since it was not possible to visit all the MSs, the dialogue was focused on seven country visits, with significant extractive activities. To make contact with all MS, the country visits were complemented with telephone calls and questionnaires sent by email. Furthermore, several workshops were organised, in which MSs and associations represent the extractive industries participated 1) to initiate exchange of information with the MSs, 2) to validate collected and estimated data from the MSs and extractive industries, and 3) to make a step forward towards collecting additional information.

In the third phase, the assessment was expanded also in two other tasks (a) an evaluation on substances used for flotation and their potential environmental impact and (b) on closed and abandoned sited resulting from the mining of metal ores. The assessment on substances used for flotation was focused on chemicals used for the concentration of metals from crushed ores (e.g. collectors, frothers, modifiers and depressants). Hereby, the purpose of this task was to assess whether their environmental impacts are sufficiently assessed in current permitting practice.

When gathering data (i.e. production data, volumes of generated waste, number of extractions site and/or extractive waste facilities) different problems have been encountered related to e.g. 1) variations in the description of the commodities, 2) lack of data due to confidentiality issues, 3) difference in units and/or in conversion factors applied, 4) reporting at different administrative levels, 5) discrepancies between number of mines and EWFs, 6) the application of different standards for reporting extractive waste depending on MSs' legislation, 7) no separation between waste data related to primary and secondary raw materials, and 8) the lack of information on the rehabilitation of closed or abandoned sites

To overcome these problems, 1) a variety of 'third party' sources were queried and these data then were compared with national data, if available; 2) waste/material flows were calculated based on information collected from operators, literature, market analyses and expert knowledge. For the metallic minerals data are given per mine, whereas for industrial minerals, aggregates, construction minerals and dimension stones material streams were calculated per commodity and per Member State; 3) to estimate the number of EWF (CAF and non-CAF) linked to the metal mineral ores the expected number of EWFs in operation was estimated based on the number of active mines and on the assumption that a given waste facility receives waste from only one mine, focusing on the management of tailings and not on the material that may be assigned under the waste code 01 01 01 "wastes from mineral metalliferous excavation". The material that is generated after accessing and extracting the ore (for the purposes of the current study this stream is named *Rock*) in some cases is not considered as a waste stream, but as a material that partly or totally may be utilised by the operator for (a) filling the excavation voids for rehabilitation and construction purposes, (b) construction purposes outside the mine, and (c) landscaping. So, the *Rock* stream is presented as the amount that was initially intended to be mined, without characterising it as waste or non-waste. The outcome of this approach led that 58 EWFs are operating in EU-27 (theoretically this number reflects mainly the operating beneficiation plants). As far as the classification of the EWFs as CAF or non-CAF is concerned this was based on some assumptions that were made for the classification of the extractive waste according to the Decision 2014/955/EU and not on the safety/ stability of the construction of the EWF (1st criteria at Annex III of EWD). For the purposes of this study, it was assumed that if an EWF receives hazardous extractive waste, given that this facility receives waste only from one mine, then the threshold 50% according to Article 7 of the Decision 337/2009/EC is satisfied and the EWF is classified as CAF (worst case scenario). Afterwards, this task was enriched with information that were collected through the list provided by the MS to the Commission presenting the EWFs that are operating in their territory and communication with MS and operators, as result, 40 Category A facilities (CAF) and 61 non-CAF were identified. The main source of information for EWF on the non-metallic minerals was given by the AMEC-Foster-Wheeler study (Cherrier et al., 2017), updated with recent information from Finland and Hungary.

Chemicals used for the flotation of crushed minerals indicate may have hazardous properties. The amount of chemicals used is negligible if compared with the amount of ore, enriched ore, and waste produced. Even if it is conservatively assumed that all chemicals used in the flotation will end up in the waste and the hazards of all chemicals are summed; this sum in most cases does not classify the waste as hazardous. However, it is reasonable to check the classification and labelling of all commercially available chemicals for the same use and perform a risk assessment at an early stage (permitting) to conclude early on their short- and long-term effects. As far as the inventory and rehabilitation of closed and abandoned waste facilities is concerned it seems that there are differences in level of detail between MSs, a general overview over the mining and milling legacies in the European Union.

To obtain a more realistic picture of the real risk situation at legacy sites, it would be desirable, if all MSs exchanged further information on the actual level of risk and their method of prioritisation for further action. To understand whether lack of funding for the rehabilitation of legacy sites is a quantitatively relevant obstacle, MS could exchange further information on the status of ownership of the sites listed in the inventories.

Besides recommendations made to improve the reporting of 1) production data, 2) waste / material streams, 3) the rehabilitation actions taken at abandoned and/or closed EWFs and its related environmental risks and a methodology given to characterise EWF, Country Fact Sheets were compiled for each Member State. For each of the Member State, the CFS gives information (reference period 2015 – 2017) on production and number of extraction sites, calculated material streams, waste management and permitting, the number of extractive waste facilities, and an overview of the existing legislation related to exploration, extraction and extractive waste management.

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Member States (27)

AT	Austria
BE	Belgium
BG	Bulgaria
HR	Croatia
CY	Cyprus
CZ	Czech Republic
DK	Denmark
EE	Estonia
FI	Finland
FR	France
DE	Germany
EL	Greece
HU	Hungary
IE	Ireland
IT	Italy
LV	Latvia
LT	Lithuania
LU	Luxembourg
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SK	Slovakia
SI	Slovenia
ES	Spain
SE	Sweden

Others

BAT	Best Available Techniques
BGS	British Geological Survey
BMNT	Austrian Federal ministery of Sustainability and Tourism (Bundesministerium für Nachhaltigkeit und Tourismus)
BMLRT	Federal Ministry Republic of Austria, Agricultures, Regions and Tourism (Bundesministerium für Landwirtschaft, Regionen und Tourismus)
BMWE	Ministry of Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie)
BMWFW	Federal Ministry Republic of Austria, Science, Research and economy (Bundesministerium für Wissenschaft, Forschung und Wirtschaft
BMFT	German Federal Ministry for Research and Technology
BVEG	German Federal Association for natural gas, oil and geo-energy
CAF	Category A Facility
CEFIC	The European Chemical Industry Council.
CEN	European Committe for Ctandardization
CFS	Country Fact Sheets
CLP	Classification, Labelling and Packaging
CSO	Polish Central Statistical Office (GUS)
DGEG	Portugese Directorate-General for Energy and Geology
EA	European Aluminium
EBRD	European bank for reconstruction and development
EC	European Commission
ECHA	European Chemicals Agency
Eco-Eff	Eco-Efficiency Consulting and Engineering Ltd.
EEA	European Environmental Agency
EE	Eesti Energia
E-PRTR	European Pollutant and Transfer Register
ESD	Estonian statistical database
EU	European Union
EUROSTAT	Statistical office of the European Union
EW	Extractive Waste
EWC-Stat	European Waste Classification for Statistics
EWD	Extractive Waste Directive
EWMP	Extractive Waste Management Plan
EWF	Extractive Waste Facility
IAEA	International Atomic Energy Agency
IAI	International Aluminium Institute
ICMM	International Council of Mining & Metals
ICOLD	International Commission On Large Dams
IDA	Polish Industrial Development Agency
IGME	Spanish Geological Institute
INAP	International Network for Acid Prevention
IRMA	Initiative For Responsible Mining Assurance
JRC	Joint Research Centre
KK	Kiviõli Keemiatööstus
LPA	Latvian Peat Association
LoW	List of Waste

MAC	Mining Association Of Canada
MBFSZ	Mining and Geological Survey of Hungary
MEERI	Mineral and Energy Economic Research Institute
MMI	Mini Maritsa Iztok
MS	Member State, each Member State of the European Union
MSs	Member States, all Member States of the European Union
MWEI BREF	BAT Reference Document for the Management of Waste from. Extractive Industries
NAMR	Romanian National Agency for Mineral Resources
NEA	Nuclear Energy Agency
NIDOE	Northern Ireland Department Of The Environment
NLOG	Dutch oil and gas portal
OECD	Organisation for Economic Co-operation and Development
OSCC	Estonian Oil Shale Competence Centre
PGM	Platinum Group Minerals
PGNiG	Polskie Górnictwo Naftowe i Gazownictwo SA (
PIG-PIB	Polish Geological Institute, National Research Institute.
PRI	Principles of Responsible Investment
SMUL	Saxon State Ministry For The Environment And Agriculture
SCB	Statistics Sweden
SGU	Swedish Geological Survey
SEAI	Sustainable Energy Authority of Ireland
SGIDS	Slovak State Geological Institute of Dionyz Stur
SRG	Silesian Regional Government
SVHC	Substances of Very High Concern
TBL	Total Business Land
UNECE	United Nations Economic Commission For Europe
UNEP	United Nations Environmental Programme
USCB	Upper Silesian Coal Basin
US-EPA	US Environmental Protection Agency
USGS	United States Geological Survey
VITO	Flemisch Institute for Technological Research
VKG	Viru Keemia Grupp
VLEVA	Liaison Agency Flanders-Europe
WEFalck	W. Eberhard Falck, scientic consulting services

Units

Kt	Kiloton
Mt	Millions of tonnes
t	Metric tonne

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This study would not have been possible without the support of the Member States competent authorities, Geological Institutes, Associations and experts. We are very grateful for their constructive collaboration during the different workshops and their participation in telephone/skype interviews and/or meetings together with the provision of relevant data, reports and technical documentation. Furthermore, also the contribution of Kari Valde (Ictus), Petra Schneider and Anna Belousova (C&E) to webinar II of the final workshop is highly appreciated.

CHAPTER 1 INTRODUCTION

1.1. Political background

Waste management in the mining industry from EU Member States (MS) has been regulated in recent times through the Directive 2006/21/EC and amending Directive 2004/35/EC (EC, 2006a) on the management of waste from extractive industries (thereafter "Extractive Waste Directive (EWD))".

The EWD was adopted in 2006 and came into force in 2008, though 2014 was the first year in which all of its provisions applied. Two sets of triennial reports from MSs were analysed in 2015 and used as the basis of an implementation report in September 2016 (EC, 2016). According to this report and Cherrier et al. (2017) it was concluded that the majority of MSs have adopted the measures needed to implement the EWD but there were a number of obstacles to the European Commission (EC) assessing the implementation of the EWD that needed to be adressed. The EWD implementation report identifies that 1) the incomplete and inconsistent set of data is a major obstacle to the European Commission assessing the implementation of the EWD and 2) diverging interpretations of the EWD are a likely source of inconsistencies in the data reported by MS. In particular, figures on the amounts of waste and waste facilities appeared not plausible. The reported numbers did not appear to match well the number of mining facilities in each country. MSs with a quite strong mining sector reported rather small amounts of waste and/or waste facilities and *vice versa*. Furthermore, only a limited number of reports on incidents and accidents have been submitted.

The tender "*ENV.B.3/ETU/2017/0039 - Study supporting the development of general guidance on the implementation of the Extractive Waste Directive (EWD*)" was launched as a result of the outcomes of the EWD implementation report.

1.2. Aim of the project

The main objective of this study was to initiate a dialogue with authorities and stakeholders on key concepts of the EWD to develop a wider picture of the entire sector. The project focussed on a reliable description of the material streams resulting from the extractive sector and their management that might lead to an exchange with MSs towards a more uniform understanding and application of the EWD.

More specific, the project broadened the discussion to all material flows in the extractive sector to get a better understanding of 1) how the relevant definitions of the EWD are applied, 2) the number of operations per MS (i.e. a comprehensive list of all metal mines and an aggregated overview at MS level with respect to the other commodities), 3) the volumes of metal ore, metal mines' material flows and the way they are designated (waste, or other) and 4) the precautions taken with respect to human health and the environment when managing "non-waste" material streams.

All information gathered by the consortium and compiled into country fact sheets will be screened by the EC and will be evaluated in the framework of possible improvements to the EWD.

1.3. LIMITATIONS

The preparation of the study followed three main steps: (a) data gathering for the description of the extractive sector (including the estimation on the amounts and category of main waste streams, as well as the classification of the extractive waste facilities), (b) a dialogue with the Member States, and (c) enrichment of the study with information related to the substances used for flotation, as well as an inventory and rehabilitation of closed and abandoned waste facilities.

The first phase of the study was limited and only included publicly available data and reliable databases (Annex B). The objective was to develop an overview of the mineral resources extraction activities in the EU and to estimate the overall material flows for the time period 2015-2017. The number of the material flows are mainly based on calculations and estimations according to bibliographic references or other available sources. They may not always reflect / align to reality, but their purpose is to show the overall flows of material.

The second phase of the study, the dialogue with the MSs, relied heavily on the goodwill of the MSs to provide information and their ‘buy-in’ (i.e., their understanding of the added value of the project). Since it was not possible to visit all the MSs, the dialogue was focused on seven country visits complemented with telephone calls and questionnaires by email. For some countries however, the responsible departements / authorities dealing with aspects of extractive waste (EW) were not always clear. Furthermore, in some MSs the government departments dealing with on-going mining activities are not the same as the ones dealing with legacy sites. Lack of continuity of responsibilities in MSs also led to rationales for past decisions and interpretation of past information being difficult to establish. For instance, the government body authorised to communicate with the Commission on such matters in some cases did not have ownership of the data and did not understand the goal of the study very well, while on the other hand the technical level of administration with the right level of knowledge of the study subject was in some cases not authorised or prepared to speak to the consultants acting on behalf of the European Commission (see Chapter 3 & Chapter 4). The apparently unclear responsibilities within some MSs led to long delays in responses. In some cases the responses appeared to contradict publicly available information. The diverging implementation of requirements under the EWD also lead to significant disparities in the data-sets and vastly different levels of available details, that could not be resolved within this study. Language may also be a barrier. Although the consortium covered a large proportion of the offcial EU languages, the technical level in the MS administration insisted upon ‘official’ translation of their responses and would not respond to inquieries in the English language.

A special case is uranium mining that was undertaken in several European countries. Some former Eastern Block countries still consider this as national security related and, therefore, data had to be obtained through other channels (e.g. reporting under the so-called Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management (IAEA, 2017) or through secondary sources, such as the OECD-NEA/IAEA ‘Red Book’ (NEA-IAEA, 2018).

The project also assessed substances used for flotation and their potential environmental impact (3rd phase). The assessment was focused on chemicals used for the concentration of metals from crushed ores (e.g. collectors, frothers, modifiers and depressants). The data collection process was mainly based on information provided by mining chemicals handbooks, since previous steps of the study did not identify information on the types and amounts of flotation agents used, which are considered commercially confidential by producers and users. The assessment of the environmental fate of the substances used for flotation was based on available bibliographic application ratios and the amounts of tailings estimated in this study. Finally, the mandatory requirements of Regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) and Regulation (EC) 1272/2008 on the classification, labelling and packaging of substances and mixtures (CLP) were also used as the regulatory limits for this assessment.

1.4. DISCLAIMER

This report has been prepared for the European Commission in accordance with the associated contract. The information and views set out in this report are those of the author(s) and do not necessarily reflect the official opinion of the Commission. Nor the Commission nor the project consortium does guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use that may be made of the information contained therein.

CHAPTER 2 METHODOLOGY

2.1. DESK-STUDY

During the desk study, information on the yearly extraction per commodity and on the number of extraction sites per country was collected for aggregates, industrial, construction, and energy minerals per MS (i.e. EU-27). Regarding the metallic minerals, information on the yearly extraction of ore for each active metallic mineral mine was gathered together with an overview of the number and location of the active mine sites (including uranium extraction). The data collection process was focused on the period from 2015 to 2017.

The aim of the inventory was to get an estimate of the size of these sectors in the MSs. This overview was the starting-point for the evaluation of reported data on the amounts of extractive waste generated and the corresponding numbers of extractive waste facilities.

A data management structure was developed to collect the data. A distinction was made between extraction sites for the following commodity categories (Figure 1):

a) aggregates, construction minerals and industrial minerals;
b) metallic mineral ore extraction sites; and
c) extraction sites for energy minerals, including uranium and thorium extraction sites.

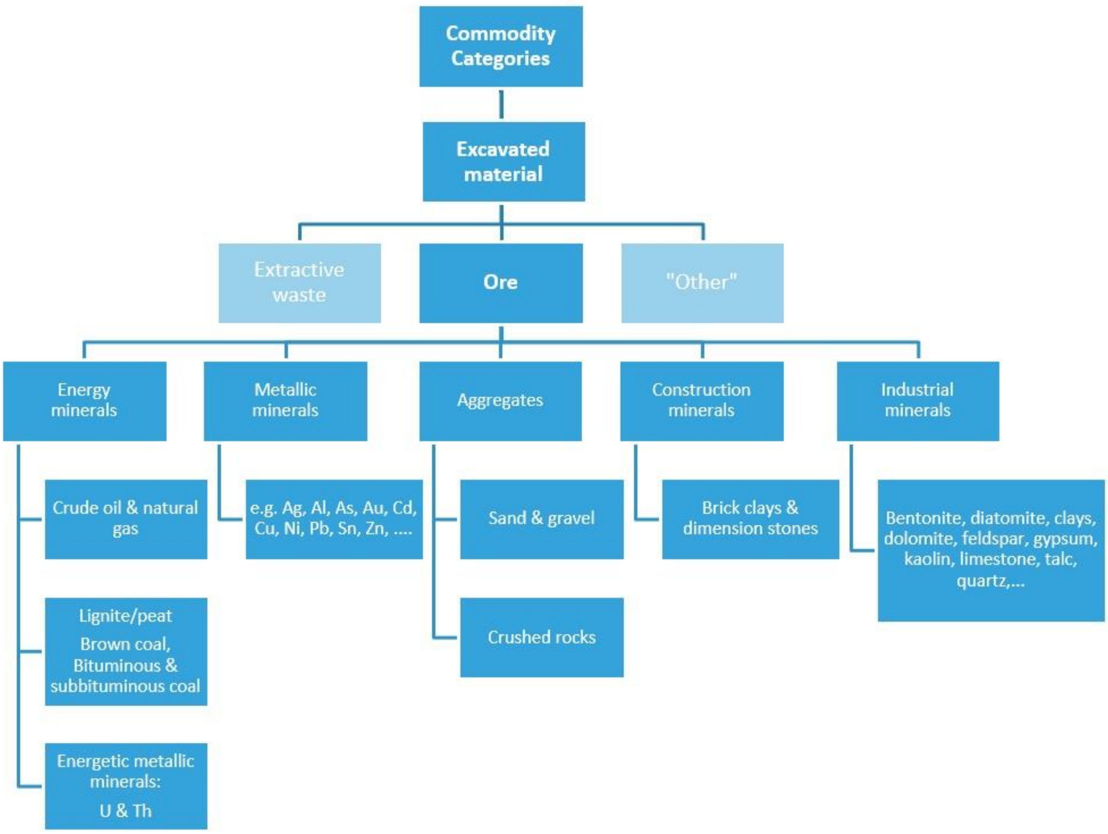

Figure 1: Overview of the commodity categories distinguished

The data presented in this study rely on a range of information sources. Not only were organisations consulted providing global annual production data for individual commodities or categories of commodities and/or waste production, but also national geological surveys, national statistical agencies, competent authorities, sector organisations, (commercial) databases and, if available, individual reports of mining companies. An overview of the websites consulted is given in Annex B. Furthermore, stakeholders from the industry and competent authorities were surveyed.

2.2. PROJECT OVERVIEW

The study was performed by the Flemish Institute for Technological Research (VITO) in collaboration with Eco-Efficiency Consulting and Engineering Ltd. (Eco-Eff), Euromines, MEERI, Total Business Land (TBL) and WEFalck.

To improve the effectiveness and efficiency of reporting under the EWD, published information was reviewed together with the collection of information on the extractive industry in the MSs and consultation with the MSs' competent authorities.

To reach the goals of the project, the specific tasks of the study were to:

- develop a coherent description of the extractive sectors and their main waste streams
- deliver plausible information on the amounts of waste generated and the corresponding waste facilities;
- foster a uniform understanding of the key concepts of the EWD by MS; and
- contribute to improving the effectiveness and efficiency on the reporting of the EWD implementation.

During the project, several workshops were organized 1) to initiate exchange of information with the MSs, 2) to validate collected and estimated data from the MSs, and 3) to make a step forward by collecting additional information:

- 11 April 2019, Brussels – DG Environment, Expert workshop:
  The purpose of the expert workshop was to inform delegates about the project and to motivate them to share information and advice with the EC and the consultants on 1) how the EWD is implemented in the different MSs and across the different sub-sectors, 2) how the key concepts of the EWD are applied, and 3) to motivate the participants to enter into a dialogue with the consultants to achieve the objectives of the study.

- 13 February 2020, Brussels – VLEVA (Liaison Agency Flanders-Europe, Technical workshop):
  During the technical workshop inter alia, the following items were discussed: 1) major accident prevention, 2) interpretation of CEN standards on sampling of extractive waste and implications for the characterisation of waste, 3) the inventory and rehabilitation of closed and abandoned EWFs, 4) reporting and statistics of extractive waste, and 5) the classification of extractive waste.

- 08, 11 & 12 June 2020, Final workshop – ZOOM webinars :
  Due to the Covid-19 pandemic, the foreseen final workshop was organized as three separate webinars focussing on:
    - Reporting of production and waste volumes (Webinar I, 08/06/2020);
    - Financial guarantees and extractive waste management plans (Webinar II, 11/06/2020);
    - Sustainable and transparent management of extractive waste (Webinar III, 12/06/2020).

For each workshop, a background document and meeting minutes (Annex A) were submitted to the Commission.

2.3. Calculation / Estimation Of Extractive Waste

The type, amount, and properties of mine waste produced at extraction sites depends on the resource being mined, the local geology, and process technology used. Consequently, different types of waste can be generated during each stage of the mining project life-cycle (prospecting, extraction, treatment, storage of minerals, and the working of quarries). Additionally, depending on countries' legislation, operators of extraction sites and extractive waste facilities may apply different guidelines for the categorisation of extractive wastes and for their management.

Mining wastes including tailings are disposed on the surface and underground. Part of the extractive residues is re-used, for example as material for filling excavation voids, for rehabilitation and construction purposes. A more detailed analyses is given in paragraph 3.2 " Generation of extractive waste".

According to the definition included in the EWD (EC, 2006a), extractive waste is waste resulting from the prospecting, extraction, treatment and storage of mineral resources and the working of quarries.

2.3.1. Metallic Minerals

One of the objectives of this study was to develop a coherent description of the metal mines in EU-27 with plausible and matching figures on the amounts of extractive waste generated and corresponding numbers of extractive waste facilities. Since not all information on the waste from metallic ore extraction was made available to this study, amounts of extractive waste from metallic ore production were estimated for each active metallic mine based on the yearly ore production data (period 2015-2017). As a starting point, the study focused on collecting information on the yearly extraction of ore for each active metallic mineral mine in EU-27 and estimating the associated generation of extractive waste and the corresponding demand for extractive waste facilities.

Taking into consideration the fact that the calculations are based on the yearly ore production the factors that informed the estimation of waste generation are:

1. The stripping ratios, which are influenced by the mine layout (e.g. surface vs. underground extraction);
2. The ore grade or the concentrate production in order to calculate the extractive waste produced during mineral processing. Often the ore grade does not itself give a realistic result as far as the generation of extractive waste is concerned, since it is linked to the metallurgical processes rather than the beneficiation processes.
3. the scope of the assessment of waste generation was limited to active metallic ore production mines and uranium and thorium mines. Therefore, metal mine sites that were under exploration, construction, or care and maintenance are not covered. The investigation was also conducted for extractive industries where the mining activities ceased, but where the mineral processing plant is still active, and thus extractive waste is still generated. For example, according to the Extractive Waste Management Plan (EWMP) from Hellenic Copper Mines LTD in Cyprus, the ore (copper and gold) is already stock-piled and the excavated material for the reference period (2015-2017) was zero. The ore continues to be processed by heap leaching and extractive waste is thereby generated. Therefore, even if the mine is not operating, there is active processing that was covered. Another example is related to some bauxite mines in Hungary (e.g. Bokonyoszlop) and Greece (Oiti Mine) that are considered as active though these mines have produced only insignificant amounts of bauxite in recent years.

4. During the data collection process, an issue of distinction between the term site and mine arose. Specifically, the MWEI BREF (Garbarino et al., 2018) provides an idea of the main European regions where extraction of mineral resources is carried out, indicating 247 metallic mineral ore sites, as well as uranium and thorium mines, out of which 85 are gold mines in French Guyana. This study shows a different picture for the number of metallic mineral ore mines, because it takes into consideration mining areas, that may include multiple sites in one municipality, under one operating management. For instance, the mining sites Marzyan-North', 'Yuzna Petrovitsa' and 'Shumacheski Dol-Androu' located in Bulgaria were merged under Erma Reka mine, whereas 'Krushev Dol', 'Petrovitsa' and 'Varba - Batantsi' fall under mine Madan.
5. Furthermore, companies themselves do not provide data for each site, but for the whole mining area.

2.3.2. INDUSTRIAL MINERALS, AGGREGATES, CONSTRUCTION AND DIMENSION STONES

One of the objectives of this study was to collect, determine and present aggregated figures for each Member State of the production streams of industrial minerals, construction minerals and aggregates, subdivided into commodities, such as kaolin, perlite and feldspar etc., per Member State, as well as to collect information of the amounts of associated generation of extractive waste and their category for the main waste streams.

Industrial minerals can be extracted from a mine or quarry, but also by dredging alluvial deposits. They are used mostly in construction (mainly sands, gravel and stones), manufacture of mineral products (e.g. glass, cement) or chemicals (e.g. mineral fertilisers, plastic additives, pharmaceuticals). In the study the so-called 'run-of-mine' amounts are accounted for, which are the mineral-containing materials before any further separation or concentration.

The relative amount of extractive residues generated during excavation of mineral resources can be estimated using the stripping ratio which generally refers to the units of materials that must be removed to extract one unit of ore in open-pit surface extraction. For the extraction of industrial minerals the stripping ratio varies from 1:1 to 2:1, whereas for underground mines from 0,5:1 and for open-pit 2:1. It is the basis for the assessment of remaining materials including mining waste. In many cases, this ratio can vary significantly over the life of the mine (JRC, 2018)

Ideally, the operators would like to sell as much as possible of the amount of excavated material. In some aggregate quarries this may be close to 100% (minus fines generated during crushing), while in dimension stone quarries the amount of waste can be considerable, if specific qualities are demanded. Operators may use residues for internal or external purposes, and in such a case these extractive materials, in principle, will qualify as by-products or products. Examples of internal or external use of are site rehabilitation (extraction site or waste management site), construction (means of access for machinery, ramps, safety barricades, berms, dams etc.) and/or production of a solidified /pasted filling that is placed back into excavation voids as an integral part of the extraction process (e.g. for safety and/or further mining purposes).

Wastes are either be stock-piled (if stored for no longer than 3 years) until a use can be found or used in the quarry for technical purposes, such as road construction. Waste in modern quarry operation may also be set aside for recontouring after closure (EC, 2019).

Ratios of saleable products to waste have been presented by Bide et al. (2020), e.g for gypsum 21:1, potash 2:1, sand and gravel 16:1. The waste ratio can be also estimated using the production data and assuming that a certain percentage of the extracted material has to be considered as waste (DEFRA, 2006).

The relative amount of materials used in the extractive residues can be estimated by the by-products / residues ratio. . According to the BAT and based on site-specific data provided by operators, this ratio can range from < 1% for ilmenite extraction to 91-99% for feldspar or quartz extraction, meaning that the latter uses almost all the residues and only a small part (1-9%) is discarded as extractive waste. In most cases, the by-products equal to 10% to 50% of the extractive residues (EC, 2018). Obviously, the use of the extractive residues is not always possible and varies considerably from site to site. It depends on various factors such as:

- site-specific conditions, e.g.: the residue characteristics (e.g. mineralogy, particle size distribution and chemical properties);
- the mineral resources extraction method (e.g. underground, surface);
- the possibility of using the residues for other purposes, such as construction and rehabilitation purposes, including placing the residues back into the excavation voids;
- economic aspects, e.g.: market demand for such residues, market location, price, transportation cost.

Crushed rock and dimension-stone is the most varied class of product in terms of the origin and occurrence of the resource that is used for their production. Crushed rock is generated to provide hard rock aggregates for concrete and base material for road building, as well as other applications. They are sourced from a variety of igneous, metamorphic and sedimentary rocks, but the main requirements are hardness, resistance to abrasion and availability in quantity at the right locations. Dimension-stone are produced from rocks of many different types and ages. They must be able to be split or sawn into the required shapes and possess the right colour, appearance and durability. The main rock types used for these applications are limestone, sandstone, and igneous and metamorphic rocks (Palumbo-Roe and Colman, 2010).

Aggregate is sold either ‘washed’ or ‘unwashed’, depending on the application and the requirement of the customer. The washing results in fine mud, which is collected in settling ponds, and which can be used within the quarries. Although, aggregates have to be stable over the long-term, the requirements may not be as stringent as for dimension-stone. Therefore, there may be veins of inert minerals, rendering also the resulting waste non-inert. However, as noted, such wastes are normally used within the quarry. Apart from the processing wastes, aggregate quarries do not normally generate other types of extractive waste, as all of the extracted material is used. There may be, however, fluctuation in the demands of certain qualities/sizes of aggregates, which can lead to stock-piling of some materials until a use or buyer can be found.

As there are no aggregated data for the non-metallic minerals, based on information collecting from operators, studies and literature mentioned above, the following assumptions have been made:

- Industrial minerals:
    - Barite: waste consists mainly of the country rocks enclosing the Barites orebody. Only 5-10% of the material mined is classified as waste;
    - Fluorspar: waste consists mainly of fine particles of limestone and clay, together with small amounts of quartz, silica, fluorspar, calcite, galena, sphalerite and pyrite;
    - Gypsum and anhydrite: opencast working produces temporary waste that consists mainly of the surface soil and beds above and between the gypsum seams (21:1);
    - Kaolin/china clay: the extraction and processing of china clay involves the production of very large quantities of waste. For each ton of china clay recovered typically 9 tons of waste is produced, comprising 4 tons of granular

waste (china clay sand), 2.5 tons of rock waste (stent), 1.5 tons of overburden and 1 ton of micaceous residues. The waste produced is of two main types: coarse material comprising sand (mainly quartz) and rock waste, which if not sold, is disposed of in large tips, and a fine slurry waste called mica residue, which is disposed of in large lagoons and abandoned china clay pits;
    - Potash - waste from the extraction process comprises insoluble clay minerals, calcium sulphate and sodium chloride. None is stored on surface;
    - Salt - the underground rock operations produce no waste at the mine site.
- Aggregates (sand, gravel, crushed stone and quarried rock used for construction purposes):
    - Sand and gravel: the amount of waste produced varies considerably depending on the specific character of the site and will range from a few per cent up to around 30% of the total material quarried. The mineral to waste ratio varied from 49:1 to 1:1 with the majority tending towards the lower figure (10:1). All minerals are considered inert.
- Construction minerals & dimension stones:
    - Sandstone: waste generally consists of overburden and oversize and undersize sandstone blocks and particles;
    - Limestone: limestone quarries produce largely variable amounts of waste, depending on the local topography and geology. There may be significant quantities of overburden to be moved. Within the limestone body significant amounts of chert, and/or clay may be present. These will be disposed of as waste, which may be classified as inert. The mineral / waste ratio varies usually from 12:1 to 9:1. All the material is considered inert;
    - Igneous and metamorphic rock: the mineral / waste ratio varies from usually 20:1 to 2:1. All the material is considered inert;
    - Clay and shale: the 'material suitable for use in brick manufacture to other material' varies between 10:1 and 1:1. There is a lack of agreement over how much this 'other material' should be classed as waste. Clay waste is estimated based on a waste to saleable product ratio of 9:1.

In summary, quarry waste is estimated based on a 1:9 ratio of waste to saleable product, except gypsum, rock salt, salt brine, fluorspar, barite, talc and potash, china clay – all 1:1.
The type the amount and the properties of the extractive waste generating from the industrial minerals sector vary depending on the resource, the geology and the process technology used. In general, the extractive waste generated are classified according to the available data as non-hazardous waste and they are managed similar to the construction minerals. In general, no hazardous mining waste is produced.

However, in the last years significant efforts have been made to implement the waste management hierarchy and circular economy business model to minimize waste generation. The mine waste management pyramid (Figure 2) continues to put waste prevention at the top of the priority list. Then there is a reprocessing option that allows to recover some of the valuable materials left in the waste. Putting materials back in the excavation voids can take place while awaiting a more favourable economy and until reprocessing becomes a profitable activity. When no recoverable minerals are deemed to be left in the waste, the waste can be used for other purposes, such as placing it back into the excavation void or selling it as road construction material. This option is lower on the priority list as it will eventually lose all other valuable components. Finally, after considering all other options, remediation *and site rehabilitation may be considered*.

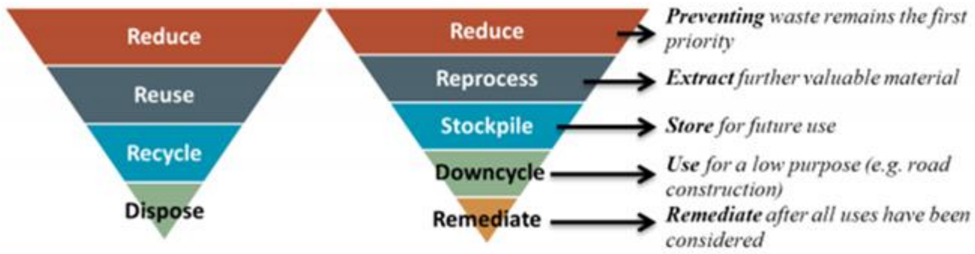

Figure 2: General waste management hierarchy (left); new hierarchy for mine waste management (right) (Lèbre & Corder, 2015).

Therefore, based on information collected from operators, literature and market analyses and expert knowledge, the following assumptions for waste flow calculation have been made. The assumptions and the methodology developed are presented in Table 1. This is only a rough estimate, based on the yearly production (period 2015-2017).

Table 1: Ratio based on the final product after the benefication

Commodities	A-SR[a]	Processing/ Beneficiation	TR[b]	Reference
Barite	X 1.1	Flotation (gravity separation). If barite is produced from primary barite deposits the genretation of extractive waste is limited. There are cases where barite is in the form of gangueor as the secondary mineral There are also a substantial number of sulfide base metal deposits containing copper, lead, zinc, pyrite, copper, and barite. The grade of barite in these deposits ranges from 20 to 45% $BaSO_4$.	X 0.2	. GS . 911metallurgist (website) . Bulatovic (2014)
Bentonite	X 0.7	Bentonite is either sieved (granular form) or milled (into powder and superfine powder form), but most of the time it undergoes processing to modify its properties. There is no waste expected to be produced. Poor quality bentonite is left behind in the pit.	X 0	. BGS . Kunimine . IMA Europe
Diatomite	X 2	Diatomite is milled or dried and calcinated to remove moisture. No waste is expected	X 0	EPA (1993)
Feldspar	X 1	Flotation process Production of waste is not expected.	X 0	

[a] A-SR: Average stripping ratio
[b] TR: Tailings ratio

Commodities	A-SR[a]	Processing/ Beneficiation	TR[b]	Reference
Fluorspar	X 3	All processing is by physical beneficiation whereby unwanted rock (gangue) is separated from the fluorite by a series of standard techniques, such as heavy-media separation and froth flotation. This necessitates size-reduction of the ore to liberate fluorite from the host rock, and standard crushing/grinding techniques. The content of run-of-mine varies considerably (from 10-60% CaF2) with underground sources generally producing higher-grade ores. On average 2-5t of mined material are required to produce 1 t of finished acid grade fluorspar.	X 2	International Fluorspar Association Newsletters
Graphite	X 2	The production amount is minor so is the extractive waste.		
Gypsum	X 0,7	Gypsum is normally only screened to remove fines (mainly clay) then crushed and finely ground. No waste is expected.	X 0	BGS
Kaolin	X 7	It is not possible to precisely indicate the exact volume of the kaolin waste produced during the kaolin mining, but it may range from 50 to 90% of the extracted/beneficiated kaolin.	X 4	Spinola et al (2019)
Limestone	X 0,5	1) Quarrying/ mining 2) Crushing 3) Screening -> End product limestone 4) Grinding -> End product limestone powder	X 0	Nordkalk website
Magnesite	X 1	According to the data provided by producers "magnesite tailings/ waste" after the beneficiation amounts to 38%.	X 0.6	Information from producers
Potash	X1.5	In Germany the excavated material contains between 11% and 25% potassium chloride. The potash deposits in Germany also contain magnesium and sulfur (between 9% and 24% $MgSO_4$)	X 4	Yager (2016)
Perlite	X 0.5	In Greece the production of perlite and of fine perlite (waste) is respectively 500,000 t/y and ~70,000 t/y.	X 0.15	The data were collected from the Decisions Approving Environmental Conditions that are available on line (https://diavgeia.gov.gr/)

[a] A-SR: Average stripping ratio
[b] TR: Tailings ratio

Commodities	A-SR[a]	Processing/ Beneficiation	TR[b]	Reference
Phosphate	X 13	Apatite concentration in the ore extracted from the mine (Yara Finland Oy Siilinjärvi mine) is the lowest of all the exploited apatite deposits in the world (approximately 4.2% P2O5 in situ). Apatite is separated from the ore flotation, increasing the P2O5 concentration to 36.5%. Approximately 80% of the The apatite is utilised in the Siilinjärvi phosphoric acid factory, where it is dissolved in sulfuric acid, producing not only phosphoric acid but also gypsum. Amount of extractive waste: 27,542,034 t (gangue 63.2%, tailings 36.8%). 29% of the gangue are utilised.	X 7.7	Kaivosvastuu website
Rock Salt		Around 10% of the rock salt mined becomes processing waste.	X 0.1	https://www.kpluss.com/en-us/.pdf/investor-relations/2018/gb2018.pdf
Talc	X 1	Any excavated material that cannot be sold is used in the quarry for construction purposes (e.g. vehicle safety barriers) or for rehabilitation (landscaping)	X 0	https://www.brgm.fr/en/news/news/publication-new-quarries-map-france-2020 https://www.eurotalc.eu/sustainability

[a] A-SR: Average stripping ratio
[b] TR: Tailings ratio

According to these estimates for individual industrial minerals, it can be shown that the ratio of volume of production to the amount of waste generated usually ranges between 0.5% and 13.0%. In operating aggregate and dimension-stone quarries the stripping ratios may be very low, as they work downwards and no new land is used or they work a high quarry face with little foot-print. Less favorable stripping ratios occurs in new quarries. The exact amount of waste is difficult to determine and depends on the type of rock quarried, the quality of the resource, the quarrying and processing techniques, the demands on the marketable products, and the market conditions.

2.4. Inventory of Closed and Abandoned Extractive Waste Facilities

This part of the study focused on the practical experience with establishing inventories of closed sites and on possible needs for an updated methodology related to such inventories or for developing further guidance for the rehabilitation of the listed waste facilities.

The focus was on closed and abandoned sites resulting from the mining of metal ores. This study gathered and assessed the following information related to establishing inventories:

- Feedback from the experts that have prepared national inventories on their experience with guidance provided by the European Commission and suggestions for improvement, if deemed relevant;

- More detailed information on the initial assumptions that were used with regard to the stability of installations (e.g. which magnitude of seismic events or extreme weather conditions including floods should the facilities withstand? Has the stability of the installations been assessed against possible changes related to global warming?);
- Number of sites that were initially listed in the inventory and that have now been rehabilitated;
- Description of the rehabilitation. This description aimed to elaborate the objectives of the rehabilitation (e.g. risk reduction, future use of the area), measures taken and an indication of the related costs;
- Identification of examples of good practice for rehabilitation;
- Examples of obstacles to rehabilitation.

The data collection was to include a minimum of five closed sites per Member State. Data were collected from publicly available sources, by contacting national authorities by e-mail or phone or by raising this topic during country visits.

A questionnaire to elucidate MSs' views on related guidance provided by the European Commission in 2011 to evaluate closed and abandoned extractive waste facilities was prepared (Annex C) and sent out to the MSs authorities.

2.5. Country Visist and Telephone Interview preparation

2.5.1. Context

An important aspect of this study was to develop an understanding of how key concepts of the EWD are applied in the respective MSs and to clarify national figures on the generation of extractive waste and of national figures on waste facilities.

2.5.2. Purpose

At a minimum, the objectives of the country visits and telephone interviews were:

- to seek for clarification on the main material streams resulting from the extraction process and which of these streams are considered as extractive waste;
- to update inventories of waste facilities (including Category A) and their permit status;
- to explore competent authorities' reasoning for differences in interpretation or understanding amongst the MSs of key concepts of the EWD;
- to inform the Commission of any revealed ambiguities or legal gaps in the Directive.

The consortium proposed a plan for contacting MSs authorities for approval by the Commission (Figure 3). Preparation of the approved plan for approaching MSs entailed the following:

1. Design of typical process/material flow sheets for the main metals mined in Europe.
2. Production of 1st Draft Country Fact Sheets (CFS) for each Member State, including contact details. These draft CFS were comprehensive, anticipating all information that would eventually be provided in this Final Study Report to DG Environment.
3. The questionnaire on mining legacies, the metal flow Sheets and the 1st Draft Country Fact Sheet were provided to the Country Lead for each Member State.
4. Each Country Lead then prepared a Pre-Meeting version of the Country Fact Sheet. The general structure for these versions was agreed with the Commission, reviewed and revised later to provide more concise information, focused particularly on clarification of the information requested by Commission Decision 2009/358/EC (EC, 2009a) and on filling information gaps to meet the objectives of the Study.
5. Each Country lead then contacted the Member State authorities to arrange a place and time for the interview.

6. Each Country lead sent in advance to the Member State authorities a pre-meeting pack made up of the Pre-Meeting Country Fact Sheet, the (Legacy) questionnaire (sent separately by email) and the relevant metal flow sheets.
7. Each Country lead conducted the interview to complete and correct the Country Fact Sheet. They used, for example, the metal flow sheets to understand how metal ores and concentrates are produced within the country and the related material flows.
8. Each Country lead followed-up by email to have written answers to the questionnaire on mining legacies.
9. The Consortium collated the comprehensive 1st Draft Country Fact Sheets with the Filled-in Questionnaires and Fact Sheets to produce a country chapter in the final project report.
10. The final draft fact sheets were send to the Member States for review and were finalized afterwards.
11. The Country Chapters in the Final Study Report should be considered as a model response for a revised reporting strategy.

2.5.3. OUTPUT

The resulting deliverables are a set of 27 country fact sheets – one for each Member State.

2.5.4. INTENDED QUALITY

To enable understanding of reported statistics, evaluation of implementation of the EWD and, if appropriate, modification of the method of reporting progress to the European Commission every 3 Years.

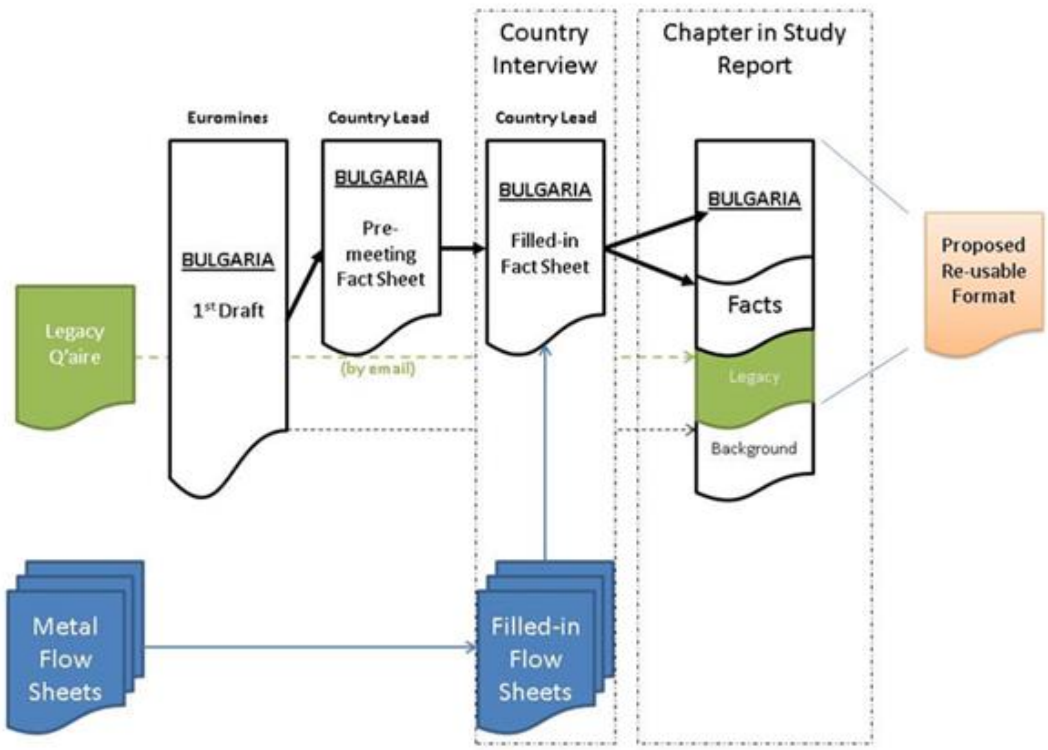

Figure 3: Flow through plan for contacting Member States authorities

CHAPTER 3 DATA COLLECTION PROCESS AND KEY FIGURES

3.1. Overview of the extractive sector in the EU

3.1.1. Aggregates, industrial and construction mineral extraction in the EU

In general, the term construction minerals is used to describe all minerals used by the construction industry in both buildings and infrastructure works (e.g. roads, bridges, railways) and contains dimension-stone and minerals used for the production of for instance concrete, bricks and screed. Separate figures for the construction minerals group were not reported by any of the EU member states. Therefore, a distinction has been made between aggregates, being the most voluminous group of the construction minerals, ceramic clay, dimension-stone and industrial minerals. For several industrial minerals it was in general not possible to make a distinction between the volume of minerals produced for application in industry versus application in construction. Therefore, data reported for lime, chalk, dolomite, and gypsum are assigned to industrial use, unless detailed production data for other uses were available.

Natural aggregates production consists of gravel and sand, crushed-stone aggregates produced from hard and moderately hard rocks of magmatic (basalts, granites, gabbro and diabases, melaphyres, porphyry, syenites, etc.), sedimentary (dolomites, limestones, sandstones, etc.), or metamorphic origin (amphibolites, migamatites, gneisses, serpentinites, etc.). In the European Union and other European countries, crushed-stone aggregates produced from magmatic and sedimentary rocks prevail (their share in the production amounts to about 55%), but there are countries in which, gravel and sand aggregates predominate (Poland, the Netherlands, and Latvia).

An overview is compiled of extraction sites for aggregates, construction minerals and industrial minerals within the 27 MSs. Publicly available data are gathered at the MS level, not for individual quarries.

As 2016 is the most recent year for which most data are available, the figures are based on this dataset.

→ **Aggregates**

The aggregates sector represents the bulk of the non-energy extractive industries. Annually, almost 2.7 billion tons of aggregates are produced and used in Europe (MIRO). For the aggregates, data from UEPG were collected for “sand & gravel” and “crushed rocks”. Marine aggregates and manufactured aggregates were out of scope in this study.

Natural crushed aggregates are obtained from compact rocks by extraction and processing. Rocks, suitable for the production of natural crushed aggregates are characterized by resistance to weathering, frost and wear, and have high compression-strength. They are extracted from deposits with the use of explosives. The output is crushed and classified as required. The shape of aggregates may be modified by granulation.

Statistical sources use the category "crushed rocks" or "crushed stones". The EW-MFA classification (Eurostat 2013, 2018) of stone minerals is not fully consistent with crushed stone (or rock) classifications in national and international mining statistics. Statistical inconsistenties may be the result of:

- data including gravel under crushed rock, or vice versa;
- data including building stone which may comprise, dimension-stone and crushed rock;
- double or multiple counting of for instance dolomite and limestone since these commodities are used for various purposes (eg crushed-rock aggregates, cement production, industrial and agricultural applications. Data for limestone are reported as such, but also included under crushed rock, resulting in double counting.

Therefore, it is difficult to assess, whether the crushed / dimension-stone production data presented in various statistical sources are complete and without duplicate calculations (UNEP, 2021).

Crushed rocks are used for constructions purposes (mainly concrete and road construction) and for cement production. In this overview the bulk number is given, and no further distinction is made between the different applications. Figure 4 shows the amount of aggregates (sum of crushed rock and sand & gravel) in Mt per Member State and the number of active quarries per country in 2016.

The total amount of crushed rock and sand & gravel for the whole EU are respectively 1063 and 1176 Mt. From the UEPG database (2016) and the country fact sheets a total of 23.466 extraction sites are reported for the 27 MSs. Germany is the biggest aggregate producer with 465 Mt, followed by France (298 Mt), Poland (246 Mt) and Italy (153 Mt).

For the active quarries Italy (2800), Poland (2746), France (2684), Germany (2660) and Finland (2530) counts for 57% of the total amount. Finland has reported 78 Mt of aggregates for 2530 active quarries (2016). Whereas Slovenia has produced 182 Mt sand & gravel in 138 quarries, which makes it the 3rd biggest sand & gravel producer after Germany and France.

The amount of extracted sand & gravel and crushed rock and the number of active quarries & pits for each Member State in the period 2015-2017 is given in Annex D.

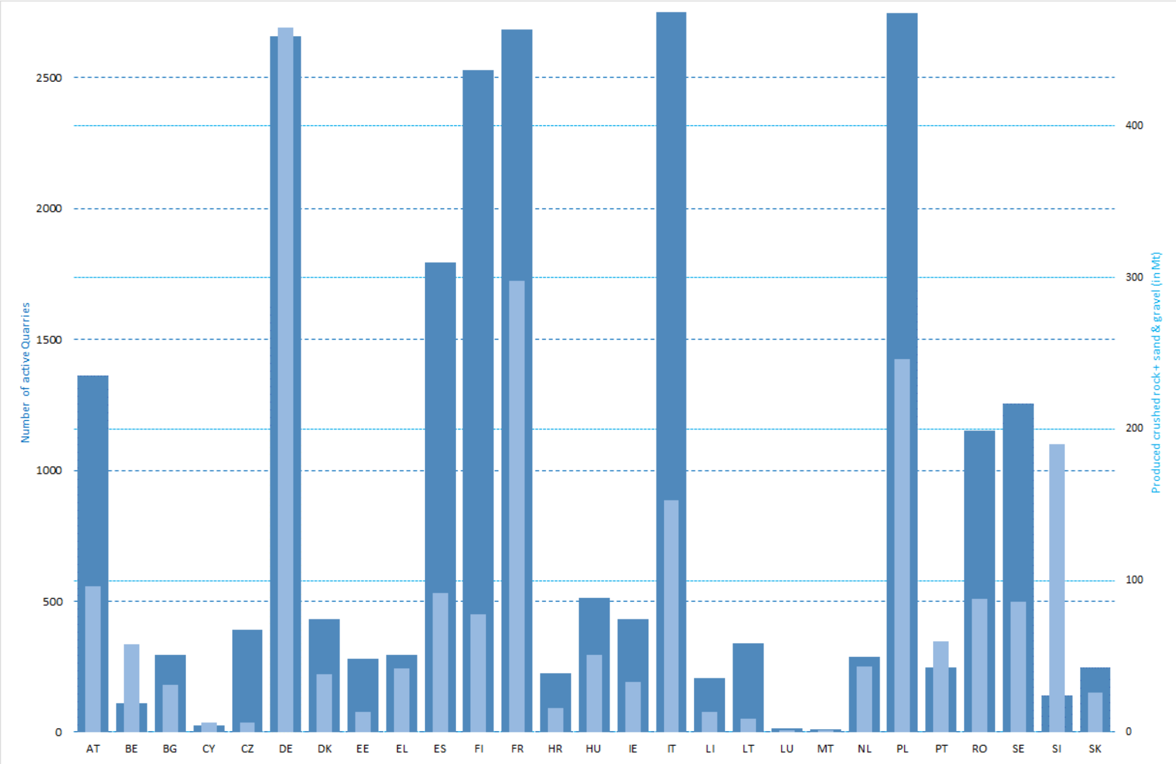

Figure 4: Number of active quarries (dark blue) and total amount of produced aggregates (light blue) in Mt (sand & gravel + crushed rocks) for 2016 for the 27 Member States (UEPG database)

→ **Industrial minerals**

Data of 27 different commodities are compiled from the different consulted data sources for the 27 MSs (Figure 5). Detailed data are given in Annex E. The 27 commodities represent a total amount of 162,86 Mt (in 2016). Potash (33,39 Mt), chalk (10,35 Mt), rock Salt salt (21,60 Mt), gypsum (23,70 Mt), lime (28,69 Mt) and kaolin (10,3 77 Mt) sum up to 79% of the exploited amount of industrial minerals in the EU in 2016. Bentonite (2,32 Mt), potash dolomite (8,52 Mt), feldspar (6,20 Mt), magnesite (2,36 Mt), quartz (5,49 Mt) and sulfur (2,50 Mt) counts for another 17%.

Germany is by far the biggest producer of industrial minerals, with potash (31,55 Mt), gypsum (3,97 Mt) kaolin (4,74 Mt) and rock salt (5,62 Mt) as the largest contributors. For Latvia, Luxembourg and Malta no production data for industrial minerals were found. Nevertheless, small amounts can be expected. Small producers of industrial minerals are Austria, Belgium, Bulgaria, Cyprus, Denmark, Estonia, Greece, Finland, Croatia, Hungary, Ireland, Lituania, Portugal, Slovania and Slovakia with a total production per country < 5 Mt in 2016. The specific geology of Finland ensures that it is the only European producer for several industrial minerals (apatite, biotite, mica concentrate and soapstone).

The number of production sites per commodity (Table 2) could not be determined for all countries (status 2016). In addition, the data reported in Annex E must be interpreted with caution. It is not always clear whether the reported numbers relate to individual mining sites or to mining companies.

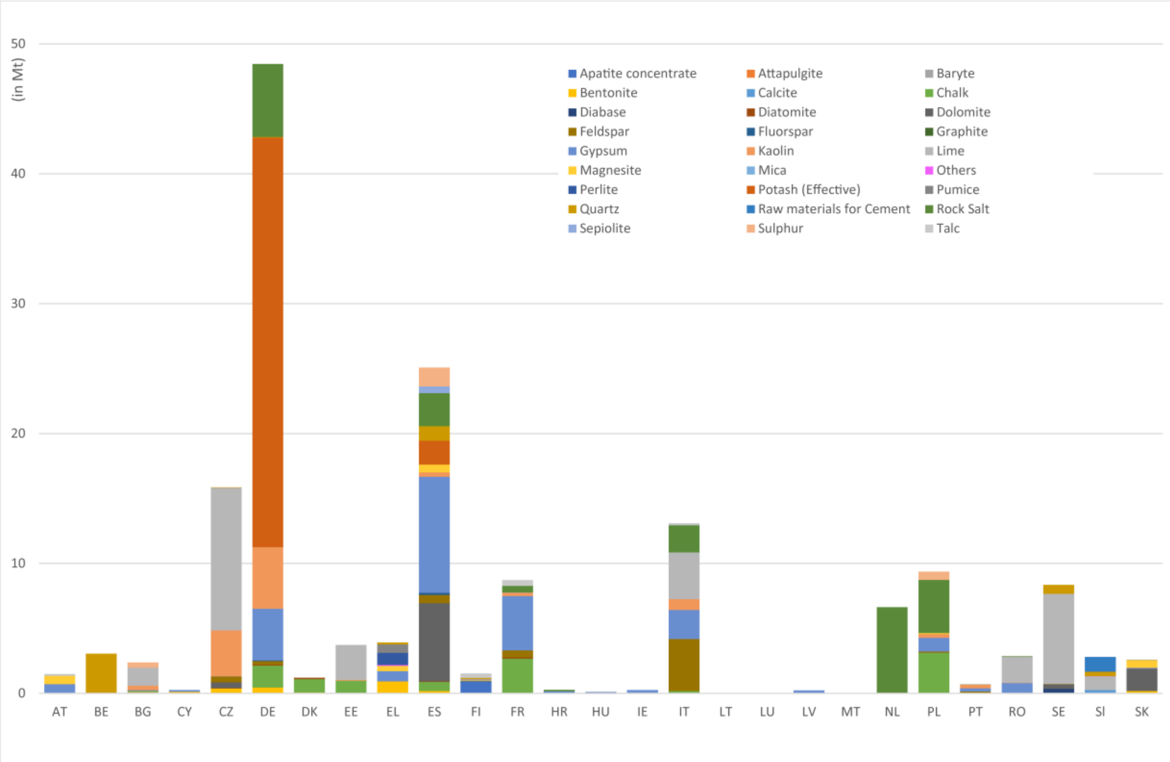

Figure 5: Industrial minerals, overview of the 27 commodities for the 27 Member States in 2016 (in Mt)

Table 2: Industrial minerals, overview of the number of production sites for the 27 Member States in 2016 (References: Annex E)

MS	Number of extraction sites 2016	other	MS	Number of extraction sites 2016	other
AT	27		HR	5	
BE	*	*	HU	7	
BG	*	*	IE	*	*
CY	*	11 (2017)	IT		36 (2018)
CZ	70		LV	*	*
DE	148		NL		5 (recent)
DK	*	*	PL	35	
EE	*	*	PT	125	
EL	*	33 (2017)	RO	27	
ES	214		SE	15	
FI	18		SK	33	
FR	*	88 (2015)	SL	20	

* no data found / available / provided

→ Clays for the ceramic industry

Most traditional (conventional) ceramic products (bricks, earthenware, white and colored fine ceramics) are made from clay or clay mixed with other material. The group of ceramic clays includes a diverse range of clay minerals (e.g. kaolinite, illite, montmorrilonite,…) composed of more than 50% clay in terms of grain fraction (grain size below 0,002 mm). Clay deposits furthermore also contain various additives, including quartz, mica, organic matter, carbonates, oxides and hydroxides of Fe, feldspar, volcanic glass, etc. Annex F gives a detailed overview of data reported. Although the number of reported extraction sites is of the same order of magnitude for Germany (210), Poland (224) and Spain (197), significant differences in production are observed for these countries (DE: 20,2 Mt, ES: 9,34 Mt & Pl: 3,7 Mt). For Belgium, Ireland (small exploitation of fireclay; http://www.mineralsireland.ie/MiningInIreland/CurrentMining.htm) and Latvia, clay mineral extraction is taking place but production data are not reported to the authorities. Production data and overview of production sites is given in respectively Figure 6 and Table 3

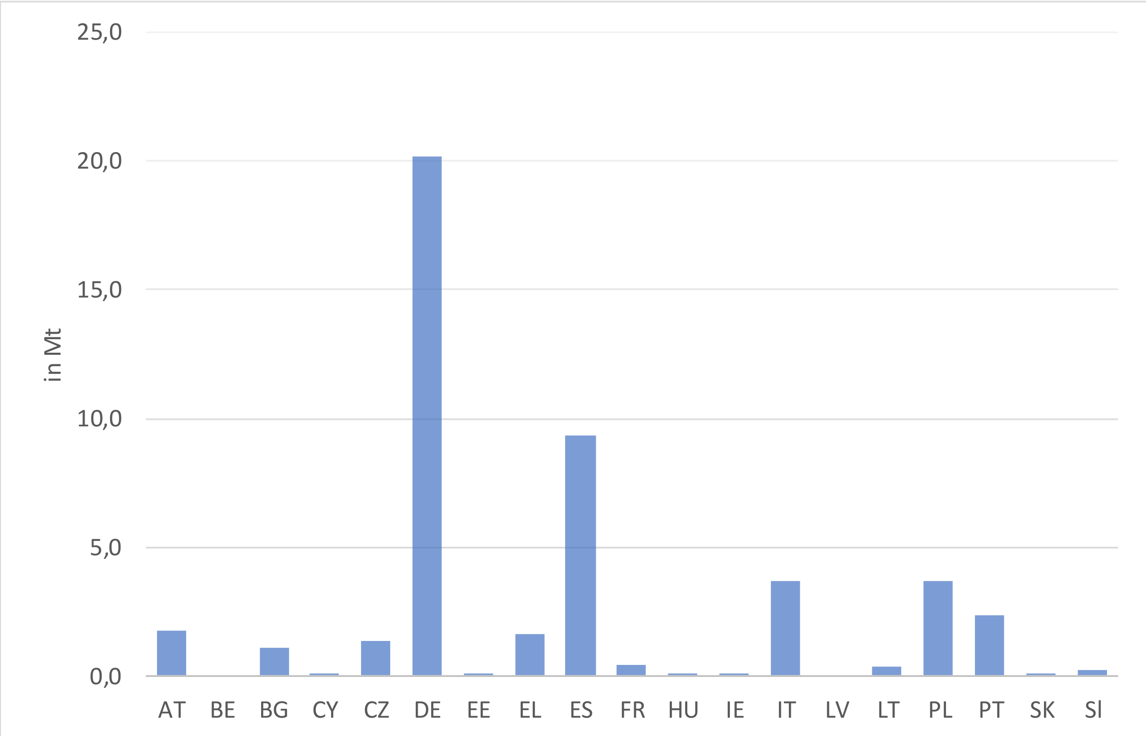

Figure 6: Clays for the ceramic industry, overview of production data for the 27 Member State in 2016 (Details are given in Annex F)

Table 3: Clays for the ceramic industry, overview number of production sites for the 27 Member States, 2016 (Detals are given in Annex F)

MS	Number of extraction sites 2016	other	Reference	MS	Number of extraction sites 2016	other	Reference
AT	47		BMWFW (2016,2017,	HU	no data*		
BE	no data*			IE	no data*		
BG	no data*			IT	no data*		
CY	no data*			LV	no data*		
CZ	20		CGS (2019)	LT	no data*		
DE	210			PL	224		PIG-PIB (2016, 2017, 2018)
EE	no data*			PT	83		DGEG (2017)
EL	no data*			SK	3		SGIDS (2018)
ES	197		IGME (2017); SMS (2017)	SI	11		GeoZS (2018)
FR		195 (2015)	BRGM (2015)				

no data*: no data found / available / provided

→ Dimension stones

Dimension-stones represents a very unique sector within the mining industry, with its own particular rules, approaches and evaluation. Market leaders in EU are Spain, Italy, Greece and Portugal (Cosi, 2015).

Dimension-stone is a technical / commercial term that includes all natural stones that can be quarried in blocks of different dimensions. Dimension stones are processed by cutting or splitting and possess specific technical (width, length, shape and thickness) and aesthetic properties (colour texture, pattern,…) for use in the building and construction industry as well as in internal decoration and landscaping projects (Cosi M., 2015).

Although a variety of igneous, metamorphic, and sedimentary rocks are used as dimension-stone, the principal rock types are granite, limestone, marble, sandstone, and slate. Other varieties of dimension-stones that are normally considered to be special minor types, including alabaster (massive gypsum), soapstone (massive talc), and various products fashioned from natural stone (https://www.usgs.gov/centers/nmic/dimension-stone-statistics-and-information).

As already indicated for the crushed rocks, reported amounts for natural rocks seldom make a distinction in the application of hard rock as respectively dimension stone or crushed rocks. Furthermore, there is no unique classification system resulting in a variety of production data, thus complicating the comparison of data between the various sources.

Unfortunately information is mainly available for dimension stone deposits (Figure 7), while information on production data and number of sites is scarce. An overview is given in Annex G.

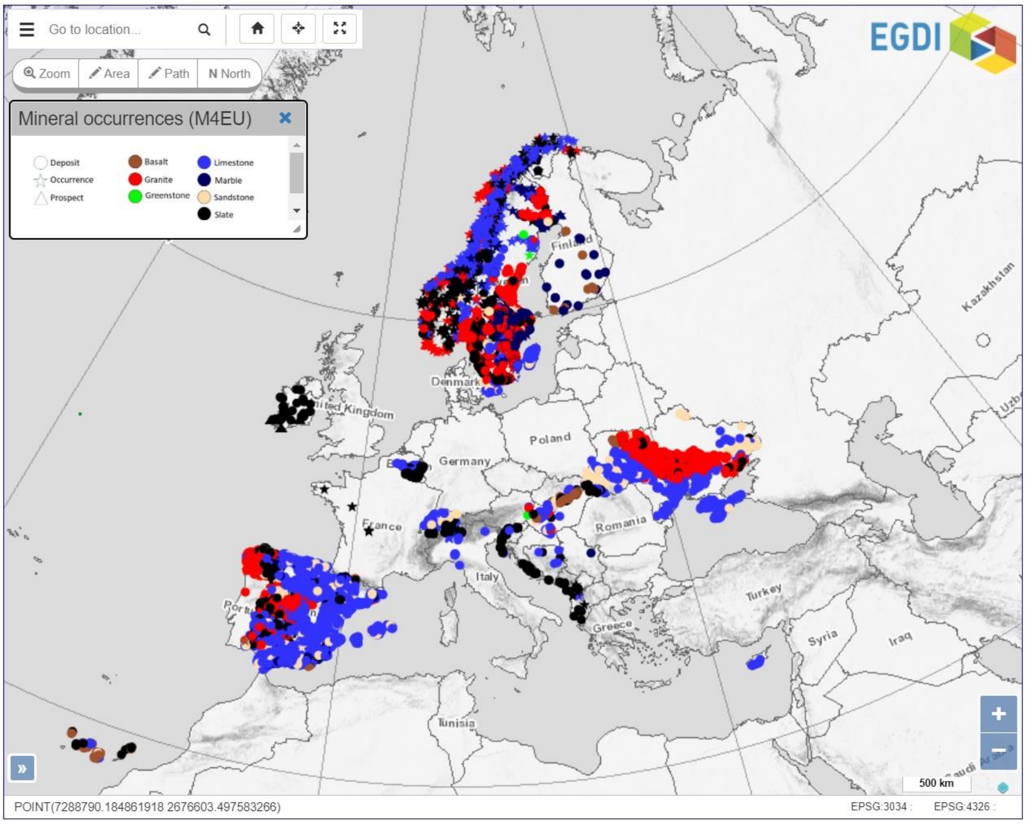

Figure 7: Overview of deposits and former and actual production sites of dimension stones in the EU (https://geoera.eu/projects/eurolithos1/ - 21/05/2021)

According to Figure 8, in 2016 the total amount of the production of dimension stones in the EU-27 corresponds to 34, 6 Mt. Italy and Spain account for around 45% of the EU's production of dimension stones. Other important producers are Lithuania (2,9 Mt), Portugal (2,8 Mt), Romania (2,6 Mt), Bulgaria (2,5 Mt), France (2, 2Mt) and Autria (1,5 Mt). Individual production data of dimension stones in Cyprus, Czech Republic, Germany, Estonia, Greece, Finland, Croatia, Hungary, Latvia, Malta, Sweden, Slovenia and Slovakia range between 0,1 Mt and 0,9 Mt. Although production is known for Belgium and Luxembourg production data were not reported. Data on the active extraction sites is scarce (Table 4).

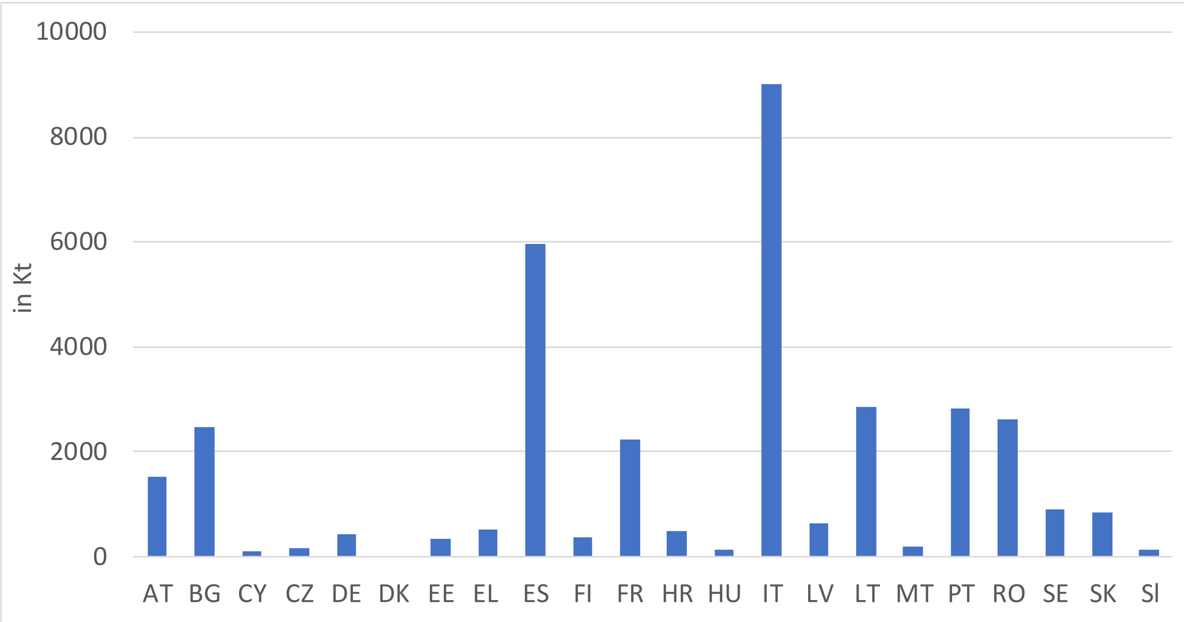

Figure 8: Dimension stones, production data for the 27 Member State in 2016 (Details are given in Annex G)

Table 4: Dimension stones, overview number of production sites for the 27 Member States, 2016 (Details are given in Annex G)

MS	Number of extraction sites 2016	other	Reference
AT	no data*		
BG	no data*		
CY	no data*		
CZ	64		CGS (2019)
DE	no data*		
DK	no data*		
EE	no data*		
EL	no data*		
ES	527		
FI	4		Tukes (2015; 2016; 2017)
FR	no data*	721 (2015)	BRGM (2015b)
HR	no data*		
HU	20		HGS
IT	no data*		
LV	no data*		
LT	no data*		
MT	no data*		
PT	363		DGEG
RO	4		NAMR
SE	56		SGU (2017;2018)
SK	no data*		
SI	29		GSS (2018)

3.1.2. METALLIC MINERAL ORE EXTRACTION IN THE EU

The EU is a major user of metals, however, only few EU countries are major producers of particular metals. Metallic mineral mining takes place in 15 EU countries[1]. Most of the mining sites are located on the Fennoscandinavian Shield, the Balkan region and the Iberian Peninsula. Most of the projects currently under exploration or development are in the Balkan region.

Europe's contribution to world metal ore production is limited to the following metals: aluminum/bauxite, copper, lead, zinc, chromium, nickel, iron, and tungsten. There is also a production of precious metals (gold and silver), cobalt, manganese, and tin. In EU-27, seventy (70) active metallic mineral mines (including the treatment of mineral resources) were indicated, which are located in Austria, Bulgaria, Cyprus, Finland, France, Greece, Hungary, Ireland, Poland, Portugal, Romania, Slovakia, Spain, and Sweden.

In 2017, these 70 active mines (i.e. integrated mine location, operated as a complete entity, where one operator excavates material from more than one site) covered 104 active metallic mineral excavation sites and two remediation sites, where uranium is recovered, and two alumina plants treating imported bauxite. Twelve sites were in a state of care or maintenance (Figure 9; Table 5). In addition, 11 projects were identified that were under development or in an exploration stage.

A list of all metallic minerals extraction sites that are in production or in a state of care and maintenance is given in Annex H.

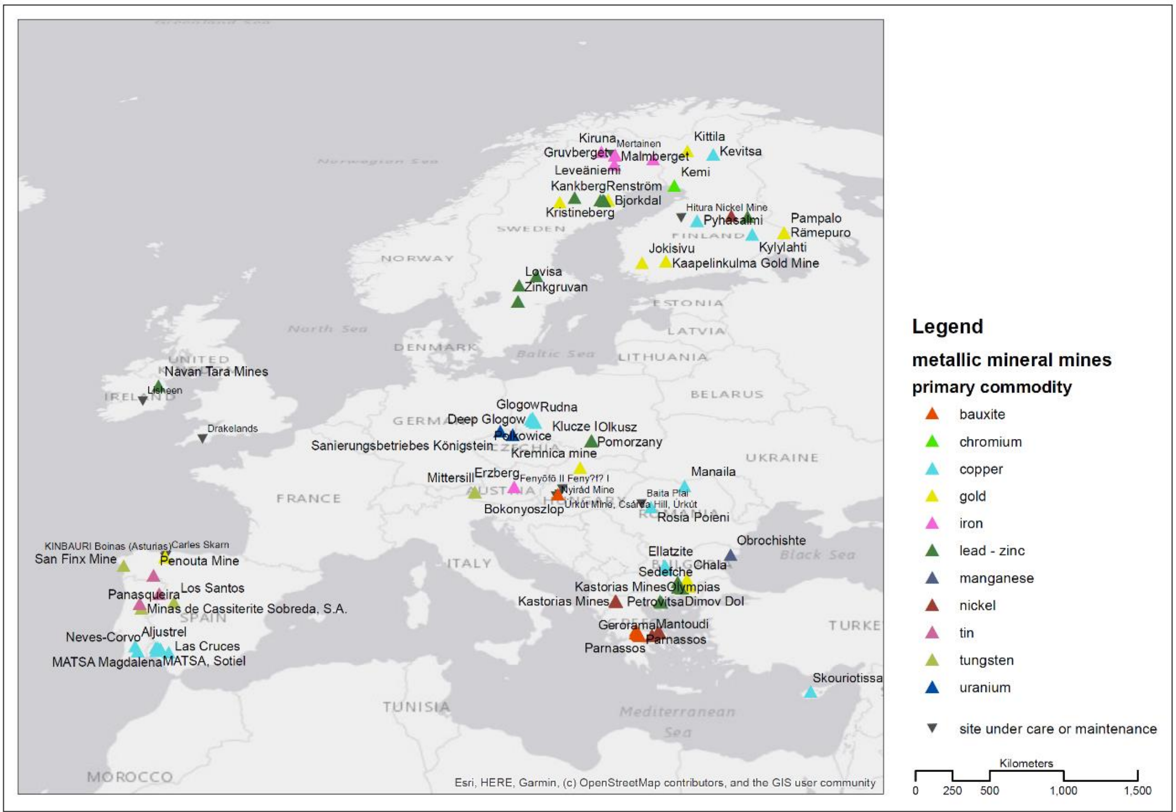

Figure 9: Location of metallic mineral mines in the EU (status 2017)

Based on all data collected for the period 2015 – 2017, we estimate that all metallic mineral extraction sites together produced about 223,000 Kt of ore per year. The annual production of

[1] i.e. 14 countries + Recovery of uranium in the context of site remediation (Table 5)

copper sulfide and polymetallic copper ore in the period 2015 – 2017 amounted to 132,500 Kt. Iron extraction produced about 38,000 Kt of ore. Together, they amount to almost 80% of the metallic mineral ores produced in the EU. The annual production of nickel ore was about 15,000 Kt, of lead-zinc ore 11,500 Kt and of gold ore 10,500 Kt. The amount of metals contained in these ores is shown in Figure 10. The difference between light and dark blue indicates the spread for the 3 years (2015-2017, lowest and highest value). Aluminum is shown in red because the information presented is not only related to aluminium extracted from bauxite mined in the EU. The metal content of imported bauxite is included.

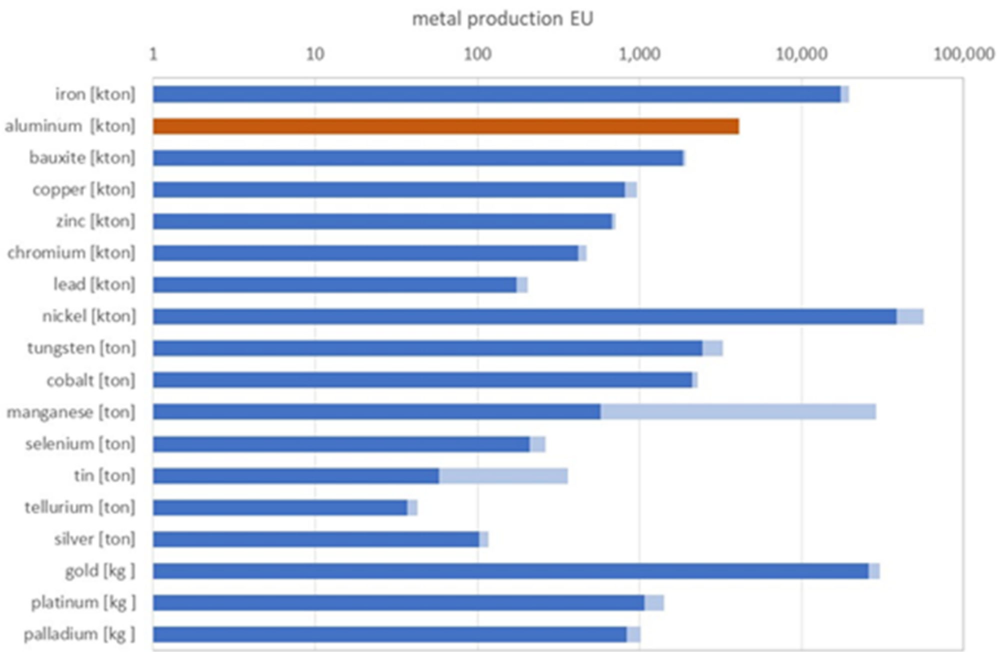

Figure 10: Amount of metal contained in the metallic mineral ores extracted within the EU (2015 – 2017). The estimate for aluminium also includes the metal content of bauxite that is imported into the EU for processing in one of the Al-refineries within the EU boundaries (World Mining Databases, USGS Minerals Yearbook and BGS World mineral statistics)

Table 5: Number of active metallic mineral mine sites per member state grouped by primary commodity (status 2017)

Country	Bau-xite	Copper	Lead – Zinc	Iron	Nickel	Chro-mium	Gold	Other	all
AT				1				1	2
BG		4	7				2	1	14
CY		1							1
CZ								1*	1
DE								1*	1
EL	18		3		11				32
ES		5					1	4	10
FI		3	1		1	1	5		11
HU	1								1
IE			1						1
PL		6	3						9
PT		2						2	4
RO		2							2

Country	Bau-xite	Copper	Lead – Zinc	Iron	Nickel	Chro-mium	Gold	Other	all
SE		1	6	5			2		14
SK							1		1
EU-27	19	24	21	6	12	1	11	11	104

* Recovery of uranium in the context of site remediation

Figure 11 shows the material flows for iron extraction in Europe. Iron extraction takes place in Austria and Sweden. About 75% of the ore is extracted in open pit mines. There is one large underground iron ore mine in Sweden and two with mixed surface and underground works. In the period 2015 – 2017, the total amount of rock that was annually extracted to produce the ore was on average 67.6 Mt. A small fraction of the side rock was used as aggregates. Processing of the ore produced 31.9 Mt of iron concentrate and about 6 Mton of tailings. The average concentrate over ore ratio is 84% (85% for the Swedish mines and 76% for the Austrian Erzberg mine) (SGU, 2017 & 2019; Erzberg, 2018).

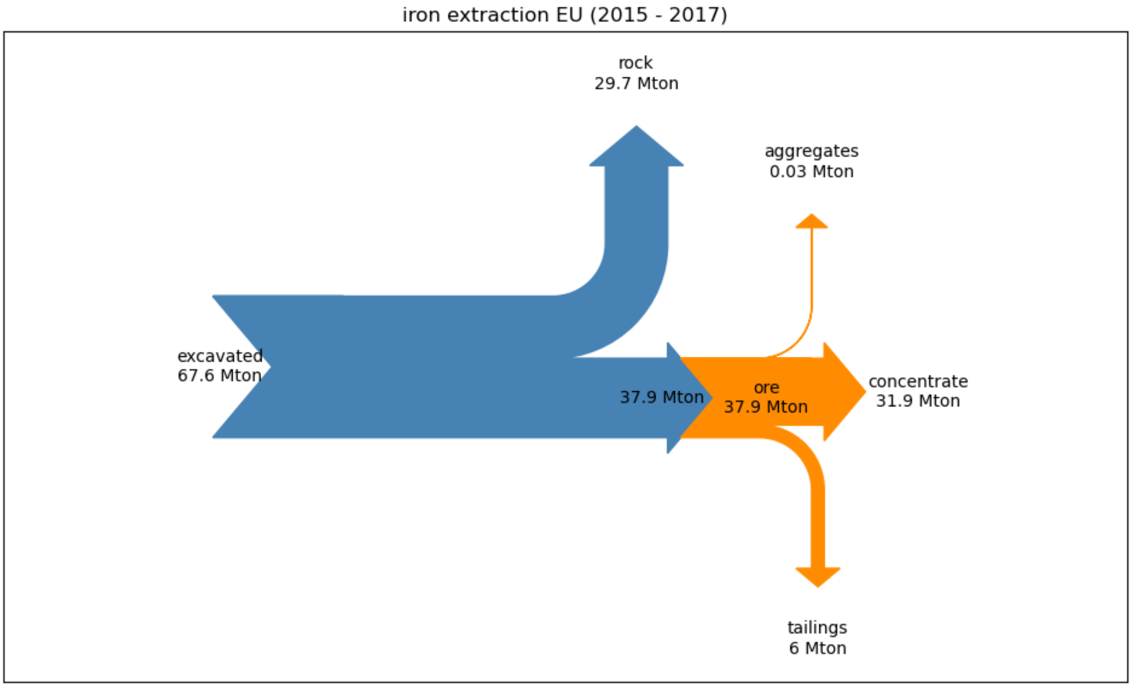

Figure 11: Material flows in iron extraction within the EU (SGU, 2017 & 2019; Erzberg, 2018)

Copper mining takes place in Bulgaria, Finland, Poland, Portugal, Romania, Spain and Sweden. In Cyprus copper is extracted from tailings at Skouriotissa. Figure 12 and Figure 13 show the material flows for copper mining in respectively Bulgaria and Finland. In Bulgaria, copper ore is mined in two large open pit mines and one underground mine. In the period 2015 – 2017, about 100 Mt of material was excavated each year to produce 26 Mt of ore. The ore was processed to produce 0.48 Mt of copper concentrate and 0.24 Mt of gold-bearing pyrite ore. Concentration of the ore generated about 25 Mt of tailings each year. The copper concentrate has a copper content between 16 and 25%. Part of the concentrate is further processed on-site to produce A-grade copper cathodes. In addition, the effluent of the tailings is hydrometallurgically treated to produce additional A-grade copper cathode.

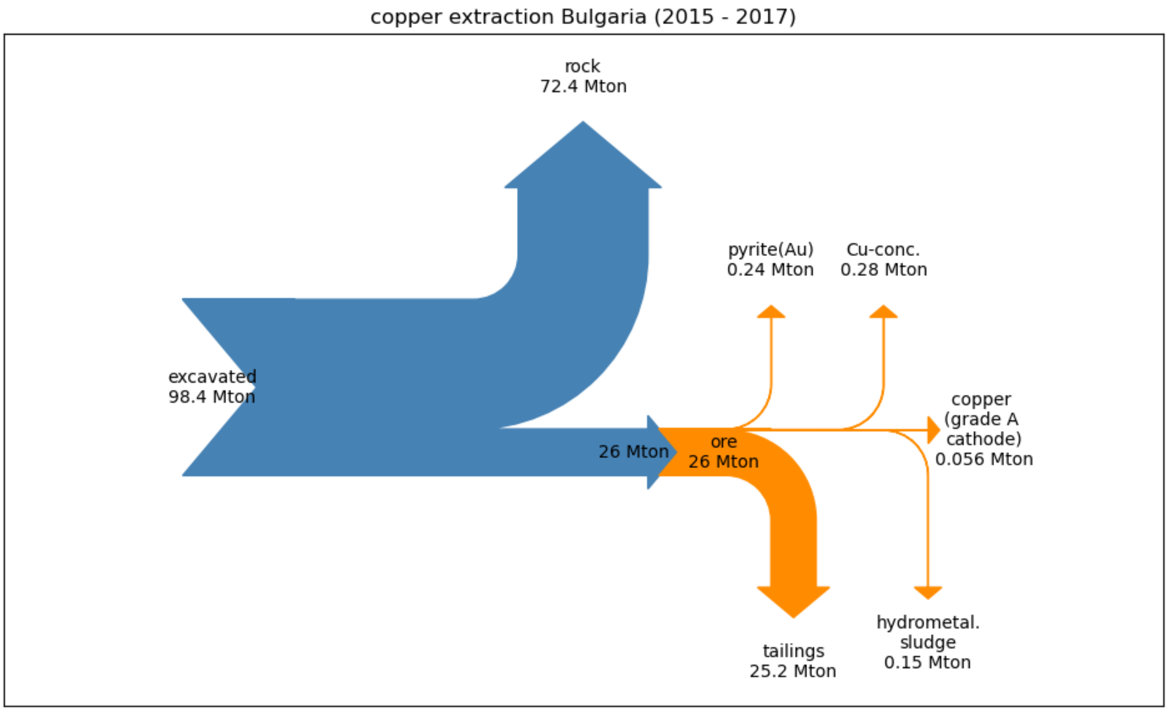

Figure 12: Material flows in copper extraction within the Bulgaria (see Annex H for references)

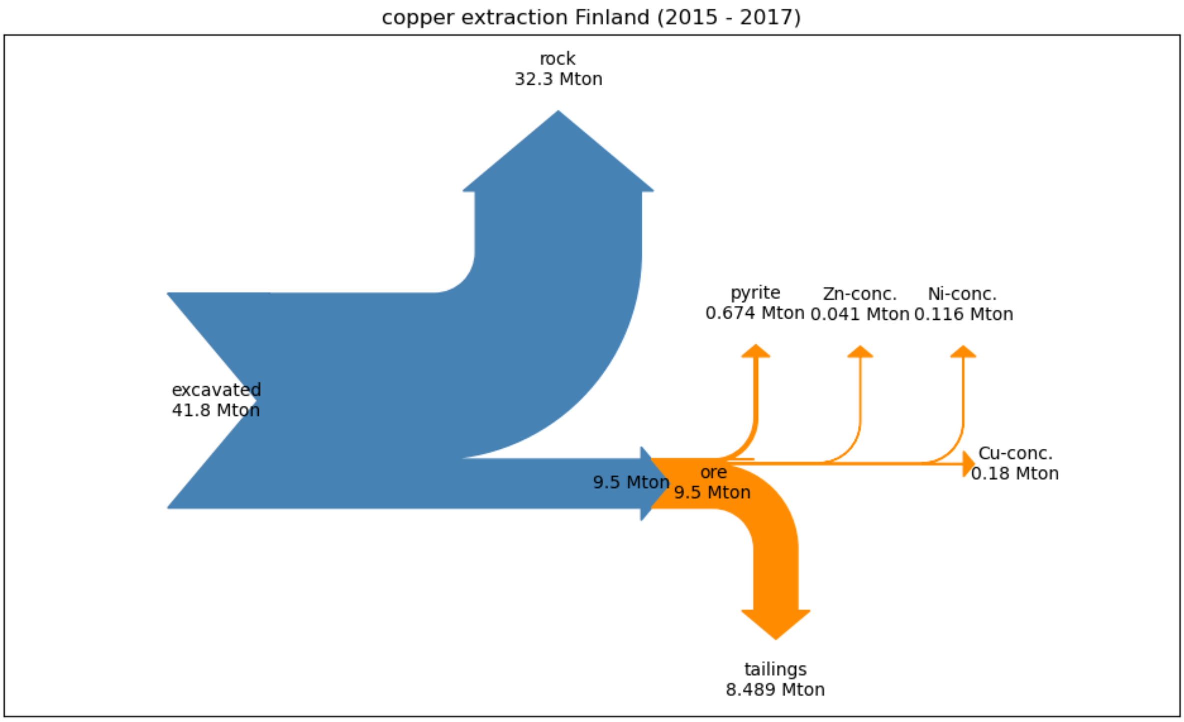

Figure 13: Material flows in copper extraction within the Finland (https://www.kaivosvastuu.fi)

In Finland, copper ore is extracted at three mines. In all cases, the ore is produced from polymetallic sulfide deposits. In the period from 2015 untill 2017, on average 41.8 Mt of material was extracted each year, resulting in 9.5 Mt of ore. The ore is further processed to produced different concentrates, including pyrite, gold-bearing pyrite, Zn(Pb)-concentrate, Ni-concentrate and Cu-concentrate (https://www.kaivosvastuu.fi). The Cu-concentrate has a copper content that varies between 13 and 30%. Concentration of the ore generated about 8.5 Mt of tailings each year.

3.1.3. IMPORTED METAL ORE IN THE EU

With regard to the import data for ore it is not possible, except for bauxite, to give a correct interpretation of the data reported and to deduce what percentage of imported materials relates to excavated material and not to already processed streams. Furthermore, statistics on the import of minerals mix data of imported ores, imported concentrates and metal content (Figure 14). Also, during the meeting with experts, no extra information could be obtained on the most relevant imported ores in the different MS.

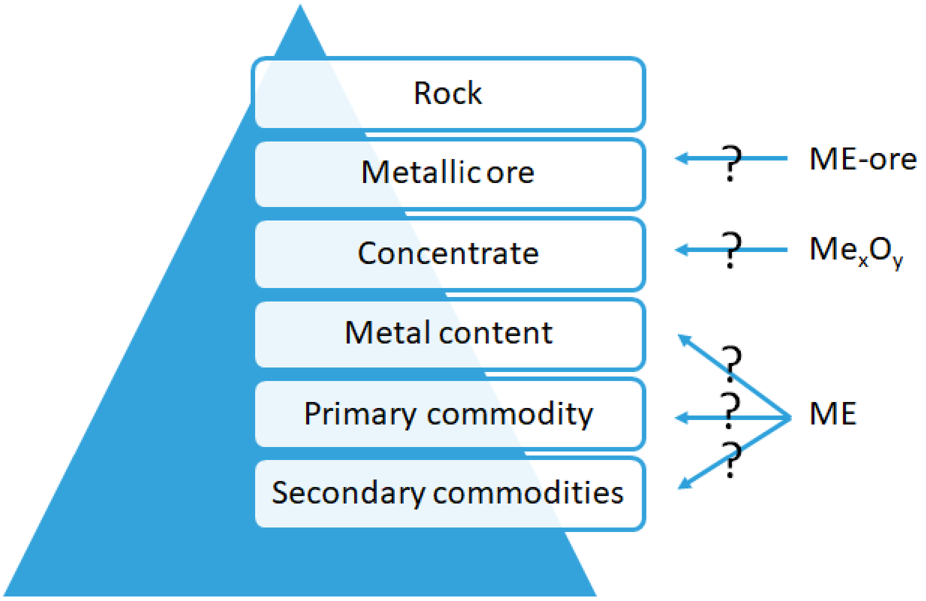

Figure 14: Schematic view on the difference in reporting of the metallic minerals (ME= metal) resulting in a difference of reported data

Eight bauxite/Al_2O_3 processing plants were identified, where extractive waste can be generated (Table 6; Figure 15). Production data per site are not available, data are related to the overall mine.

Table 6: Smelter-grade alumina refineries in the EU importing bauxite (European Aluminium)

Country	Name	Location	Alumina Annual Capacity kt
DE	Aluminium Oxid Stade GmbH[2]	Stade-Bützfleth	1,050
EL	Mytilineos S.A – Aluminium of Greece[3]	Agios Nikolaos, Distomo	850
ES	AWAC – San Ciprian alumina refinery	San Ciprian, Cervo	1,500
FR	Alteo – Gardanne	Gardanne	635
IE	Rusal Aughinish Ltd.	Aughinish	1,990
IT	Eurallumina - RUSAL	Portovesme	closed since 2006
RO	ALUM – Tulcea	Tulcea	500

[2] They process imported bauxite, but the resulting ‚red mud'-tailings are not reported as EW, but as hazardous industrial waste.
[3] Aluminium of Greece uses as raw material the domestic bauxite produced from the mines near the plant (diasporic bauxite). There is an additional 20% of the treated bauxite that it is imported (gibbsitic bauxite).

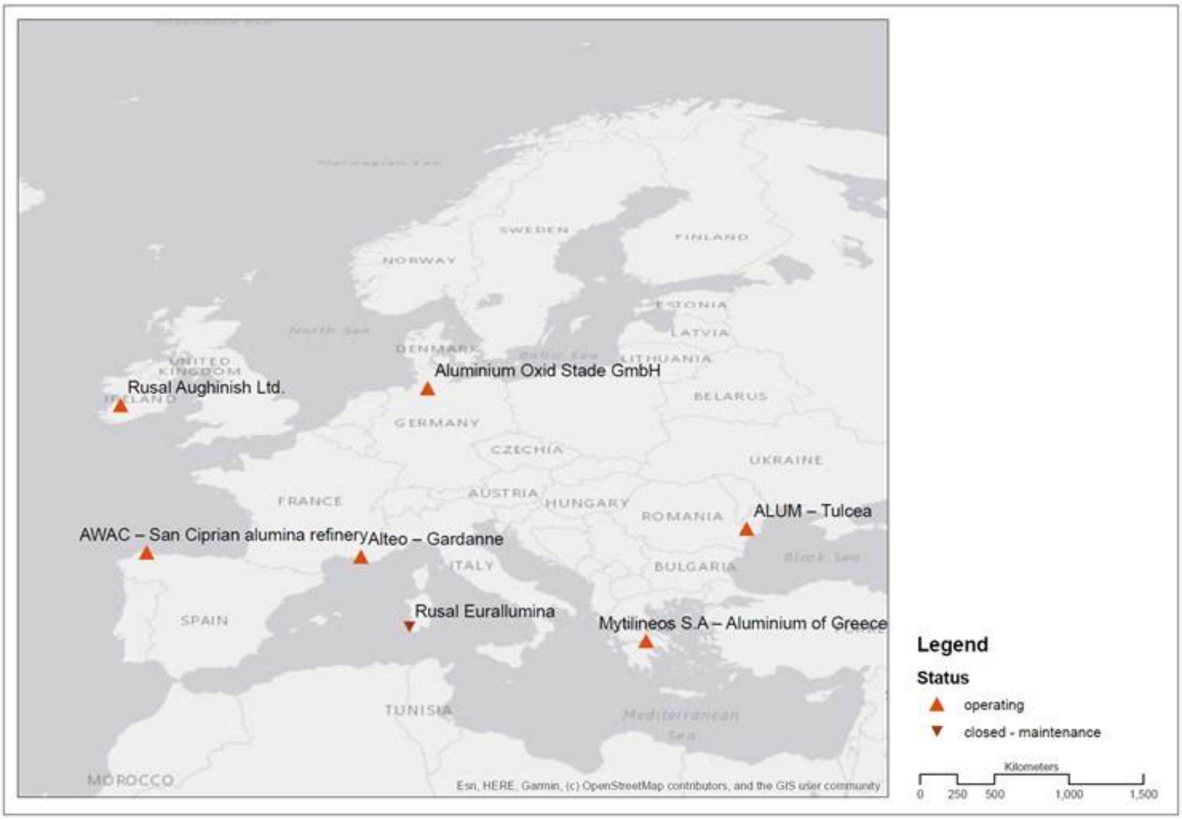

Figure 15: Location of Aluminum production plants importing bauxite (https://www.european-aluminium.eu)

3.1.4. ENERGY MINERALS EXTRACTION IN THE EU

The onshore energy minerals are classified into "Oil & Gas", "oil shale" and solid minerals "Coal, Lignite and peat". Domestic extraction records material flows from the environment to the economy as solid, liquid and gaseous fossil mineral fuels, extracted in underground or open-cast mining, and from of petroleum and natural gas fields. Extraction of oil-shale and -sands is included. These fossil fuels are the basic fuel for the world's energy economy. Coal accounted for more than half of the total of fossil energy carriers, followed by natural gas (about 30%) and oil (about 20%). The extraction of peat has only regional significance in some European Union countries (UNEP, 2021).

→ **Oil & Gas**

The onshore production of oil in the EU[4] is relatively small compared to the offshore production. Figure 16 gives an overview of the oil & gas production in 2016 in the EU-27. For 2016, France and Hungary report both 6,77 Mt, Italy 3,74 Mt, Romania 3,69 Mt and Germany 2,36 Mt. By far the biggest onshore gas producer in the EU are the Netherlands with 80 000 Mm^3 in 2008 and over 50.000 Mm^3 in 2016, mainly produced from the large Groningen gas field. The gas production in the Netherlands will further decrease in the coming years. Romania (10.000 Mm^3), Germany (8.600 Mm^3) and Poland (5.500 Mm^3) are the other important on-shore gas producers in the EU. Details are given in Annex I.

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[4] References (links see Annex B): BGS – world mineral statistics 2008-2017, OECD_CrudeOil_Proddata, IGME, 2015-2017 (Panorama Minero), USGS Min. 2012-2016, Mining Departments of Ministries and geological surveys of Member States (MS)

Reliable data for the number of oil and gas production wells are lacking for most Member States (except the Netherlands, Germany and Italy) (Table 7).

Table 7: Number of production wells for oil and gas (2016)

	Oil wells	Gas wells	Reference
Netherlands	60	696	NLOG
Italy	100	375	Assomineraria (2017)
Germany	991	469	BMWE (2018)

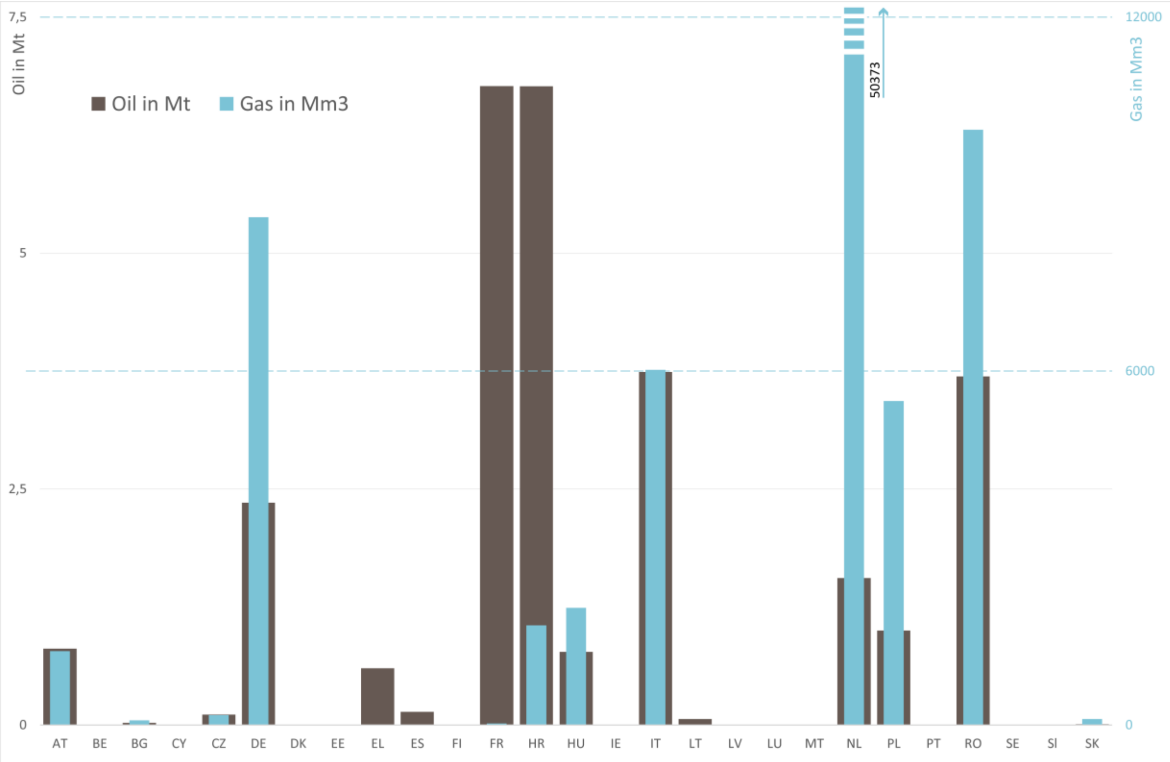

Figure 16: Overview of energy minerals "oil & gas" for the 27 Member States in 2016 (in Mt for oil, and Mm³ for gas) (references BGS – world mineral statistics 2008-2017, OECD_CrudeOil_Proddata, IGME, 2015-2017 (Panorama Minero), USGS Min. 2012-2016, Mining Departments of Ministries and geological surveys of Member States (MS)

→ Oil shale

Oil-shale is a sedimentary rock containing up to 50% kerogen, a solid mixture of organic chemical compounds. Massive deposits are found in a number of countries around the globe, including Estonia, but most are too deep or too costly to be exploited. Today, only China and Estonia produce oil-shale commercially as fuel. In Estonia four oil-shale mining companies hold excavation permits: the state-owned Eesti Energia Kaevandused (part of the Eesti Energia Group, 88% of total production in the country in 2012) and three private firms (OECD, 2017).

Oil-shale in Estonia is produced mainly from three large open pit mines (Narva, Põhja-Kiviõli, Ubja) and one underground mine (Ojamaa). Due to the low yield, there is no oil-shale production in Austria for commercial use in the energy sector. Shale oil is applied only for medical and cosmetic purposes (BWMFW, 2016; 2017). An overview of the oil-shale production in the EU is given in (Table 8).

Although USGS reports production data for France (estimates) no oil shale production takes place in in this country. Furthermore, also Germany reports small volumes of oil-shale extraction (0,493 Mt for 2016; BGR, 2017). In Germany, however, oil-shale is being extracted from the so-called "Ostfeld" near the Dormettingen community since summer 2018 (https://www.holcim.de/de/oelschieferbruch-dormettingen). The material is the most important component for the cement Optimo, a Portland composite. Its use is attractive due to little additional energy needed in the kiln. Reported data are most probably related to prospection activities.

Table 8: Oil shale, Overview of the production for the 27 Memberstates in 2016 (Details are given in Annex I)

Oil shale (Mt)	2016	Production sites	Application
Austria (t)	169	2	Medical & cosmetic use
Estonia (Mt)	16		Energy production

→ **Coal and lignite**

Although the production of coal has substantially reduced in most of the European countries, there are still 94 coal mines in seven MSs (
Table 9) with a combined annual ouput of approximately 72,25 million tonnes of coal in 2016. An overview of the production data for energy minerals minerals covering 2015 – 2017 is given in Annex I.

Lower grades of coal, with a calorific value less than 24 MJ/kg, are classified as brown coal divided into subbituminous coal (hard form, with calorific value above 17.5 MJ/kg) and lignite (soft form, with calorific value below 17.5 MJ/kg). In many countries lignite is one of the most common and inexpensive sources of energy. It is usually consumed directly at nearby power stations, while its use as domestic fuel has largely disappeared.

Figure 17 gives an overview of the solid energy minerals "coal and lignite"[5]. In recent decades, there has been a very significant decline in coal production in the EU. Most striking example is Germany, where 191 Mt was produced in 2008, but only 3,9 Mt were still produced in 2016. In Germany, the last mine closed in 2018. Poland is now the biggest producer with 84,25 Mt in 2008 and 57,58 Mt in 2016. The Czech Republic reports a coal production of 12,2 Mt in 2008, 6,07 Mt in 2016, and 4,87 Mt for 2017. Spain reported 1,4 Mt coal in 2016 (and 3 Mt in 2017). In many EU countries production of coal stopped completely over the last decades, whereas this is not the case for lignite.

Lignite and brown coal are produced in 62 mines in nine Member States (
Table 9) with a combined annual production of 370,89 Mt in 2016. While Spain and Italy produce exclusively hard coal, Slovakia, Slovenia, Hungary and Greece produce only lignite and/or brown coal. ForBulgaria, hard coal production has been reported as a by-product in lignite production. The largest lignite mines are located in Poland, Germany, Bulgaria and Romania. The largest hard coal mines are located in Poland and the Czech Republic.

Table 9: Number of Hard Coal and Lignite-Brown Coal mines in 11 Member States in 2015

	Hard Coal	Lignite - Brown Coal	Country Total	Reference

[5] Sources (links see annex B): BGS – world mineral statistics 2008-2017; BGS WMP, 2018; CGS site; EURACOAL Statistics; IGME, 2017; USGS Min. 2012 – 2016; Mining Departments of Ministries and geological surveys of Member States (MS)

Country				
Bulgaria	8	4	12	Alves Dias et al. (2018)
Czech Republic	8	9	17	CGS (2019)
Germany	3	13	16	BMWE (2016; 2018)
Greece	-	9	9	Alves Dias et al. (2018)
Hungary	1	7	8	HGS (2019)
Italy	1	-	1	Alves Dias et al. (2018)
Poland	51	9	60	PIG-PIB (2016, 2017, 2018)
Romania	1	6	7	Alves Dias et al. (2018)
Slovakia	-	4	4	Alves Dias et al. (2018)
Slovenia	-	1	1	Statista
Spain	21	-	21	IGME (2017)
Total	**94**	**62**	**156**	

Lignite (or 'brown coal') production in Germany, the biggest producer in the EU, is decreasing less than hard coal production, with 175 Mt in 2008 and 171 Mt in 2016. Production in Poland remains stable 59 Mt (2008) – 60 Mt (2016). The Czech Republic produced 45 Mt in 2009 compared to 38 Mt in 2016. In Greece, the production decreased by 50% from 64 Mt in 2008 to 32 Mt in 2016. Bulgaria produced 26 Mt in 2008 and 29 Mt in 2016. Romania produced 34 Mt in 2008 and decreased to 22 Mt in 2016. Hungary, Slovenia and Slovakia produced 9, 3,3 and 1,8 Mt respectively. Italy is the smallest producer with 0,06 Mt.

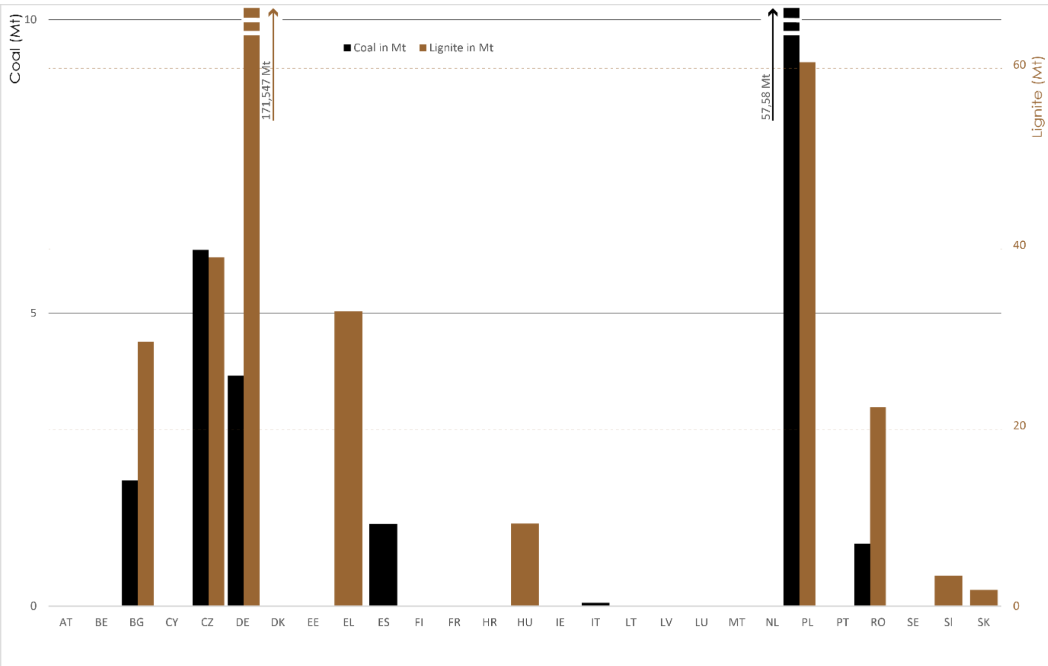

Figure 17: Production data of solid energy minerals coal and lignite for the 27 Member States in 2016 (in Mt)

→ **Peat**

As a fuel for general use, peat is only used in significant quantities in regions with extensive moorland. In Europe, these are primarily Scandinavia (Finland, Sweden), Ireland and the Baltic States (Estonia, Latvia, Lithuania).

In the different sets of source data, figures for peat are reported in Mm^3 or in Mt. The data are presented in Figure 18. In this study, we applied a conversion of 250 kg/m^3 for the data reported in Mm^3, but the true density depends on the water content. Next to peat harvested for energy production, a larger amount is harvested for horticultural use. The production numbers given here are specific for energy production.
Finland is the main producer of fuel peat at 16 Mt. For Ireland there is an important difference between the 0,679 Mt reported by SEAI (Sustainable Energy Authority of Ireland) and 3,7 Mt reported by USGS (website, data 2016)
and Estonia 0,0807 Mt (USGS website, data 2016). For Latvia, 0,813 Mt are reported by the Latvian Peat Association (LPA, 2017; 2018) and 1,76 Mt by USGS (2016). For Poland 0,893 Mt are reported. For Sweden 1,407 Mt are given by SCB (2020).

In Germany, Denmark, Hungary and Spain peat production is only related to horticultural use (Stenild et al., 2010; USGS, 2018; Industrieverband Garten e.V., 2021[6]).Also in Poland, since many years peat is no longer used as a fuel. Depending on its physico-chemical properties its is used in agriculture, horticulture, balneology, medicines and as therapeuthical mud (PGI website peat http://geoportal.pgi.gov.pl/surowce/skalne/torfy).

Table 10 shows numbers of peat extraction sites. Reporting, however, is sometimes found in number of hectares, rather than as concessions/quarries. Furthermore it is not always clear whether the numbers refer to the extraction of energy peat or horticultural peat or both.

[6] Mail d.d. 01/06/2021

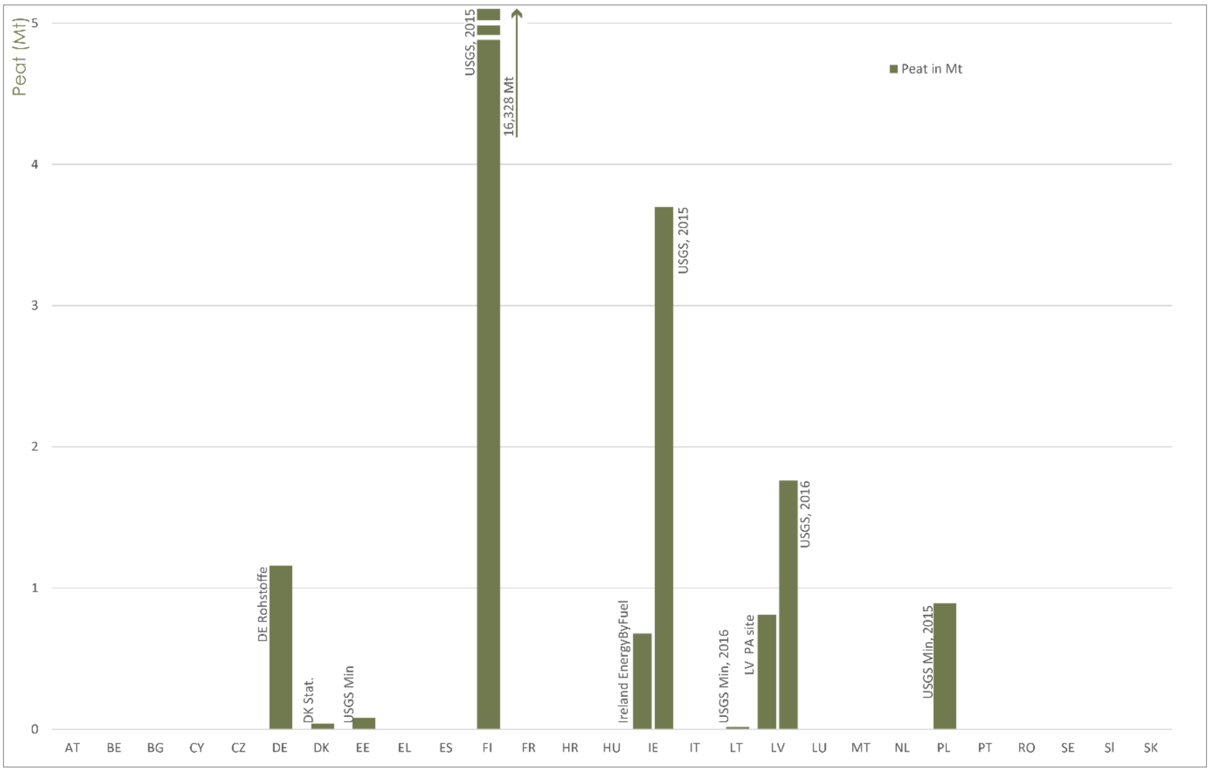

Figure 18: Peat, production data for the 27 Member States collected from different sources (2016) (For more details: see Annex I)

Table 10: Peat, overview of the number of peat extraction sites in the EU (peat as energy mineral)

Country	Commodity	number of production sites			Reference	JRC (2021)
		2015	2016	2017		2018
EE	Peat		266		Niitlaan (2017)	26
FI	Peat					606
IE	Peat					3
LT	Peat		68		Januska (2016)	8
LV	Peat		96		Krigere (2017)	3
SE	Peat	84	79	63	SGU (2018)	40*

3.2. Generation of extractive waste

3.2.1. Introduction

Whereas in national and EU statistics, Eurostat and MSs data are based on Regulation (EC) 2150/2002 on waste statistics and its amending Regulation (EU) No 849/2010 (EC, 2020), MSs are obliged to report statistical data on waste generation and waste treatment according to the statistical waste nomenclature EWC-Stat (European Waste Classification for Statistics). The EWC-Stat is a mainly substance-oriented aggregation of the waste types defined in the European List of Wastes (LoW). The result is a relationship between EWC-Stat and European LoW that allows for the unambiguous conversion of the LoW waste types into the EWC-Stat waste categories (Eurostat, 2010). The current LoW was published in the Commission Decision 2014/955/EU (EC, 2014a) and is aligned with developments in EU chemicals legislation that aims to ensure a high level of protection of human health and the environment. According to the Eurostat guidance on the classification of waste using EWC-Stat categories published in 2010, the EWC-Stat has to be used for the reporting of data to

Eurostat but it does not prescribe a specific classification to be used for data collection. Technical guidance on certain aspects of LoW was given by the EC in the Commission notice on the classification of waste (EC, 2018) to support the correct interpretation and application of relevant EU legislation on the classification of waste. MSs are free to use any waste classification as long as they can use defined formats. MSs can even collect their data according to the LoW and subsequently convert them into the required EWC-Stat-categories. The discussion on this issue was presented in the Report from the Commission to the European Parliament and the Council on statistics compiled pursuant to Regulation (EC) No 2150/2002 on waste statistics and their quality (EC, 2020), which concluded that significant progress had been made in compiling waste statistics since 2016. The completeness of data delivered by MSs has steadily improved in that time. However, in the new report the 2016 statement was repeated, that mineral waste is relatively minor, but together with extractive waste makes up a large proportion of all waste. For this reason, the Commission (Eurostat) has developed waste-related indicators excluding major mineral wastes. As indicated in Figure 19, the total amount of waste generated in 2016 in the EU countries by “mining and quarrying” was 633 million tons (Mt), out of which five MSs generated 83.2%. The largest contributions came from Romania (24.3%), Sweden (17.3%), Bulgaria (15.6%), Finland (14.8%) and Poland (11.2%) (Table 11).

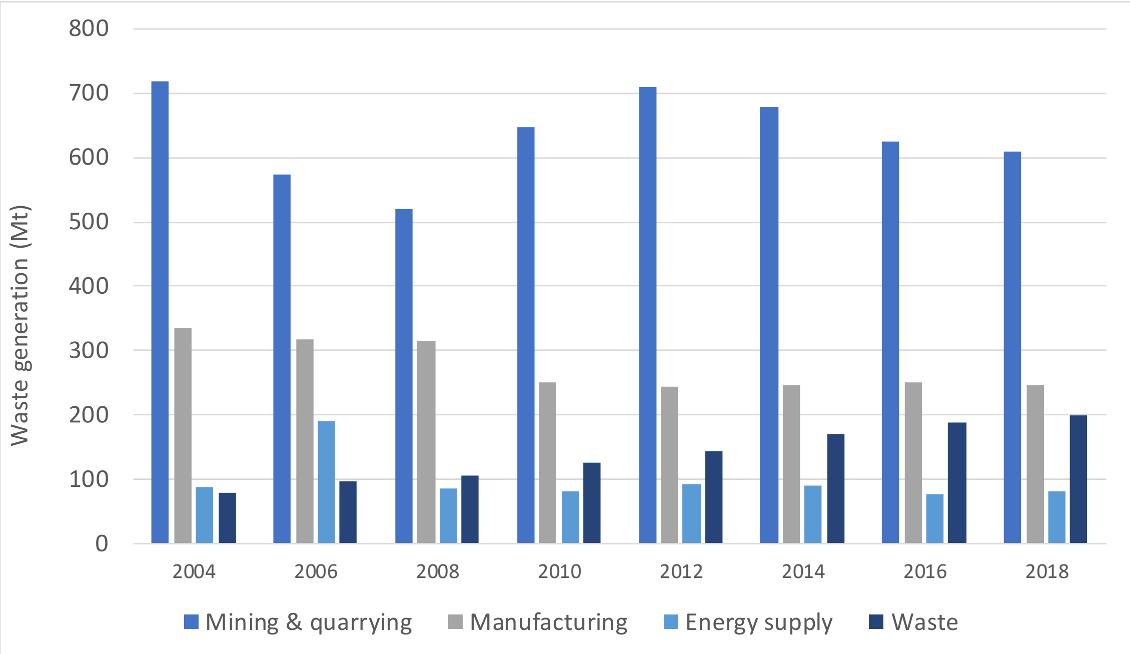

Figure 19: Annual waste generation from four aggregated industrial sectors (Eurostat, 2020)

Table 11: Waste from mining and quarrying in the EU and selected countries (Eurostat, 2020)

Country	**2012**		**2014**		**2016**		**2018**	
	Mt	**%**	**Mt**	**%**	**Mt**	**%**	**Mt**	**%**
EU (27 countries), incl.:	709,9	100,0	679,0	100,0	624,0	100,0	608,3	100,0
Bulgaria	141,1	19,9	159,3	23,5	98,7	15,8	106,9	17,6
Poland	68,0	9,6	75,7	11,1	70,7	11,3	64,3	10,6
Romania	223,3	31,5	152,8	22,5	153,9	24,7	178,6	29,4
Finland	52,9	7,5	62,8	9,2	93,7	15,0	96,1	15,8
Sweden	129,5	18,2	138,9	20,5	109,7	17,6	103,6	17,0

Mt = million tons

According to information from the European Environment Agency (EEA, 2020) 96% of the extractive waste is non-hazardous solid mineral waste (Figure 20). The remaining 4% are hazardous extractive waste (e.g. from processing mineral resources or from extraction of oil and gas). The EEA hosts the European Pollutant and Transfer Register (E-PRTR), but the E-PRTR only gathers data on off-site waste transfers (as opposed to waste managed on-site). So, E-PRTR is not an appropriate reference for verification of a complete dataset on hazardous waste generated.

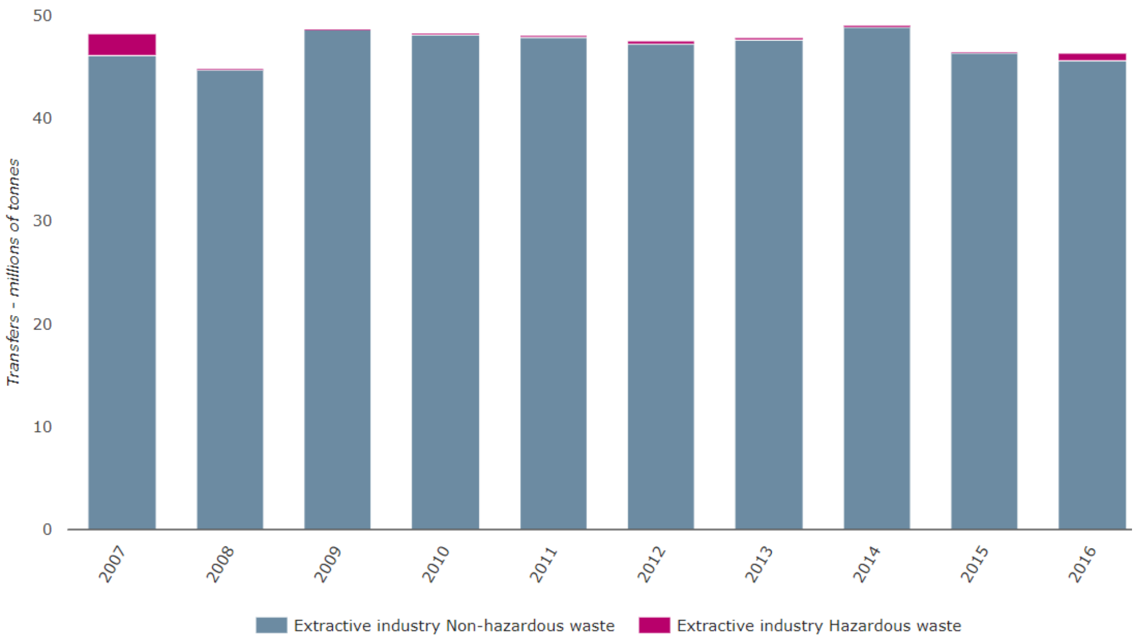

Figure 20: Extractive industry, total reported tonnage of hazardous and non-hazardous waste from (EEA, 2020)

3.2.2. DATA COLLECTION – WASTE CLASSIFICATION

Many efforts were made to collect as much original data on extractive waste as possible, unfortunately data on extractive waste generated in individual MSs according to the LoW are not easy to retrieve or are not available at all. A conclusion which was already made by Twardowska et al. (2004). For Poland, and for many MSs in the EU, only general data without division to waste codes is available from National Central Statistical Offices.

Although alternative sources of data are available, these are not always coherent (Kulczycka et al., 2019). Causes of inconsistencies are:

1. Reporting at different administrative levels:
   Reporting of extractive waste is handled at different administrative levels in the MSs resulting in aggregated data at national (e.g per entity / holding company), regional (e.g. Polish Voivodship) or even local level, which does not allow tracing back from national level. In some MSs reporting to national government bodies is limited to only hazardous wastes.
2. Discrepancies between number of mines and EWF:
   Many mine sites may deposit their waste into one EWF (e.g. Renström, Kristineberg, Kankberg and Maurliden in Sweden). Or, vice versa, a single mine may exploit more than one deposit (e.g. KGHM in Poland) and/or make use of more than one EWF (e.g. Kittilä gold mine in Finland).
3. The different types, amounts and properties of waste generated at extraction sites depend on the resources being mined, the process technology used and the local geology. Different

geological and mineralogical conditions mean that waste volumes cannot be conclusively extrapolated from the volumes of primary extraction.

4. The generation of different types of waste during each stage of the mining project life-cycle.
5. The application of different standards for the reporting of extractive waste depending on MSs' legislation (statistics offices, regional and EU database) (see discussion chapter 4.4). Most publications and reports on waste from extractive industries rely on Eurostat data defined as 'waste from mining and quarrying' (in total tonnes, Mg or kg/per capita). Eurostat entries for waste, however, do not line up exactly with the definitions of the EWD. For example, Eurostat reports 'waste from mining & quarrying', 'hazardous waste' and 'mineral & solidified waste', all of which most likely include a mix of extractive waste and other waste because of misaligned definitions. The LoW does not distinguish between 'inert waste' and 'non-inert waste' or 'reactive waste' and 'non-reactive waste'.
   Some MSs use additional national sub-lists (8-digit codes). For instance, in Poland there is an additional number to the waste code including the number 80 as the 5th and 6th digits, i.e. 100980 – discarded cast iron products or as the 3rd and 4th digits, i.e. 1080 – waste from ferroalloys production followed by 108001 – slags from the production of ferrosilicon.
   Furthermore, several unofficial systems for mining waste exist. Each system has its own unique classification, harmonisation, collecting and reporting tools - the input datasets in existing systems are scarce, dispersed and non-comparable (Bide et al., 2017).
6. EU waste codes cover extraction of different types of minerals:
   It is difficult to separate data for individual minerals (construction, energy, industrial, metallic). Some minerals occur together geologically and are processed jointly or in consecutive processes. Waste from these processes cannot be easily allocated to production of individual commodities, i.e. copper or zinc. Additionally, waste from production of primary and secondary raw materials (e.g. from mine tailings) is not reported separately.
7. Implementation of the concepts of Circular Economy:
   Some MSs have implemented "Circular Economy" concepts and encouraged the re-use of materials previously considered discarded, in which case the materials are no longer considered wastes and do not therefore appear in the statistics.

To overcome these inconsistencies the following additional actions are needed:

1. Analysis about legal assessment when "waste/run of mine/co-by-product" not reported as a waste;
2. Unification of presented data to get consistency in all databases (Eurostat, National Statistical Office, regional offices);
3. Mechanism of introducing additional waste codes on the country level to avoid reducing waste levels in other categories;
4. The change of waste codes to separate data for individual raw materials (coal and industrial minerals);
5. More detailed data about extraction waste given by companies - also for deposits and mines (1 company often more then 1 deposit and 1 mine);
6. Additional information in waste generation statistics - from primary or secondary sources; and,
7. Technical rules that determine the criteria of losing the status of waste have not been established so far and need to be carried out.

Based on the example of Poland, the collection of data related to a waste code at the level of each mining company can be recommended. These data should be made available to the public through data platforms (e.g. Eurostat) to come to a proper waste management. The Polish extractive waste reporting methodology (Kulczycka et al., 2019) is decribed in Annex J.

3.2.3. PROCESSING OF INDUSTRIAL MINERALS

Based on the statistics and a scientific and technical assessment of current practices of processing industrial minerals the life cycle of individual minerals has been analysed to define types of wastes that can arise during the extraction process.

→ **Barite**

Barite is a naturally occurring mineral ($BaSO_4$), mainly present in stratiform deposits, as well as vein and residual deposits. Extraction of natural barite occurs through surface and underground mining. After extraction, it is usually sorted (physical separation from other compounds, flotation methods) and crushed on or near the mining site, to obtain ground barite, micronized barite, barite aggregate, etc. In the majority of cases, barite produced at the mine site is sold as ground material, i.e. directly manufactured as a final product.

Barite is the main industrial source of barium. It is mainly used as an industrial mineral, with the use of barium metal remaining minor. Various compounds are used in the manufacturing of end-products. The main end-use of Barite is in the oil and gas industry (as weighting agent in drilling fluid). Barite is used, to a lesser extent, in the rubber, plastic and paint industries (as heavy filler) and in chemical (including paints, for its brightness and colour) and medical (x-ray contrasting agent) applications.

Identified global resources of Barite are estimated to be around 740 million tonnes, and USGS estimated total resources of Barite (identified or not) around 2 billion tonnes. Barite reserves in the EU are estimated at 13.8 million tonnes, with Bulgaria accounting for up to 5% of global reserves . Other countries with barite reserves are France, Germany, as well as Slovakia and Croatia. The top producer countries are China (38%), India (12%), Morocco (10%) and Iran (8%). In the EU 27, the production of primary barite is located in Bulgaria, Germany and Slovakia (respectively 41%, 40% and 19% of the European production in 2016). Italy was also a producer of primary barite until 2011. The Minerals4EU project (http://www.minerals4eu.eu) provides quantified data at MS level, but does not provide a complete figure at EU level. The database includes estimates based on information from operators, using various reporting codes, and non-comparable datasets (e.g. historic estimates, inferred reserves, etc.) (Matos et al., 2021).

Estimates of total excavation and waste based on the production of Barite is presented in Table 12.

Table 12: Estimation of total excavation and waste based on production of Barite

Barite (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Bulgaria	0,060	0,070	0,080	0,070	0,077	0,014	0,161
Germany	0,045	0,049	0,034	0,043	0,047	0,009	0,098
Slovakia	0,020	0,025	0,016	0,020	0,022	0,004	0,047
EU 27 total	**0,125**	**0,144**	**0,130**	**0,133**	**0,146**	**0,027**	**0,306**

[a] Rock = Average Stripping Ratio * Average Production
[b] Total Excavated Material = Rock + Average Production + Tailings
[c] Tailings = Ratio * Average production

Waste arising from barites production is mainly results from grinding and milling and due to some cleaning treatment, mostly filter dust. If barite is produced from primary deposits, there is probably nearly no waste due to them being pure (90-95%) minerals. There is a substantial number of sulfide base metal deposits containing barite in addition to copper, lead, zinc, and pyrite. The grade of barite in such deposits ranges from 20 to 45% $BaSO_4$.

The Bulgarian Barite Mining EOOD (RUA Group) extracts raw materials for the production of iron and barite concentrate from a former tailings pond.

Figure 21 shows the material flows for Barite extraction in Germany.

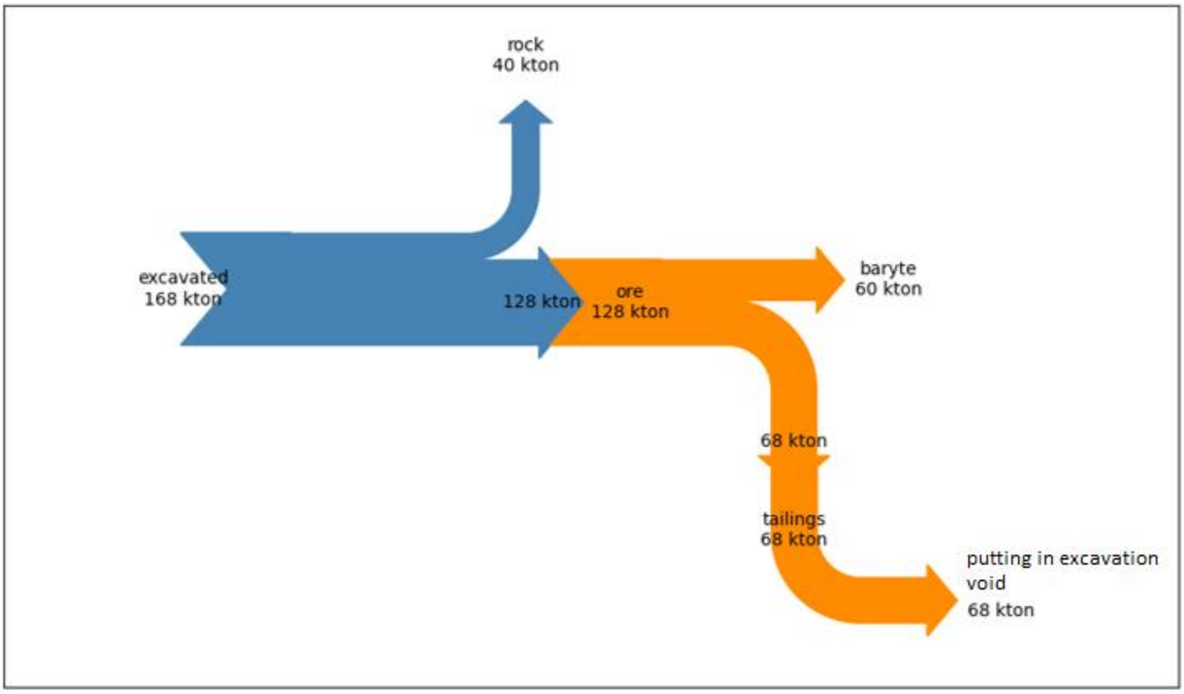

Figure 21: Material flows for Barite extraction in Germany

→ **Bentonite**

Bentonite clay is composed predominantly of the clay mineral smectite, usually montmorillonite. According to the MWEI BREF and confirmed by the production data compiled in this study, the leading producers in EU-27 are Greece, Germany, the Czech Republic and Slovakia (Garbarino et al., 2018). In statistics, bentonite may be grouped together with other clays under the heading 'industrial or special clays'.

Estimates of total excavation and waste based on production of bentonite are presented in Table 13, whereas the material flows for bentonite extraction in Europe are shown in Figure 22.

Table 13: Estimation of total excavation and waste based on production of bentonite

Bentonite (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Bulgaria	0,062	0,037	0,054	0,051	0,036	0,000	0,087
Cyprus	0,129	0,119	0,098	0,115	0,081	0,000	0,196
Czech Republik	0,369	0,374	0,254	0,332	0,233	0,000	0,565
Denmark	0,054	0,066	0,070	0,064	0,044	0,000	0,108
France	0,036	0,043	0,024	0,034	0,024	0,000	0,058
Germany	0,393	0,393	0,416	0,401	0,280	0,000	0,681
Greece[a]	1,123	0,883	1,088	1,032	0,722	0,000	1,754
Hungary	0,014	0,020	0,035	0,023	0,016	0,000	0,039
Italy	0,013	0,046	0,086	0,048	0,034	0,000	0,082
Poland	0,000	0,001	0,000	0,000	0,000	0,000	0,001
Romania	0,019	0,027	0,034	0,027	0,019	0,000	0,046
Slovakia	0,205	0,158	0,226	0,196	0,137	0,000	0,334
Spain	0,101	0,155	0,178	0,145	0,101	0,000	0,246
EU 27 total	**2,519**	**2,322**	**2,563**	**2,468**	**1,728**	**0,000**	**4,196**

[a] Bentonite crude
[b] Rock = Average Stripping Ratio * Average Production
[c] Total Excavated Material = Rock + Average Production + Tailings
[d] Tailings = Ratio * Average production

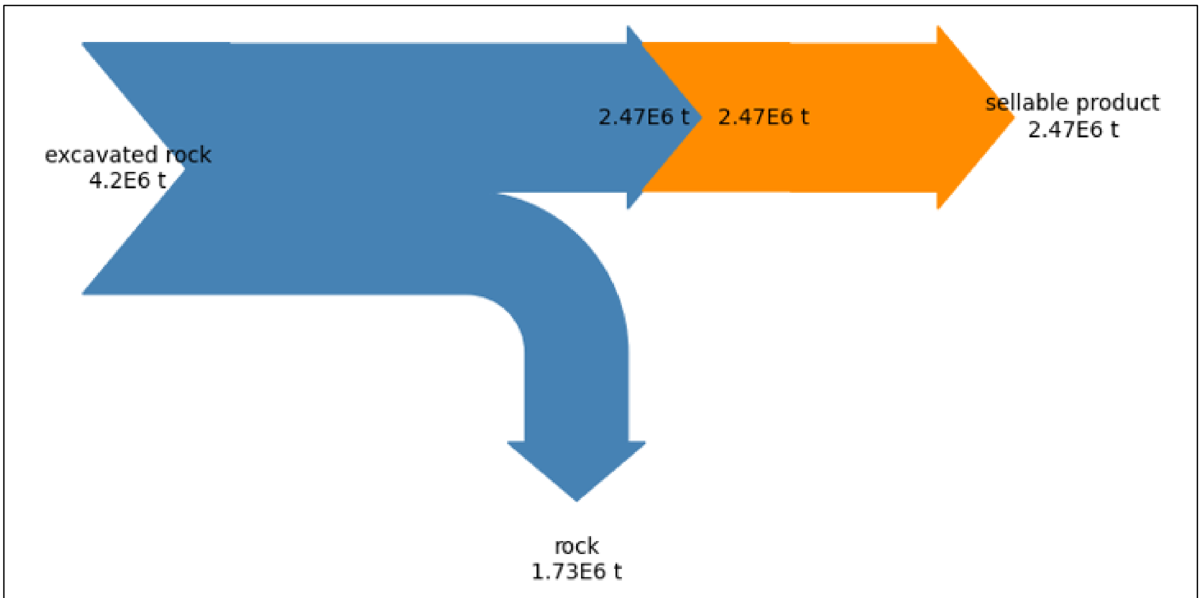

Figure 22: Material flows for bentonite extraction in EU-27

In Greece, the main European producer, the extraction and the processing of bentonite takes place on Milos Island. There are five major quarries, nl. Aggeria, Aspro Chorio, Agia Irini, Zoulia and Koufi (Hellenic Ministry of Environment and Energy, latomet.gr). Taking into consideration the Decision on Approval of Environmental Terms published by the Hellenic Ministry of the Environment and Energy on 2nd of May 2012 (valid for ten years) (ADA[7] B49H0-ΦΑΗ) the quarry Aggeria has been licensed to operate two Extractive Waste Facilities (Grilia and Roussou). The extractive waste that is generated from the excavation process is assigned under the waste code 01 01 02 wastes from mineral non-metalliferous excavation (Decision 955/2014/EU). The extractive waste generated by the excavation is assigned the waste code 01 01 02 (wastes from mineral non-metalliferous excavation, Decision 955/2014/EU). This waste is classified as inert. Part of the ‘waste’ is used for filling-in excavation voids (which is not considered ‘waste’) and when this is not technically feasible, the resmaining amounts will be deposited into the extractive waste facilities (both are classified as non-Category A Facilities).

In all the operating quarries the overburden has already been removed and as a consequence, the stripping ratio is near 0.1:1.

The processiong of raw bentonite includes: (a) milling and activation of bentonite with soda, (b) drying, and (c) storage of the product. The current waste generation is minor and only marketable amounts are produced, as the quarries were developed 20 years ago and most of the overburden has already been removed. However, there are a few cases that the product does not meet the market specifications and it has to be considered waste. Taking into consideration the ‘Decision on Approval of Environmental Terms’ by the Hellenic Ministry of the Environment and Energy (ADA 4I090-Z1[1]) it is estimated that 2000 t of non-marketable bentonite have to be considered inert extractive waste and are used inside the quarries for remediation purposes.

In a report of the Hellenic Ministry of Environment and Energy[8] for the year 2015 production data for bentonite as primary mineral and final product where published (Table 14).

Table 14: Production of bentonite in Greece between 2015-2016

Mineral	Production 2015 (Mt)	Production 2016 (Mt)
Betonite (primary mineral)	1,123	0,883
Betonite (final product)	0,808	0,683

However, it should be highlighted that the difference in tonnage between final product and primary mineral is also related to the removal of water. The moisture content of the primary material is about 30% and in the final product it is reduced to 13%.

The Czech Republic ranks among the top European clay and bentonite producers, from the areas of Tertiary volcanism in the western and North-western parts of the country, where bentonite deposits are extracted by open pits (quarries). Most of the Czech bentonite deposits have a thin overburden, usually ranging between 1 and 3 m. The extracted materials are deposited on storage heaps, from which the required amounts are taken for subsequent processing and commodity production. The raw material is processed in the Obrnice and Prunéřov plants (The KERAMOST a.s.). In addition, secondary bentonite (montmorillonite clay) has been also produced since 2004 from the overburden (average thickness 2–10 m) of majority of the active kaolin deposits, mainly for cat litter production. Since 2017 almost one half of the Czech bentonite production comes from this source (Starý et al., 2021).

[7] ADA it is the code of the Hellenic Transparency Program, by which all the administrative acts and decisions are valid if they are published online
[8] Hellenic Ministry of Environment, Energy (latomet.gr)

→ **Diatomite**

Diatomite is a powdery, non-metallic mineral composed of the fossilised skeletal remains of microscopic single-celled aquatic plants called diatoms. Diatomite is typically mined by open-pit quarrying using conventional, heavy duty earth moving equipment and then transferred to a processing plant (IDPA).

The leading producer of diatomite in Europe is Denmark, which is the only commercial producer of moler (marine diatomaceous earth), which consists of a natural mixture of diatomite and 20–25% bentonite. Danish moler contains a high amount of clay, and it is available in the North-western region of Denmark (Statistics Denmark).

The Czech Republic produces diatomite in the Borovany Quarry and a processing plant in the South Bohemian Region operated by the LB MINERALS, s.r.o. mining company. The existence of a large stockpile of extracted raw material near the production facilities, is due to sharp fluctuations in raw material consumption between 0 to 83 thousand tons in the last two decades (Zahradnik et. al, 2019).

Estimates of the total excavation and waste based on the production of diatomite is presented in Table 15, and the diatomite materials flows in EU-27 are illustrated in Figure 23.

Table 15: Estimates of total excavation and waste based on production of diatomite

Diatomite (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Czech Republik	0,015	0,026	0,034	0,025	0,050	0,000	0,075
Denmark	0,128	0,114	0,176	0,139	0,279	0,000	0,418
France	0,090	0,090	0,090	0,090	0,180	0,000	0,270
Germany	0,053	0,055	0,057	0,055	0,110	0,000	0,165
Hungary	0,001	0,001	0,001	0,001	0,002	0,000	0,003
Poland	0,001	0,001	0,001	0,001	0,001	0,000	0,002
Spain	0,048	0,048	0,071	0,056	0,111	0,000	0,167
EU 27 total	**0,335**	**0,335**	**0,43**	**0,367**	**0,733**	**0,000**	**1,100**

[a] Rock = Average Stripping Ratio * Average Production
[b] Total Excavated Material = Rock + Average Production + Tailings
[c] Tailings = Ratio * Average production

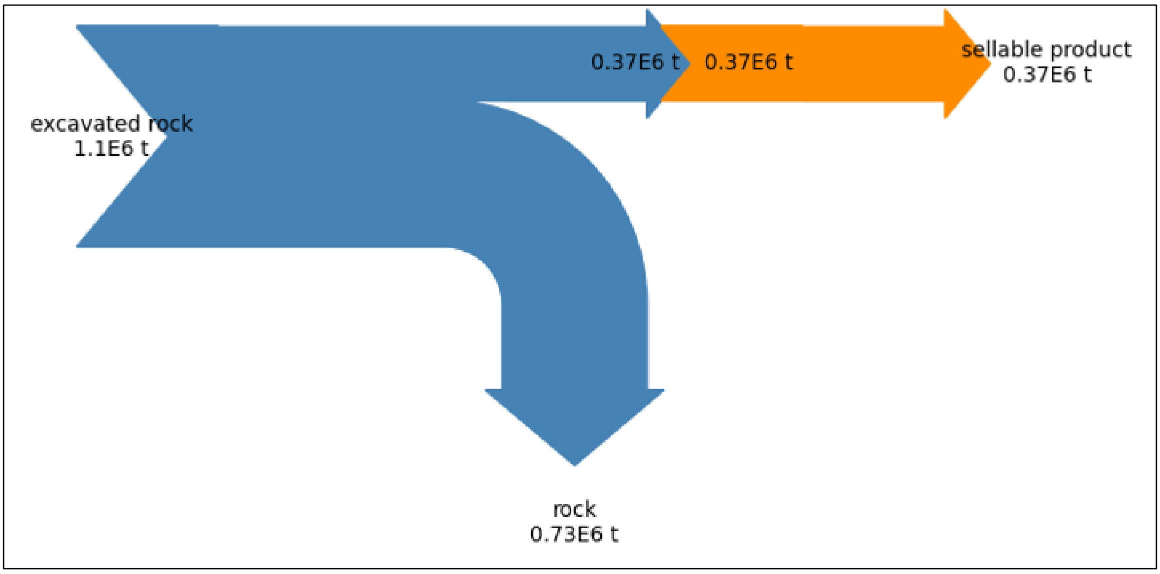

Figure 23: Material flows for diatomite extraction in EU27

→ **Feldspar**

Feldspar is the most abundant group of minerals, forming about 60% of the earth's rocks. Most European deposits contain potassium feldspar, as well as sodium feldspar and mixed feldspars. Among the numerous rocks in which they are present, feldspars occur particularly in igneous rocks, such as granite, which contains up to 50 or 70% of alkaline feldspar. Granite is however rarely used for its feldspatic content. Rather a whole range of rocks geologically connected to granite are used. Most often, commercial feldspar is mined from pegmatite or feldspatic sand deposits. Aplite, which is a feldspar-rich fine-grained igneous rock with the same mineralogical composition as granite is also frequently mined (IMA-Europe).

Conventional open-pit quarrying methods, including removal of overburden, drilling and blasting are used, followed by a froth flotation process in most cases. The leading producer in Europe, (above 60% of total production) and the second most important producer globally is Italy. Significant deposits are also found in the Czech Republik, where two basic types of mining are used: conventional quarrying followed by crushing, sorting, and grinding, and wet or dry extraction from alluvial (river sediment) deposits, followed by a separation of the specific fraction that contains the feldspar. Both cases could be followed by electromagnetic separation (Zahradnik at al., 2020).

Estimates of total excavation and waste based on the production of feldspar is presented in Table 16. Material flow in EU 27 are given in Figure 24.

Table 16: Estimation of total excavation and waste based on production of feldspar

Feldspar (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Czech Republik	0,433	0,454	0,368	0,418	0,418	0,000	0,837
Finland	0,038	0,019	0,015	0,024	0,024	0,000	0,048
France	0,550	0,550	0,550	0,550	0,550	0,000	1,100
Germany	0,253	0,285	0,277	0,272	0,272	0,000	0,543
Italy	4,700	4,000	3,500	4,067	4,067	0,000	8,133
Poland	0,077	0,088	0,091	0,085	0,085	0,000	0,170
Portugal	0,094	0,132	0,126	0,117	0,117	0,000	0,235
Romania	0,013	0,005	0,005	0,008	0,008	0,000	0,015
Spain	0,558	0,635	0,819	0,671	0,671	0,000	1,342
Slovakia	0,004	0,008	0,016	0,009	0,009	0,000	0,019
Sweden	0,029	0,022	0,022	0,024	0,024	0,000	0,049
EU 27 total	**6,749**	**6,198**	**5,789**	**6,245**	**6,245**	**0,000**	**12,490**

[a] Rock = Average Stripping Ratio * Average Production
[b] Total Excavated Material = Rock + Average Production + Tailings
[c] Tailings = Ratio * Average production

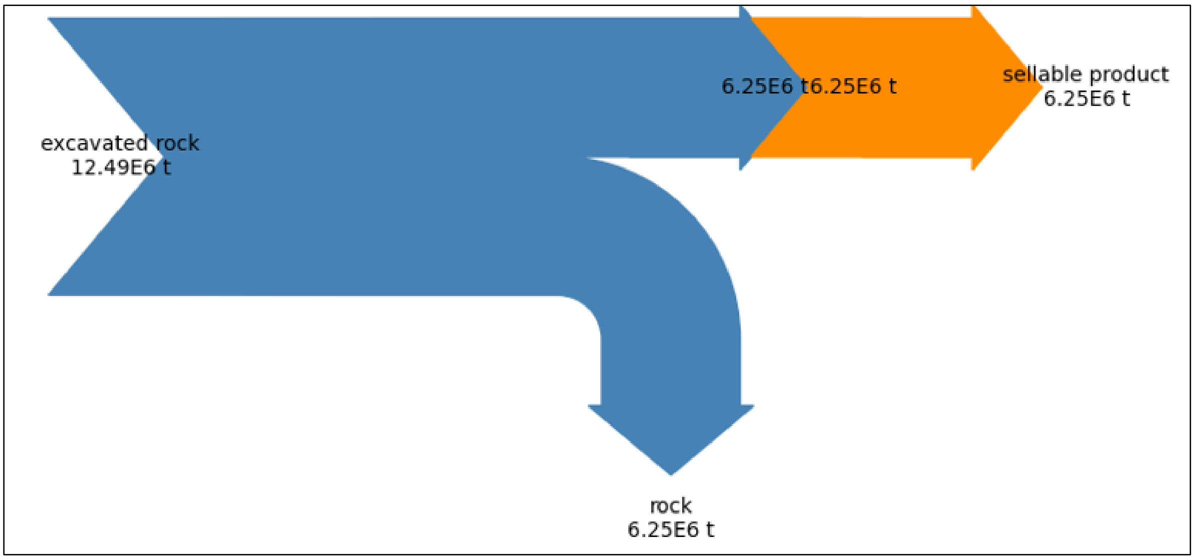

Figure 24: Material flows in feldspar extraction in EU27

Wastes arising from feldspar production are mainly grinding, milling and separation fines. The flotation process it is not expected to produce waste. Moreover, the flotation process results in feldspar poducts that meet market specifications whereas the residual product is usually high grade quartz (Heyes et al, 2012).

→ Fluorspar

Fluorspar (also known as fluorite or fluoroapatite) is mined by both open-pit surface and underground methods, depending on the geology and location of the deposit. Surface deposits are mined using standard open-pit methods, whereas deeper deposits are exploited using underground techniques, either by deep-shaft or adit access. Underground extraction techniques are typically room-and-pillar for bedded deposits, shrinkage or open stoping for deeper vein deposits. It is industrially used as a flux for smelting, and in the production of certain glasses and enamels.

The F content of run-of-mine ore varies considerably (from 10-60% CaF_2) with underground sources generally producing higher-grade ores. On average, 3 tonne of mined ore are required to produce one tonne of finished acid grade fluorspar. The extractive waste consists of unwanted waste rock which is separated through physical beneficiation (crushing and upgrading through heavy-media separation and froth flotation).

Estimates of total excavation and waste based on the production of fluorspar is presented in Table 17, material flows for the EU27 are given in Figure 25.

Table 17: Estimates of total excavation and waste based on production of fluorspar

Fluorspar (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Bulgaria	0,147	0,004	0,000	0,050	0,151	0,101	0,303
Germany	0,050	0,053	0,045	0,049	0,148	0,098	0,295
Spain	0,157	0,163	0,155	0,158	0,475	0,317	0,950
EU 27 total	**0,354**	**0,220**	**0,200**	**0,258**	**0,774**	**0,516**	**1,548**

[a] Rock = Average Stripping Ratio * Average Production
[b] Total Excavated Material = Rock + Average Production + Tailings
[c] Tailings = Ratio * Average production

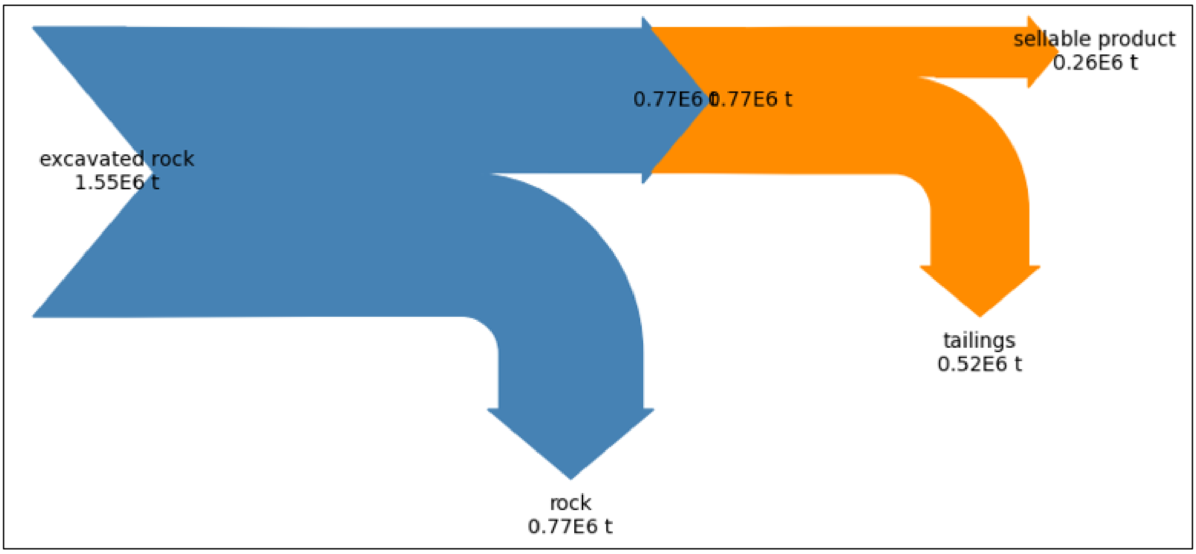

Figure 25: Material flows in fluorspar extraction in EU27

In Europe Spain has the highest fluorspar output (Table 17). The only producer is Minerales y Productos Derivados SA (Minersa). The Emilio, the Jaimina, and the Moscona underground mines produced a combined 420,000 t/year of crude ore fluorspar. Ore is processed by froth flotation. The capacity is 150,000 t/year of acid-grade fluorspar grading over 97% CaF_2 (Minerales y Productos Derivados S.A., 2010 after U.S. Geological Survey, 2011).

Wastes from fluorspar production mainly arise from grinding, milling and flotation, hence are classical tailings. All processing is by physical beneficiation whereby unwanted waste rock (gangue) is separated from the fluorite by a series of standard techniques, such as heavy-media separation and froth flotation. This necessitates size-reduction of the ore, to liberate the fluorite from the host rock, by standard crushing/grinding techniques.

→ **Graphite**

Natural graphite is a form of crystalline carbon, the physical separation of graphite from its host rock is expensive, and energy- and time-consuming. Extraction involves crushing the rock to liberate the graphite particles followed by gravity separation or froth flotation. As a result 'flake graphite' is obtained. Carbon seam-metamorphism indicates a state in which the carbon (organic source) is subjected to heat and pressure, forming amorphous graphite. This process removes impurities from coal by volatilization of oxygen, hydrogen, nitrogen and sulfur, giving an almost pure crystallised carbon, i.e. mineral graphite. The hydrothermal vein or lump graphite is considered less important in terms of the size of the ore deposit, as it is a rare form of graphite (Jara et al., 2019).

Figure 26 presents the simplified beneficiation flowsheet for natural graphite.

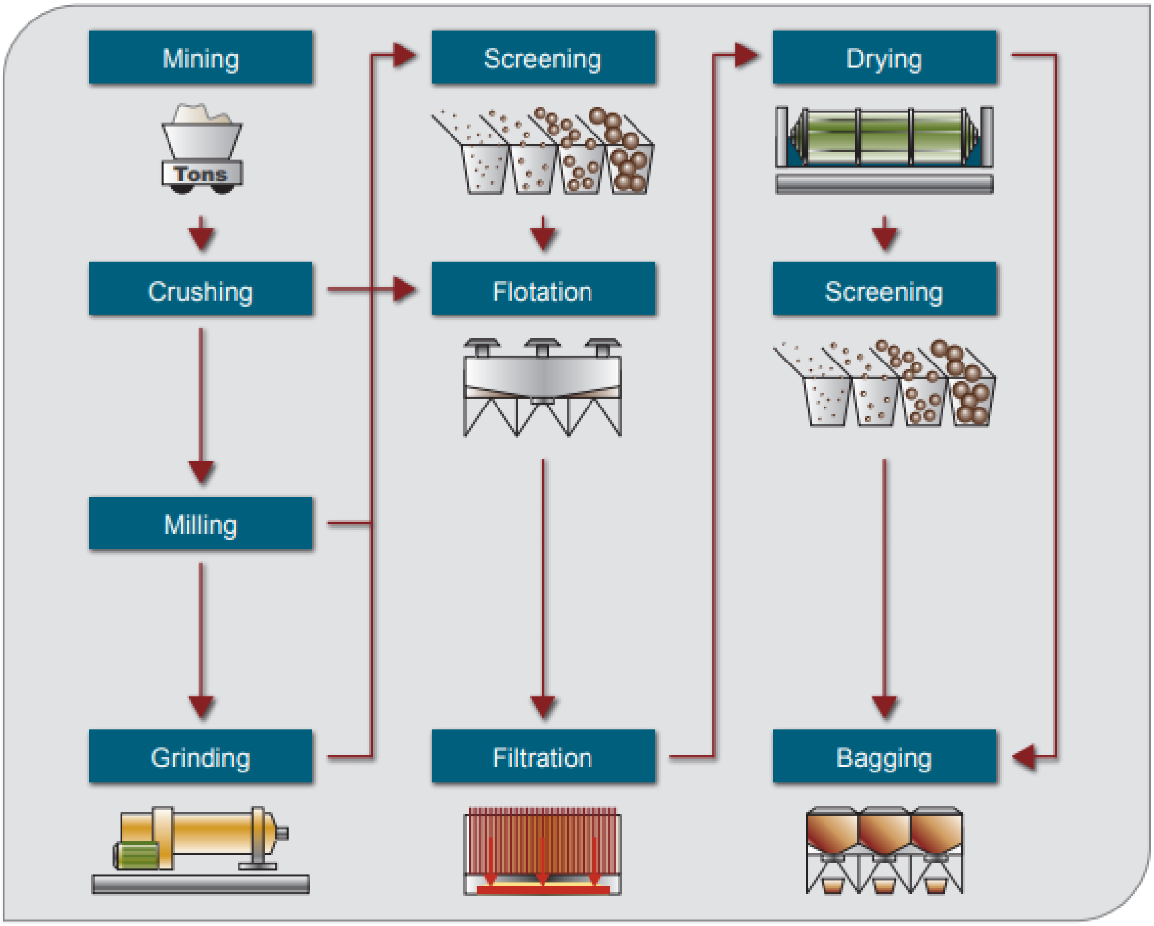

Figure 26: Natural graphite, simplified beneficiation flowsheet (Qizhong & Damm, 2020)

Small amounts of graphite are produced in Europe, but new deposits are explored to increase European resource base (Qizhong Z. and Damm 0, 2020). In Austria, the largest producer of graphite has been mined at Kaisersberg since 1755, now operated by Grafitbergbau GmbH, offering a broad assortment – from large to very fine grained flakes with diverse carbon contents ranging from 70% up to 99,9%. (Grafitbergbau, Mayer-Jauck & Schatz, 2020). Most other former producers have turned to processing imported graphite.

Estimates of total excavation and waste generation based on the production of graphite are presented in Table 18.

Table 18: Estimation of total excavation and waste based on the production of graphite

Graphite (Mt)	**Production**				**Estimations**		
	2015	**2016**	**2017**	**Average**	**Rock[a]**	**Tailings from beneficiation[b]**	**Total excavated material[c]**
Austria	0,0220	0,0230	0,0240	0,0230	0,0460	N/A	0,0690
Germany	0,0004	0,0005	0,0004	0,0004	0,0009	N/A	0,0013
Sweden	0,0090	0,0000	0,0000	0,0030	0,0060	N/A	0,0090
EU 27 total	**0,031**	**0,024**	**0,024**	**0,0264**	**0,0529**	**N/A**	**0,0793**

[a] Rock = Average Stripping Ratio * Average Production
[b] Total Excavated Material = Rock + Average Production + Tailings
[c] Tailings = Ratio * Average production

Wastes from natural graphite production mainly arise from grinding and milling and are, therefore, mainly filter dust. The production is very small in the EU thus resulting in a limited aùount of extractive waste.

→ Gypsum

Gypsum is an abundant mineral commonly found in the earth's crust and is mined around the world. In Europe regional natural gypsum production is concentrated mainly in France, Germany, Italy, Spain and Poland. Raw gypsum from quarries and underground mines is crushed and stockpiled near a plant. When needed it is crushed and screened to about 50 millimeters in diameter. If the moisture content of the raw gypsumis too high, it must be dried in a rotary dryer or a heated roller mill.

Estimates of total excavation and waste based on production of gypsum are presented in Table 19. An overview of the material flow is given in Figure 27.

Table 19: Estimates of total excavation and waste based on production of gypsum and anhydrite

Gypsum (Mt)	**Production**				**Estimations**		
	2015	**2016**	**2017**	**Average**	**Rock[b]**	**Tailings from beneficiation[c]**	**Total excavated material[d]**
Austria[a]	0,715	0,674	0,712	0,701	0,490	0,000	1,191
Bulgaria	0,109	0,061	0,088	0,086	0,060	0,000	0,146
Croatia*	0,126	0,150	0,148	0,142	0,099	0,000	0,241
Cyprus*	0,315	0,129	0,703	0,382	0,268	0,000	0,650

Czech R.	0,011	0,010	0,007	0,009	0,007	0,000	0,016
France*	2,027	4,183	3,014	3,075	2,152	0,000	5,227
Germany*	4,200	3,970	4,450	4,207	2,945	0,000	7,151
Greece*	0,649	0,778	0,547	0,658	0,461	0,000	1,119
Ireland*	0,250	0,250	0,200	0,233	0,163	0,000	0,397
Italy	3,306	2,233	2,085	2,541	1,779	0,000	4,320
Latvia*	0,225	0,224	0,225	0,225	0,157	0,000	0,382
Poland	1,018	1,043	1,108	1,056	0,740	0,000	1,796
Portugal	0,310	0,255	0,152	0,239	0,167	0,000	0,406
Romania	0,889	0,754	0,814	0,819	0,573	0,000	1,392
Slovakia*	0,067	0,053	0,046	0,055	0,039	0,000	0,094
Spain*	7,404	8,936	9,545	8,628	6,040	0,000	14,668
EU 27 total	**21,622**	**23,704**	**23,844**	**23,057**	**16,140**	**0,000**	**39,196**

[a] incl. anhydrite
[b] Rock = Average Stripping Ratio * Average Production
[c] Total Excavated Material = Rock + Average Production + Tailings
[d] Tailings = Ratio * Average production

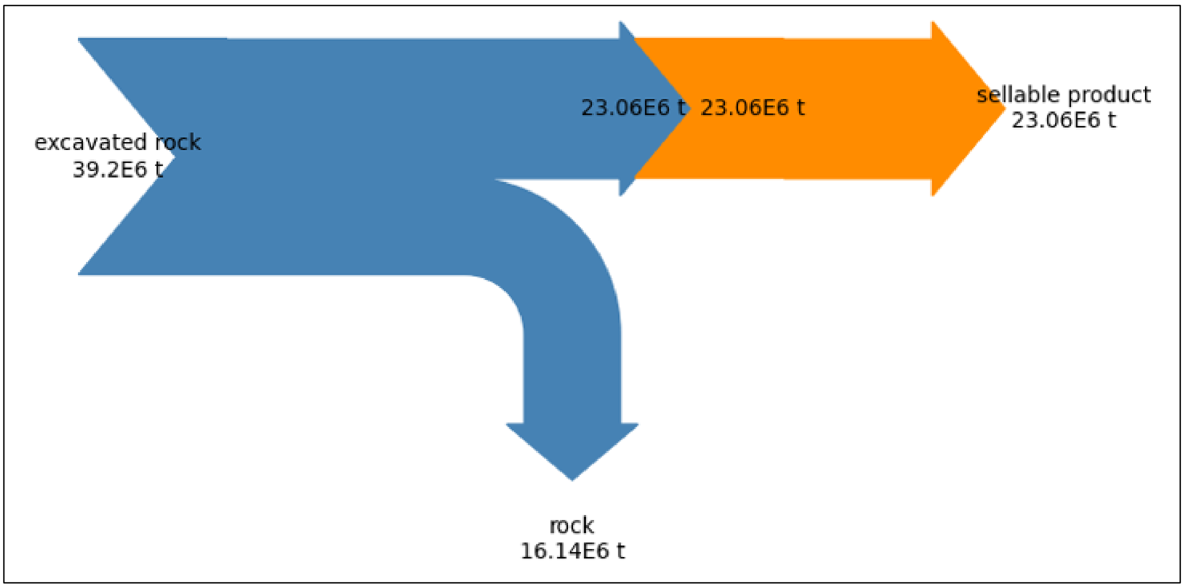

Figure 27: Material flows for gypsum extraction in EU27

Opencast working produces temporary waste that consists mainly of the surface soil and beds above and between the gypsum seams. Underground mining produces little or no waste, as all the operations are in-seam (Coleman et al., 2006). For several decades primary gypsum has been replaced by flue-gas desulfurication gypsum from coal- or lignite-fired power plants, which arises in quantities exceeding total gypsum demand. However, with the successive replacement of fossil-fuel burning power-plants by other forms of energy conversion, it is expected that the demand for primary gypsum will rise again and with it the related extractive wastes.

How difficult it is to assess waste arisings can be seen from the overview provided by Eurogypsum in 2019 on EWD commitments in gypsum quarries. Information from some countries is provided below:

- Austria – There is no obligation to report overburden removal and no requirement to carry out scientific studies.

- Germany - As long as it is needed for rehabilitation / recultivation, extractive waste is not defined. The material is included in the balances, as there is no intention to discard anything. There is no need to report overburden to authorities. The annual quantities of overburden are only collected for internal use. According to the Guideline for Companies under Mining Authority rules, overburden should not be treated as waste, but the absence of contamination must be controlled.
- Ireland – There is no requirements to report volumes and undertake scientific studies.
- The Netherlands – There are no gypsum quarries in the country.
- Poland – These issues are regulated by the Act on mining waste (10 July 2008) and the Geological and Mining Law (9 June 2011). Overburden removed outside the quarry is considered as mining waste. In this case, a “mining waste management programme” must be issued and approved by local authorities. Overburden moved and stored at the excavation site is not treated as mining waste but is reported. Quantities of mining waste are reported annually to local authorities. There is no class A waste in Polish legislation, so it is not reported. The environmental impact of the overburden has not been studied as it is neutral. The industry commissioned a study of soil removed outside the mines.

→ **Kaolin**

Kaolinite (china clay) is a clay mineral. In statistics, kaolin may be grouped together with other clays under the heading 'industrial or special clays'.

In Europe the leading producers of kaolin are: Germany and the Czech Republic. Estimates of total excavation and waste based on production of kaolin are presented in Table 20. Materials flows in EU27 are illustrated in Figure 28.

Table 20: Estimates of total excavation and waste based on production of kaolin

Kaolin (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[c]	Tailings from beneficiation[d]	Total excavated material[e]
Austria	0,013	0,014	0,014	0,013	0,094	0,054	0,162
Bulgaria	0,334	0,330	0,322	0,329	2,301	1,315	3,944
Czech Republik	3,454	3,540	3,669	3,554	24,880	14,217	42,652
France	0,275	0,264	0,279	0,273	1,909	1,091	3,273
Germany	3,734	4,740	5,168	4,547	31,831	18,189	54,567
Italy[b]	0,683	0,839	0,847	0,790	5,528	3,159	9,476
Poland	0,287	0,300	0,285	0,290	2,033	1,162	3,486
Portugal	0,252	0,284	0,308	0,281	1,969	1,125	3,376
Romania	0,031	0,031	0,031	0,031	0,217	0,124	0,372
Slovakia	0,006	0,011	0,021	0,013	0,088	0,051	0,152
Spain[a]	0,392	0,347	0,475	0,405	2,833	1,619	4,856
Sweden	0,122	N/A	0,085	0,104	0,725	0,414	1,242
EU 27 total	**9,974**	**11,029**	**11,979**	**10,630**	**74,408**	**42,519**	**127,557**

[a] Kaolin, not calcined / washed
[b] China Clay

[c] Rock = Average Stripping Ratio * Average Production
[d] Total Excavated Material = Rock + Average Production + Tailings
[e] Tailings = Ratio * Average production

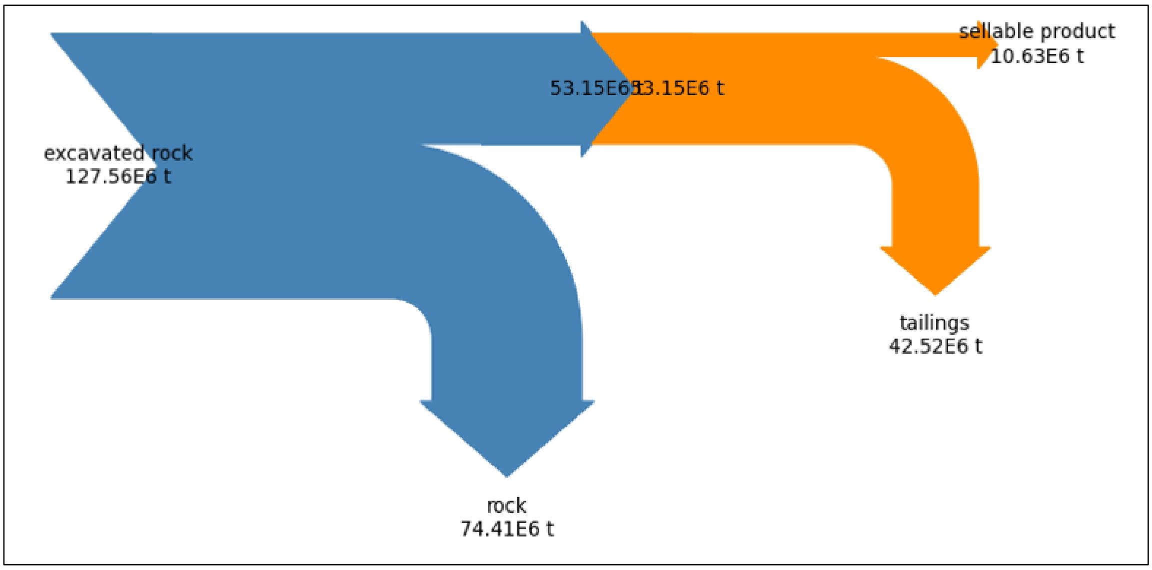

Figure 28: Material flows for kaolin extraction in EU27

It is not possible to precisely indicate the exact volume of the waste generate by kaolin mining. It ranges from 50–90% of the extracted/beneficiated kaolin or an estimated at around 80% to 90% of the gross volume exploited. The problem of kaolin waste is that it is highly powdery and its inhalation may cause lung disease and the skin contact causing dermatitis. Therefore, a great deal of research has been conducted to investigate the recycling and reuse of kaolin residues (Brasileiro et al., 2012), i.e. using kaolinite sludge as a raw material for the production of geopolymer binders (Longhi et a., 2016).

→ **Limestone**

Limestone for industrial applications is extracted from numerous deposits of different age and quality, entirely by open pit method. Special attention should be paid on limestone statistics since they often under report amounts of limestone extracted for construction purposes, in particular for cement production. Often cement manufacturers extract limestone from their own quarries. These amounts are potentially not reported in production statistics (the latter may only report the output of cement). This position, however, commonly represents a large mass flow representing a considerable share of total domestic extraction of non-metallic minerals (EU, 2018).

As industrial limestone is extracted only by open pit method, during the excavation there may be significant quantities of overburden to be removed, but because it is usually used for reshabiliation of the quarry on closure, is not treated as waste. In Poland, it is assumed that the “overburden thickness” / “deposit thickness” ratios should not exceed a value of 0.3 (meaning max. 3 m^3 of overburden per 10 m^3 of limestone). However, a typical mean values of Overburden/Deposit ratio is: 0.15 to 0.25 (although within a given deposit these values can vary considerably). The total thickness of overburden rocks commonly is within a range of 1-10 m, rarely more for economic reasons.

Karst features, such infilled dolines or pipes are a common feature in limestone and the fill sediments have be treated as extractive waste. They can amount to 5-15% of the rock volume.

Commonly, overburden and karst infill are deposited in the pits/quarries at designated area and then reclaimed for rehabilitation. Top-soil is temporarily stored in layers not execeeding 3 m thickness to protect its fertility, for later use in rehabilitation (Galos et al., 2021).

Some limestones may contain significant amounts of chert (very fine grained SiO_2) and/or clay, which are disposed of as (inert) waste. Such limestone bodies may also have just the right composition for cement clinker production, in which cases they are used whole with no waste being generated. Much of the waste generated in underground mines for dimension-stone is disposed of there, never reaches the surface and thus is not classified as waste. Surface quarries for dimension-stone may generate significant amounts of waste from defective blocks and trimmed-off pieces from production blocks. However, it will be roughly the same material as the saleable product and therefore inert (Coleman et al., 2006). If economically viable routes exist, such material can also be sold as by-product.

Estimates of total excavation and waste based on production of lime is presented in Table 21.

Table 21: Estimates of total excavation and waste based on production of lime

Lime (Mt)	Production				Estimations		
	2015	2016	2017		Rock[d]	Tailings from beneficiation[e]	Total excavated material[f]
Bulgaria	1,474	1,518	1,503	1,498	0,749	0,000	2,248
Czech Republic[a]	10,568	10,995	10,787	10,783	5,392	0,000	16,175
Estonia[b]	2,6928	2,98815	2,8281	2,836	1,418	0,000	4,255
Italy[c]	3,500	3,500	3,600	3,533	1,767	0,000	5,300
Romania	1,907	1,951	2,126	1,995	0,997	0,000	2,992
Slovenia	1,103	1,046	1,174	1,108	0,554	0,000	1,662
EU 27 total	**21,245**	**21,998**	**22,0181**	**21,722**	**10,861**	**0,000**	**32,583**

[a] Limestone cement
[b] Limestone & gypsum
[c] Hydrated, hydraulic and quicklime
[d] Rock = Average Stripping Ratio * Average Production
[e] Total Excavated Material = Rock + Average Production + Tailings
[f] Tailings = Ratio * Average production

Except for the cases mentioned, the extraction of limestone is largely waste-free. Usually it is used for coarse-grained products, such as industrial limestone rock (commonly >80 mm) and limestone aggregates (mixes e.g. 0-31.5 mm, 0-63 mm, breakstone, grits) used for construction, mostly road construction. Coarse-grained industrial limestone rock, depending on the mine/plant, can be used for burnt and hydrated lime or cement production, or further processed into fine-grained limestone products. Other industrial uses are: as flux in production of pig iron (in steelworks), for production of calcined soda and caustic soda, for molasses purification in sugar industry, and others. A part of the coarse-grained limestone and the majority of fine-grained limestone are used for the production of various limestone flours (<2 mm, but mostly <0.5 mm) of various grain sizes and purity. These flours are used e.g. as precipitation reagent in flue-gas desulfurication at coal-fired power plants, in mineral-asphalt masses for roads etc., for construction chemicals and as calcium carbonate fertilisers. The highest purity limestone flours of appropriate grain sizes are used in the glass and ceramics industry, as well as fillers for plastics and rubber. The fine-grained fraction from sieving (<2 mm) in processing, commonly constituting ca. 20-30% of the feed, is used as lower quality calcium carbonate fertilizers, if they do not have an increased content of heavy metals (e.g. Pb, Cd). However, due to seasonal demand for such fertilisers, they often have to be stored in temporary landfills (Galos et al., 2021).

Material flows for limestone are presented in Figure 29.

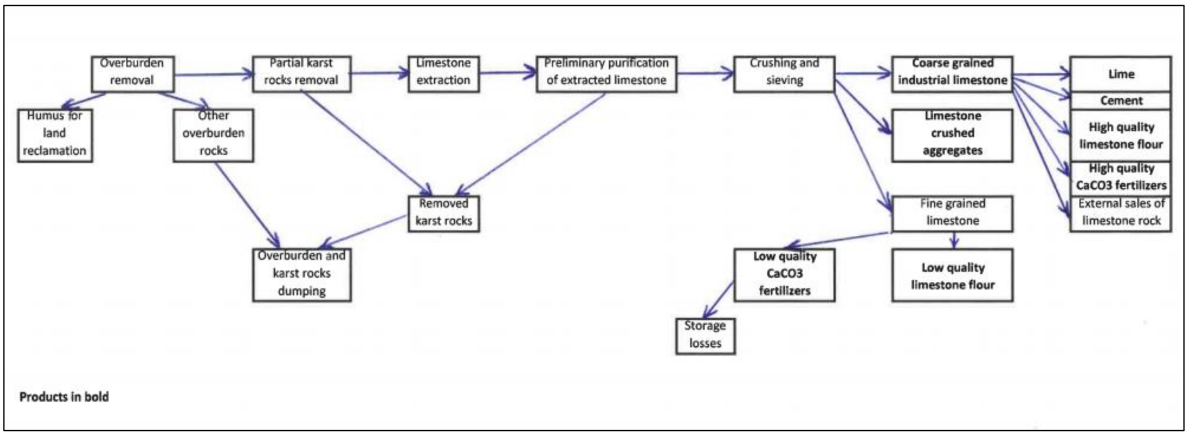

Figure 29: Diagram of material flow of limestone

→ Magnesite

Magnesite ($MgCO_3$) is derived from the chemical weathering of serpentine rocks. The main European magnesite producers are Grecian Magnesite S.A., Magnesitas De Rubián S.A., Magnesitas Navarras, Nedmag B.V., RHI Magnesita, SLOVMAG, SMZ, a. s. Jelšava and Terna Mag S.A (EUROMINES, 2020).

Magnesite is processed by firing it at 1000°C in rotary and shaft kilns into MgO (magnesia). Firing at temperatures of only 800°C results in mixture of magnesite and magnesia. Both intermediates are used in the production of building materials, such as refractory bricks and other refractory or fire-resistant materials. Emissions form production process, if not contolled, are problematic due to the kaustic behaviour of the magnesite-magnesia mixtures. (Csikósová et al., 2013).

Estimates of total excavation and waste based on production of magnesite are presented in Table 22, the material flows in Europe are illustrated in Figure 30.

Table 22: Estimation of total excavation and waste based on production of magnesite

Magnesite (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock*	Tailings from beneficiation**	Total excavated material***
Austria	0,703	0,646	0,730	0,693	0,693	0,416	1,801
Greece	0,383	0,398	0,443	0,408	0,408	0,245	1,061
Finland	0,022	0,054	0,064	0,047	0,047	0,028	0,121
Poland	0,096	0,078	0,102	0,092	0,092	0,055	0,239
Slovakia	0,773	0,598	N/A	0,686	0,686	0,411	1,782
Spain	0,465	0,584	0,789	0,613	0,613	0,368	1,593
EU 27 total	**2,441**	**2,358**	**2,128**	**2,538**	**2,538**	**1,523**	**6,598**

* Rock = Average Stripping Ratio * Average Production
** Total Excavated Material = Rock + Average Production + Tailings
*** Tailings = Ratio * Average production

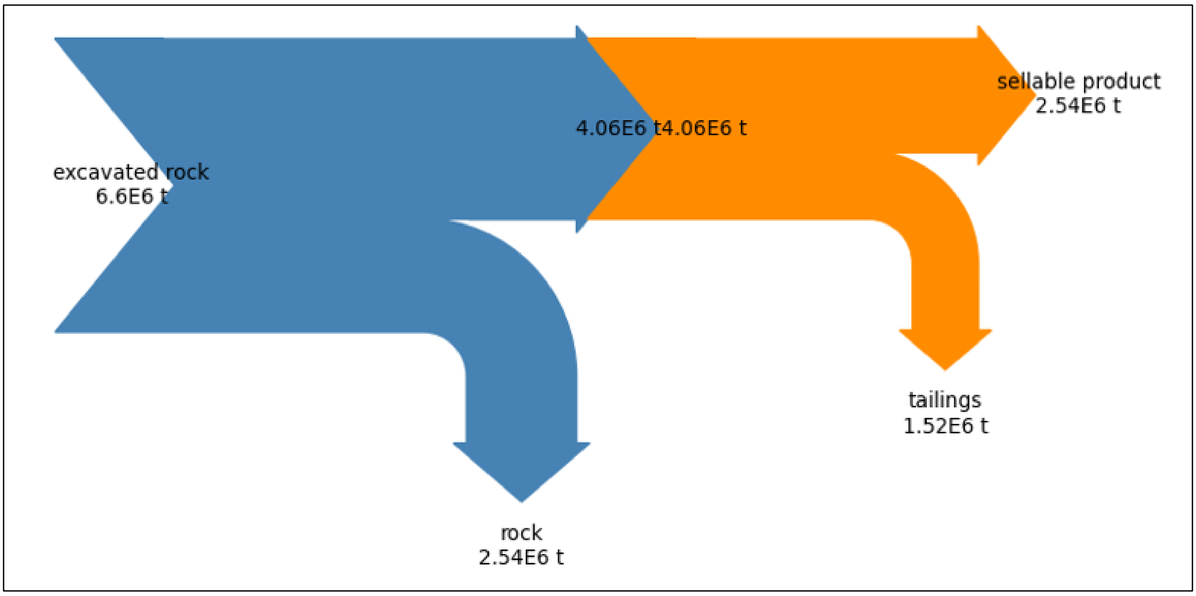

Figure 30: Material flows for magnesite extraction in EU27

Waste arises from the grinding, milling and calcining, mainly in the form of filter dust. According to data from producers 'magnesite tailings/waste' after beneficiation amounts to 38%. However, due to implementation of circular economy model in some companies the waste has been significantly reduced and recycling increased (i.e. by RHI Mangesita from Austria).

→ **Perlite**

Perlite is a naturally occurring volcanic rock formed from siliceous lava or ash. It is mined by heavy excavation machinery or by precise blasting. The material then is crushed and sized into marketable fractions. In processing plants it is expanded or 'popped: when roasted, the water content of perlite reacts and the perlite pops like popcorn. This results in a lightweight product that is up to 40 times less dense than the original material and used e.g. as insulating material, to produce light-weight construction materials and in horticulture.

Estimaties of total excavation and waste based on production of perlite are presented in Table 23, material flows in Europe are illustrated in Figure 31.

Table 23: Estimates of total excavation and waste based on production of perlite

Perlite (Mt)	**Production**				**Estimations**		
	2015	**2016**	**2017**	**Average**	**Rock[a]**	**Tailings from beneficiation[b]**	**Total excavated material[c]**
Bulgaria	0,000	0,000	0,005	0,002	0,001	0,000	0,003
Greece	0,891	0,921	0,933	0,915	0,458	0,137	1,510
Hungary	0,031	0,071	0,080	0,061	0,030	0,009	0,100
Slovakia	0,025	0,019	0,048	0,031	0,015	0,005	0,051
EU 27 total	**0,947**	**1,011**	**1,066**	**1,008**	**0,504**	**0,151**	**1,663**

[a] Rock = Average Stripping Ratio * Average Production
[b] Total Excavated Material = Rock + Average Production + Tailings
[c] Tailings = Ratio * Average production

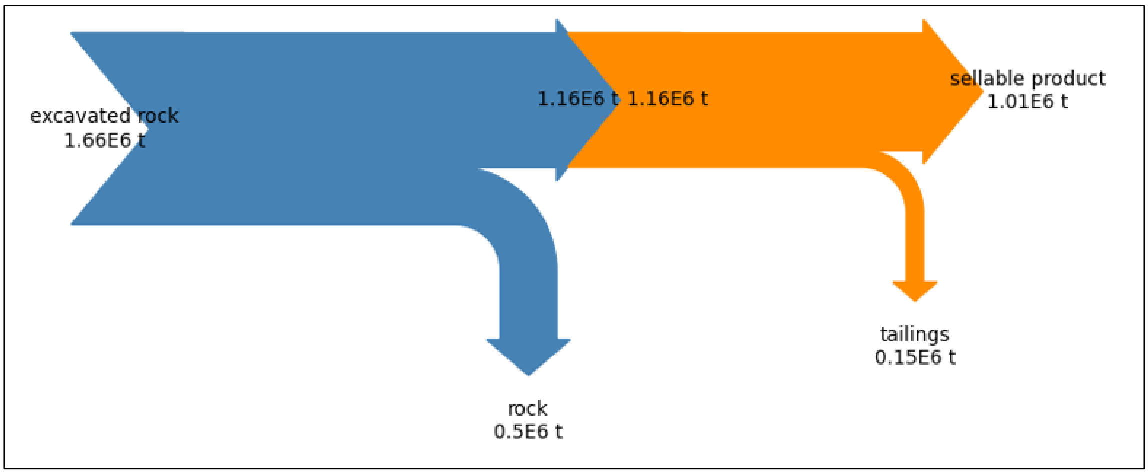

Figure 31: Material flows for perlite extraction in EU27

Waste arises from crushing, sieving and drying mainly in the form of filter dust.

The leading producer in EU is Greece, where it is extracted on the islands Milos and Nisiros. On Milos are two main quarries, Tsiggardo and Trahila. According to the 'Decision on the Approval of Environmental Terms' by the Hellenic Ministry of the Environment and Energy (ADA 45ΟΠ0-ΥΗ8) at the quarry Trahila there is one extractive waste facility. The extractive waste is assigned the waste code 01 01 02 (wastes from mineral non-metalliferous excavation, Decision 955/2014/EU)and is classified as inert. A part of the 'waste' is used for filling excavation voids and when this is not technically feasible, the rest will be deposited into the extractive facility, which is classified as non-Category A Facility.

The extractive waste from processing is extra fine perlite from dust scrubbing of the wet and dry separation processes. According to the 'Decision on Approval of Environmental Terms' by the Hellenic Ministry of the Environment and Energy (ADA 4Ι090-Ζ[9]) it is estimated that 70,000 t of extra fine perlite were generated. According to the EWMP 800,000 m^3 of pulp of extra fine perlite and sea water are produced yearly at a ratio of 10:90, which are discharged into the sea. According to reports by the Hellenic Ministry of Environment and Energy[10] for year 2015 and 2016, the final product amounted to about 42% of primary material. However, it should be highlighted that the difference between final product and primary mineral are also due to the loss of water during processing.

→ Potash

Potassium is an abundant element in the upper crust of the earth. Potash minerals are found in bedded-evaporite deposits. These are usually chloride (Cl) or sulphate (SO_4) based compounds that contain different amounts of K and/or Mg and Na. Potash minerals are typically pink-red in colour (due to traces of iron), soft and extremely soluble in water. The economically important potash rocks (sylvinite) are mixtures of the minerals carnallite ($KMgCl_3 \cdot 6H_2O$), sylvite (KCl) and halite (NaCl).

[9] ADA it is the code of the Hellenic Transparency Program, by which all the administrative acts and decisions are valid if they are published online
[10] Hellenic Ministry of Environment, Energy (latomet.gr)

In Europe potash is extracted mainly in Germany by 'K+S'. The Zielitz potash mine in Saxony-Anhalt is the largest individual K+S mine and, in terms of annual output, is one of the largest and most modern potash mines in the world. Crude salts are extracted here for the production of fertilizers, products for industrial applications, as well as products for the feed and food industries (K+S, https://www.kpluss.com). Solid residues occur in mining during the extraction and processing of crude potash salts, In 2020, 29.3 million tons (in 2019: 27.1 million tons) of solid residues on tailings piles was disposed at all potash sites (whereas 1.2 million tons in 2020 (in 2019: 1.5 million tons) of residues were saved by implementing technical measures for increasing raw material exploitation or by recovering them. In 2020 the annual production for potash and magnesium reached up to 8 million tons, whereas about 35 million tons of crude salt were extracted from potash deposit in Germany, and 1.9 million tons of potassium chloride at Bethuane (finish product). Production from salt deposits in Europe reached 3.9 million tons (K+S Annual Report 2020).

The aim of company is to reduce the environmental impact and conserving natural resources by re-examining the potential of residues stored on tailings piles to reach in 2030 3 milion tons of residues used for other purposes than talings piles coverage.

Estimates of total excavation and waste based on production of potash are presented in Table 24.

Table 24: Estimation of total excavation and waste based on production of potash

Potash (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Germany	36,777	31,551	35,973	34,767	N/A	139,068	173,835
Spain	1,709	1,839	N/A	1,774	N/A	7,096	8,870
EU 27 total	**38,486**	**33,390**	**35,973**	**36,541**	**N/A**	**146,164**	**182,705**

[a] Rock = Average Stripping Ratio * Average Production
[b] Total Excavated Material = Rock + Average Production + Tailings
[c] Tailings = Ratio * Average production

Waste arises due to treatment of grinding, milling and drying and arises mainly in the form of filter dust. In Germany the excavated material contains between 11% and 25% potassium chloride. The potash deposits in Germany also contain magnesium and sulphur (between 9% and 24% magnesium sulphate content).

→ **Salt**

This material group concerns sodium chloride. Salt may be produced from rock salt, brine or seawater. For the scope of this study only rock salt have been taken into account. In some countries 'table salt' is produced by solution mining, e.g. in Austria, which results in no wastes. In other countries, notably in Germany most of the salt is mined by traditional underground methods.

Estimates of total excavation and waste based on production of salt are presented in

Table 25.

Table 25: Estimation of total excavation and waste based on production of salt

Salt (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Austria	0,0002	0,0002	0,0004	0,000	N/A	0,000	0,000
Croatia	0,112	0,112	0,019	0,081	N/A	0,008	0,089
Denmark	0,000	0,000	0,000	0,000	N/A	0,000	0,000
Germany	6,124	5,617	6,531	6,091	N/A	0,609	6,700
Greece	0,000	0,000	0,000	0,000	N/A	0,000	0,000
Malta	0,000	0,000	0,000	0,000	N/A	0,000	0,000
Poland	3,468	4,079	4,660	4,069	N/A	0,407	4,476
Portugal	0,030	0,006	0,008	0,015	N/A	0,001	0,016
Romania[a]	0,050	0,052	0,052	0,051	N/A	0,005	0,056
Slovenia	0,000	0,000	0,000	0,000	N/A	0,000	0,000
EU 27 total	**21,545**	**21,603**	**23,722**	**22,290**	**N/A**	**2,229**	**24,519**

[a] Rock, brines, marine
[b] Rock = Average Stripping Ratio * Average Production
[c] Total Excavated Material = Rock + Average Production + Tailings
[d] Tailings = Ratio * Average production

Mining of rock salt and subsequent processing, which involves crushing and treating the salt to keep it free-flowing, does not produce any waste. The underground rock operations produce no waste at the mine site (Coleman et al., 2006).

When it is extracted as a mineral any wastes are arising from grinding and milling and drying and would be arising as filter dust. Probably a 10% of the rock salt processing is waste (UNEP, 2021)

→ **Sulphur**

In nature, sulfur occurs as the pure element or as sulphide and sulphate minerals. The crystallography and mineralogy is complex due to the various oxidation oxidation states in which this element is stable in a variety of environments.

The presence of sulphur in the earth's crust is quite common. Most of the native sulphur is associated with volcanic activity and can occur as large deposits. Many sulphide minerals are known: pyrite and marcasite are iron sulphide; stibnite is antimony sulphide; galena is lead sulphide; cinnabar is mercury sulphide and sphalerite is zinc sulphide. Probably the most common sulphate mineral is gypsum, but there are many others.

Sulphur is in most cases a by-product and a co-product in virtually all the other cases. Sulphur production from the purification of fossil fuels, especially natural gas and petroleum, accounts for 50% of the annual production, where it is obtained as involuntary by-product. Sulphur is also produced by roasting pyrites and by the Frasch-process from massive deposits in salt domes. Sulphur is also a by-product from the off-gas treatment of the pyrometallurgical treatment of sulphidic metal ores. Sulphidic ores are the major sources of nickel, lead, silver, tin, and copper. In the Frasch process, native sulphur is melted underground with superheated steam and brought to the surface by compressed air (EC, 29. SULPHUR). The only remaining operating "Frasch" mine in Europe is located in Poland. In Europe some sulphur is still produced from pyrites. Poland supplied on average in the decade analysed (2009 – 2018) about 880,000 t/y of sulphur with over 60% coming from the exploitation of native sulphur deposits (Kot-Niewiadomska et al., 2021).

Estimates of total excavation and waste based on production of sulphur are presented in Table 26.

Table 26: Estimates of total excavation and waste based on production of sulphur

Sulphur (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation b	Total excavated material[c]
Bulgaria	0,439	0,396	0,501	0,445	N/A	N/A	0,445
Poland	0,651	0,645	0,686	0,661	N/A	N/A	0,661
Spain	1,510	1,455	1,518	1,494	N/A	N/A	1,494
EU 27 total	**2,600**	**2,496**	**2,705**	**2,600**	**N/A**	**N/A**	**2,600**

[a] Rock = Average Stripping Ratio * Average Production
[b] Total Excavated Material = Rock + Average Production + Tailings
[c] Tailings = Ratio * Average production

→ Talc

The mineral talc is a hydrous magnesium silicate. A high-talco metamorphic rocks are referred to as steatite or soapstone. Pyrophyllite is a hydrous aluminum silicate with a structure similar to talc. Steatite/soapstone has been used for thousands of years as carving material. The modern industrial use of talc is for the production of talcum powder (cosmetics, baby-care products), while steatite is used as heat-resistant building material that is easily carved, laboratory counter-tops, etc.

Estimates of total excavation and waste based on production of talc are presented in Table 27, talc material flows in Europe are illustrated in Figure 32.

Table 27: Estimates of total excavation and waste based on production of talc

Talc (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Austria	0,122	0,123	0,124	0,123	0,123	0,000	0,246
Finland	0,332	0,346	0,355	0,344	0,344	0,000	0,689
France[a]	0,450	0,450	0,470	0,457	0,457	0,000	0,913
Italy	0,165	0,165	0,165	0,165	0,165	0,000	0,330
Portugal	0,011	0,012	0,014	0,012	0,012	0,000	0,025
Slovakia	0,001	0,007	0,014	0,007	0,007	0,000	0,015
Spain	0,000	0,000	0,012	0,004	0,004	0,000	0,008
EU 27 total	**1,082**	**1,102**	**1,154**	**1,113**	**1,113**	**0,000**	**2,226**

[a] Talc, steatite & pyrophillite
[b] Rock = Average Stripping Ratio * Average Production
[c] Total Excavated Material = Rock + Average Production + Tailings
[d] Tailings = Ratio * Average production

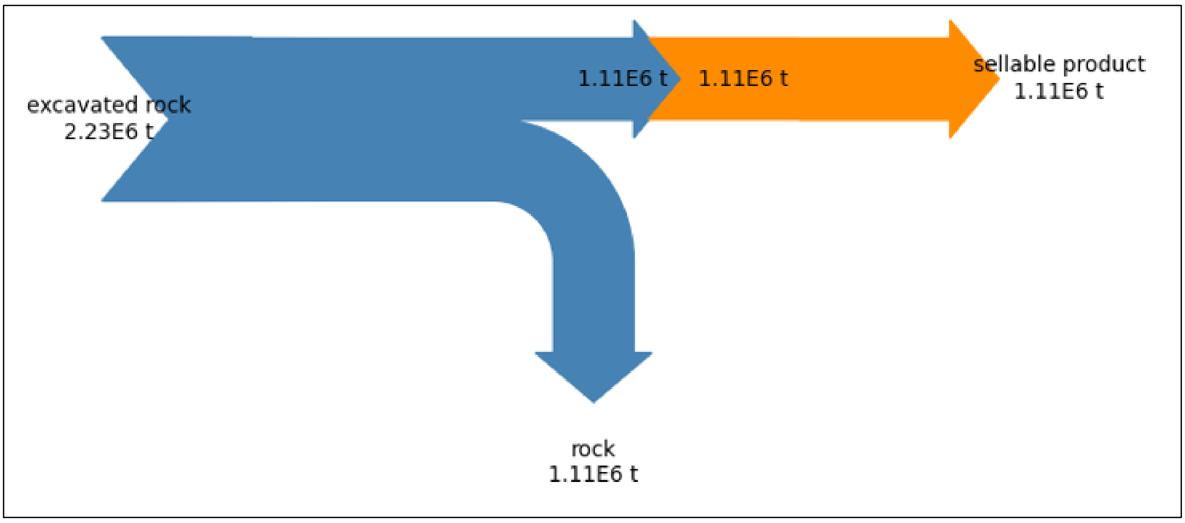

Figure 32: Material flows for talc extraction in EU27

The extraction and processing of talc generates various waste materials, including waste rock, which has to be excavated in order to provide access to the talc deposit. Wastes are used on site for landscaping, rehabilitation and the creation of safety barriers for mobile equipment in the mine (EUROTALC).

3.2.4. PROCESSING OF AGGREGATES

Based on the statistics and a scientific and technical assessment of current practices of processing aggregates the life cycle of sand & gravel and crushed rock assumptions has been analysed to define types of wastes that can arise during the extraction process.

The aggregates industry does not use treatments, such as leaching and other physico-chemical treatments, nor does it use hazardous substances.

In the extraction of aggregates and construction/dimension rocks, the stripping ratio varies from site to site, but is on average lower than 0.1:1 (EC, 2018).

Figure 33 and Figure 34 show the material flows for aggregates extraction in France and Germany respectively.

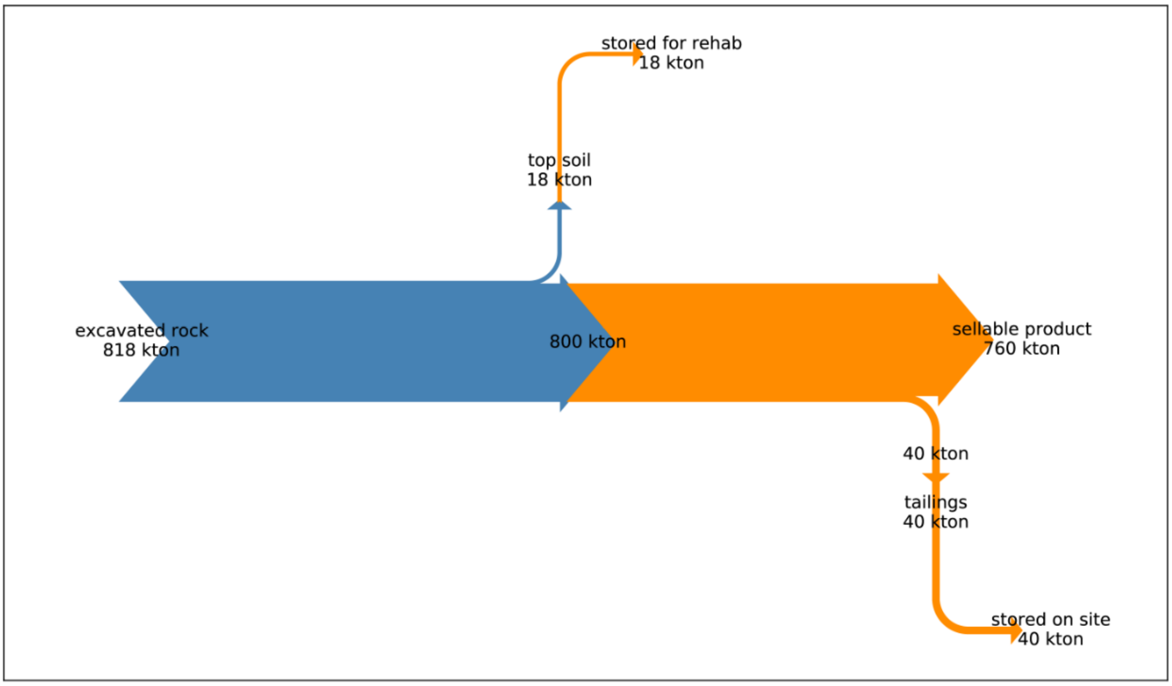

Figure 33: Mining of aggregates in France, material flows

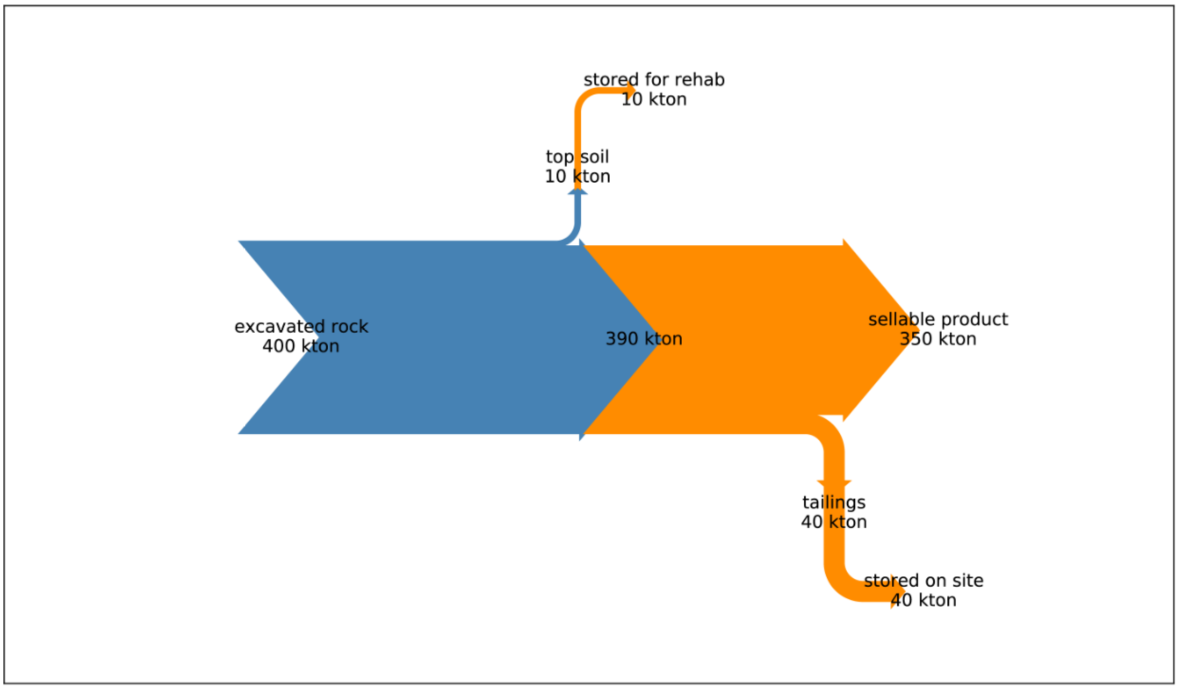

Figure 34: Mining of aggregates in Germany, material flows

The lack of or limited natural aggregates in many EU countries and increasing difficulties in obtaining licenses for their extraction indicate the need for separate storage of sand aggregates instead of putting them into mined-out excavation pits. In 2017–2019, there was an increase in demand for these aggregates due to the relatively large scale implementation of infrastructure investments and this increasing trend is likely to continue in the future (Kozioł and Baic, 2019).

→ **Sand & gravel**

Sand and gravel are the most common aggregates along with crushed rock. They are produced from natural sources extracted from open pits. Treatment of sand and gravel is simple and includes washing and screening, resulting in supensions and slimes as residues. The products can be used directly.

The possibility of obtaining permit to extract minerals is linked to the requirement to rehabilitate the sites. The material removed before extraction (top-soils) and materials unmarketable materials that do not fulfil the quality requirements as aggregates, may be stored temporarily in berms or tips to reduce noise, dust, as visual mitigation and then have a final use in the rehabilitation. There is a time limit on storage (EWD, 2016), but the materials are not waste when intended for rehabilitation and recultivation (MIRO).

There are two major groups of uses for sand and gravel: industrial (with specific requirements on properties for use in iron production, glass-making, ceramics production, and in chemical industry, etc.) and for structural engineering (construction, e.g. aggregates in concrete) and civil engineering (e.g. roads). Statistics for sand and gravel often under-report or fail to report the total amount extracted for both industrial and construction use. Frequently, only special sand and gravel for industrial use is included (UNEP, 2021). Statistics may also not report total numbers for sand and gravel for construction, e.g. without small scale enterprises operating their own quarries. If no adequate statistical data are available, the total amount of sand and gravel extracted for construction can not be estimated (EU, 2018).

Obtaining sand and gravel for construction increasingly becomes a challenge due to the limited availability of resources with suitable granulometrie and frequently a resources use conflict with the use of these formations as aquifers for drinking-water supply. Increasing use of less suitable resources with higher proportions of fines (< 2 mm diameter) results in more discards being generated that are typically returned to the excavated pits. This challenge has triggered research around the world to develop new construction materials that utilise finer fraction, which at the same time reduces the discards.

The ratio between total extraction, marketable product and residues that are commonly returned to the pit eventually depends on the the geological conditions (granulometry), but also on the extraction technology. Suction dredgers and dredger-cutters are mainly used on deposits with a sand fraction higher than 35%, while single-bucket dredgers are mainly used on deposits with a relatively low sand fractions:

- suction dredgers: oversized solids are not extracted,
- single-bucket grapple: oversized solids are separated on the initial grate and discharged directly to the excavation pit, while in the processing plant silty (< 0.063 µm), clay and undersized sand are separated and discharged as processing waste into an (old) excavation pit or a settling pond,
- multi-bucket dredger: as this is a continuous process, separation takes place directly on the excavator and the fraction below 2 mm is usually discharged back into the excavation pit.

Further separation of the extracted material (feed) takes place in the sorting and washing plant with a division into commercial products and processing waste, consisting mainly of the remaining silty (< 0.063) and clay fractions, which usually constitute about 10% of the feed. The separation of suspended clays from the washing water is usually effected in settling ponds and occasionally in hydrocyclones, but these tend to be too expensive for small operations. A large quantity of fresh water is required for washing and modern operations recycle this water in order minimise water resources use.

Demands for sand&gravel products are highly variable and depend on economic cycles or public infrastructure construction programmes. The latter can lead to deman for finer sand fractions for road-base construction that would be otherwise not marketable.

→ **Crushed rocks and dimension stones**

According to information received from Euroroc and MSs (pers. Comm.), in both industries the difference between the amount of extracted rock and sold rock is not recorded, as all the material not sold stays in the quarry (as infill, for construction and rehabilitation) and is not measured. In addition, waste generation depends largely on the individual quarries and on the market demands. As the profitability of a quarry directly depends on the amount of marketable material, there is an incentive to generate as little 'waste' as possible.

Both extractive industries (aggregates and dimension stone) do not produce waste in the sense of the EWD because the material is either used within the quarries or stored on site to be sold, if and when an opportunity arises. Therefore, there is no need to report this to the authorities. In addition, both industries only quarry inert material, as non-inert materials would rapidly lose the properties for which they are extracted. Hence, in most cases any residue or 'waste' would also be inert. Apart from processing waste (washing fines, cutting slurries), quarries not normally generate other types of extractive waste, as all of the extracted material is used. There may be, however, fluctuation in the demands of certain qualities/sizes of materials, which can lead to stock-piling of some materials until a use or buyer can be found.
However, it is known that some quarries have problems with handling the fines that result from washing aggregate or from cutting in the dimension stone industry. While these fines eventually would be placed back into the quarried-out voids rather than an EWF, some material may be lost due to inadequate handling.

The construction of a new quarry or the extension of an existing one, both for aggregates and for dimension stones, normally begins with the clearance of the vegetation and the topsoil. The topsoil is frequently arranged in the form of a talus or dam around the quarry, if the topographical situation permits this. The purpose is to reduce the visibility, deflect noise. The dams are made not higher than about 3 m to retain the fertility of the topsoil for later rehabilitation.

The extractive processes in both industries may result in significant amounts of fines and below grade material that are typically used for construction purposes within the quarry or stored for later backfilling and rehabilitation. Drilling muds and fine mud resulting from washing aggregates are in general collected in settling ponds. In well-operated quarries, the process waters are recirculated to reduce freshwater use

According to Kaźmierczak et al. (2019) the following applications of "rock raw material waste" are distinguished:

- Industrial use of fines, including multifunctional sorbent-fertilizers, feed additives, additive to pesticides and as adsorbents in water treatment technologies;
- Production of rock meals for application as soil improvers;
- Application as aggregates and granulates; and
- As fillers for thermoplastics.

According to the waste recordings for Poland (Blachowski et al., 2018) the share of extractive 'waste' can be estimated taking the following percentages into account:

1. Dimension stone and crushed rock → 1-5%
2. Natural aggregate → 0,5%

In certain dimension stone industries with particularly high quality demands, the marketable percentages may much smaller though. The development of new processing techniques, e.g. impregnation with acrylic or epoxy resins, and a market for such composite materials allows the reduction of spoil or 'waste'.

3.2.5. ENERGY MINERALS

→ **Oil and gas**

The oil & gas industry has two major extractive waste streams, although volumes are small compared to other energy minerals. The majority of wastes generated during drilling activities are spent drilling fluids and drill cuttings (IOGP, 2016).

Drill cuttings are crushed rock particles produced by the action of the rotary drills. The cuttings are brought from the borehole to the surface by the circulating 'drilling fluid'. These are typically mixtures of bentonites or similar clays, inorganic salts and dissolved or dispersed organic compounds to stabilise the suspensions (emulsifiers). In most cases the 'continuous phase' is water, but when drilling through water-soluble formations, organic liquids have to be used. Drilling fluids are pumped from the mud-tanks on the rig, down the drill-pipe string, exit through the holes in the drill and return to surface through the ring space between the string and the borehole wall (Figure 35). Drilling cuttings are separated on a screen before the fluid is returned to the mud-tank. The drilling fluid is continuously monitored for its composition and properties, such as viscosity and density, and is adjusted to the needs of the particular phase of the drilling operation. The drill cuttings are collected to be disposed of or re-used, if not contaminated by drilling fluid additives or hydrocarbons from the formations. The choice of drilling waste management options depends on the type of drilling fluids used, local regulations, space / weight restrictions, environmental considerations, availability of disposal options, and cost-benefit analyses.

Complete separation of the drilling fluid from the drilled solids is difficult to achieve with conventional solids control equipment and a proportion of the fluid is usually retained on the cuttings after the initial stage of separation. The waste cuttings are therefore a mixture of the natural rock with the base fluid plus additives, such as emulsifiers, salts, barite (to increase the density of the suspension) or calcium carbonate and lost-circulation materials (LCM, i.e. typically organic fibres or crushed rock to enhance the formation of filter-cakes along the borehole walls, reduing the loss of drilling fluids). There may also be some reservoir fluids mixed with the cuttings. This mixture of cuttings and fluids has the potential to cause impacts on the surrounding environment and its disposal is therefore regulated.

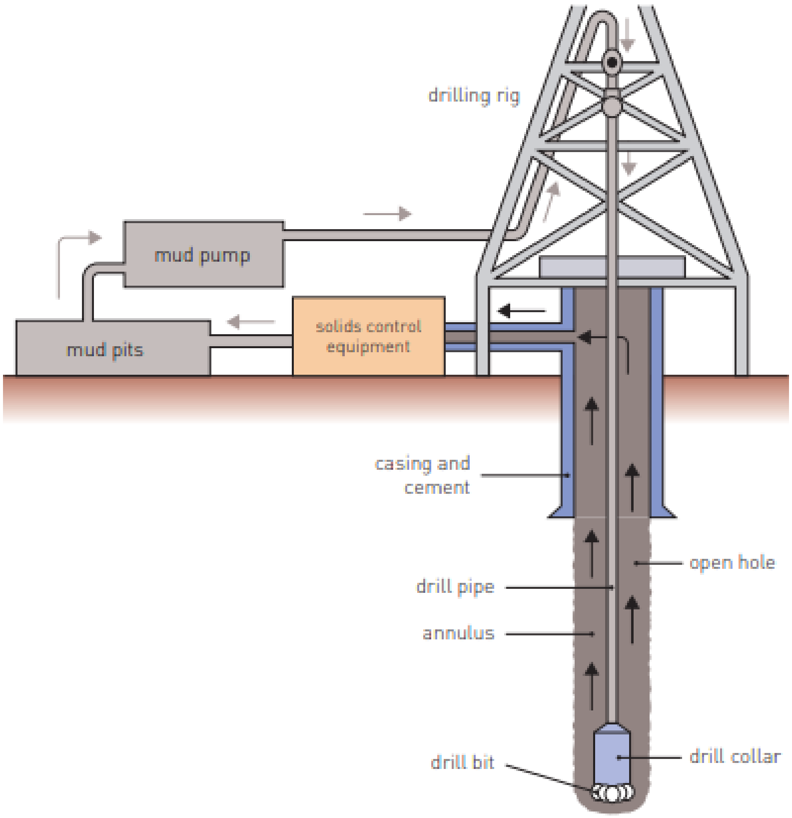

Figure 35: Drilling fluids circulating system of a drilling rig and well (IOGP, 2016)

Other types of waste can be:

- Cement used to hold the casing in place and to seal different formation to prevent fluids from migrating between different formations. Cement circulating back to the surface during cementing work is referred to as cement returns which become a waste stream.
- Interfacial mixtures (slops) form when non-aqueous drilling fluids (NADF) become polluted with water or brine, or when aqueous drilling fluids become contaminated with reservoir hydrocarbons. Such contaminations affects the drilling fluid properties: they change the oil/water ratio (OWR), decrease or increase the viscosity, decrease emulsion stability and ultimately render the drilling fluids unusable. The composition of slops can be highly variable, and can include both oil-in-water and water-in-oil emulsions.
- Spacer and completion fluids - spacers are used primarily when changing fluid types and to separate fluid from cement during cementing operations. Spacer fluid that is displaced to the surface will become waste, if it cannot be re-used or if it is contaminated with cement, NADF or formation hydrocarbons – in the latter cases it will require being managed as slops, since it will be an interfacial mixture of aqueous and non-aqueous liquids. Completion fluid is placed in the well to facilitate final operations prior to initiation of production, such as setting screens, production liners, packers, downhole valves or shooting perforations into the producing zone. The fluid is used to control a well, without damaging the producing formation or completion components, should downhole hardware fail. Completion fluids are typically brines (chlorides, bromides and formates), but could be any fluid of appropriate density and flow characteristics. The fluid should be chemically compatible with the reservoir formation and fluids, and is typically filtered to a high degree to avoid introducing solids to the near-wellbore area.

- Return fluids from fracking operations, although the stabilising solids (e.g. zircon oxide pellets) are usually inert.

Management of drilling wastes varies from one jurisdiction to another, ranging from limited controls, to mandated, dedicated landfills. It should meet the objective of compliance with national environmental regulations and ensures that drilling operations are not unreasonably delayed. Moreover, it should be consistent with the waste hierarchy principles. Possible management options for drill cuttings are presented in Figure 36. Research has been conducted e.g. in Poland on the selection of binding agents for the solidification and stabilization of drilling-related wastes (Steliga et all., 2018). The process of the solidification aims at hydraulic binding of soluble substances (e.g. chlorides), as well as heavy metals and petroleum substances to transform it into a solid with limited leachability.

As an example for the possible classification of waste during oil and gas production the Polish procedure for shale gas exploration is presented in Annex K.

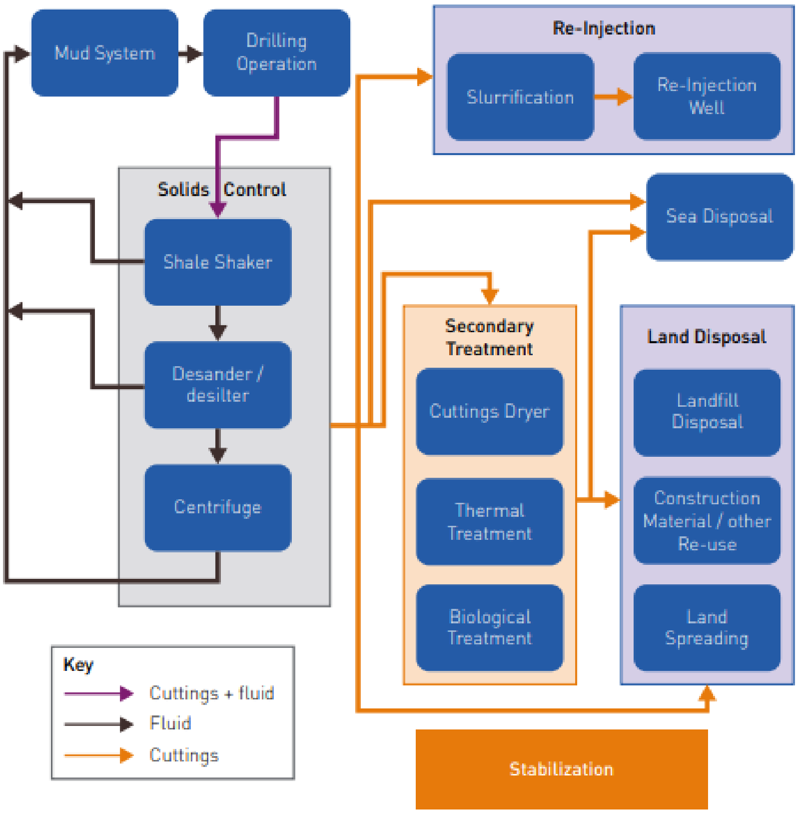

Figure 36: Schematic showing possible management options for drill cuttings (IOGP, 2016)

→ **Oil shale**

Since 2009, more than half of Estonia's mined oil shale has come from underground mines (Gaškov et al., 2012). The extraction technology is more complex for underground mining than for open-cast mining and the process leads to greater losses as almost one-third of resources is left behind in form of pillars and/or unmined areas. In 2013, mining losses accounted for 8% of the total production in open-cast quarries and for 29% in underground mines (NAO, 2015).

According to Estonian Oil Shale Industry Yearbook 2018 oil extraction generates mine tailings that are used to produce crushed limestone which contains a small residual amount of oil shale. In 2018, oil the shale industry produced 6.46 million tons of crushed stone, more than half of which was used in other fields. The Viru Keemia Grupp (VKG) generated 2.3 million tons crushed limestone from the extraction and valorisation of crude oil shale shale in 2018 and the vast majority of it went to road construction and as filling material.

Additionally VKG extracts fine chemicals from the phenol waste water of the Kiviter processing plant. Thus in 2018, VKG produced 1,911 tons of fine chemicals and phenol products. Oil shale chemicals are various grades of alkylresorcinols, which are widely used in making moulds and as epoxy adhesives in rubber, plywood and the petroleum industry. Phenols produced in Estonia - Honeyol 80, Honeyol and Rezol – are used in Lexus and Toyota automotive parts and they are used to make highly durable tyres. The fine chemicals obtained from oil shale – anhydrates of 2-methylresorcinol and monohydroates of 5-methylresorcinol – are used in perfumery, cosmetics and the electronics industry. Products with high – over 99% – purity can be found in pharmaceuticals and hair dyes. LCD monitors' liquid crystals are also made from them.

Although research has continued into loss-reducing mining technologies, oilshale is the country's largest source of hazardous and non-hazardous industrial waste. Approximately half of the extracted oil shale becomes waste (70% of the country's non-hazardous waste generation). Oil shale processing also generates up to 98% of the country's hazardous waste, including ash from oil shale combustion, as well as semi-coke and retorting waste from its conversion to shale oil (OECD, 2017).

Waste rock is usually sorted into low-quality gravel (for road construction or backfilling) and oil shale residues. Oil shale residues are deposited in landfills because it is not economically feasible to re-use them (Gaškov et al., 2012). The risk of self-ignition and leaching, with consequent negative impacts on air quality and groundwater, is particularly high in Soviet-era landfills, where the oil shale content in waste is very high.

→ **Coal and lignite**

Counterintuitively almost no extractive waste is generated during lignite/brown coal mining because:

- overburden is not classified as waste if stored in the mining area and managed as per EWD (2016),
- intergrowth/interlayers in deposits are treated as overburden,
- soil and rock mass moved within excavations are not classified as extractive waste when deposited within the excavated pit or used for landscaping and other rehabilitation measures,
- associated minerals (by-product) sold or to be sold in the future, i.e. gravel and sand, are not classified as waste,
- extractive waste reported by brown coal producers comes from e.g. associated aggregate production plant,
- fly-ashes and flue-gas desulfurication gypsum coming from the power-stations that are normally associated with mines are either commercialised or deposited in the mined-out areas – a large proportion of the gypsum used in the building industry comes in fact from this source.

→ **Hard coal**

As noted earlier, hard coal mining has ceased in most European countries except for Poland and the Czech Republic.

Poland

According to Galos & Szlugaj (2014) the amount of waste generated in the hard coal industry has been declining amounting to 33,7 million tons in 2012, with 28.6 million tons of this being utilised. Roughly 4.8 million tons of this was generated in 2012 by the only mine in the Lublin Coal Basin – the Bogdanka mine – while the rest resulted from the mines in the Upper Silesia Coal Basin. Around 20% of this waste arises from the opening up of mines or new areas in existing ones with highly variable composition depending on rock types and geological conditions of the extracted deposits.

The amount of generated extractive waste is directly related to the volume of coal production, currently exploited part of deposit, exploitation system used, and sorting technologies applied in the processing plants. It comes from the floor, roof and overgrowth of coal seams and then during sorting is separated from the coal**.** In the 1980s the extraction of 1 t of coal was accompanied by 0.5 t of the extractive wast and then decreased to 0.25 – 0.35 t as a result of more modern coal extraction technologies in spite of coal deposits becoming more and more difficult to access.

The basic way to manage mining and processing waste was to deposit them close to the mine or on a central site. A significant part of the waste was used for filling natural or anthropogenic depressions and treated as land reclamation. Some of the waste is used as aggregates and material for the construction and building industry. A groundwater contamination hazard arises from the chloride salinity, sulfur content and acid generation potential in these wastes.
Hard coal mines report extractive waste mostly with code 01 04 12 – 23.9 Mt in 2017 (95% of total generated waste with code 01). More detailed information is presented in Table 28.

Coarse-grained materials are recovered for industrial processes:

1. Engineering, hydraulic engineering, and road construction aggregates are mainly produced by Haldex S.A. Aggregate of 3–45 mm is commonly a mixture of carbonaceous claystone, shales, mudstone, and sandstone, with a predominance of shales and claystones and a small share of sandstone (<10%). This aggregate exhibits variable water absorption and – commonly – weak freeze resistance. It can be used in engineering works (road construction, hydrotechnical construction), for land reclamation, for construction of landfills, and for backfilling of underground workings. Due to weak freeze resistance, such aggregate can be used in road construction only after stabilization with the use of cement, active fly ash, or granulated blast furnace slag. Some modifications in the Haldex plant in recent years made it possible to change the assortment of produced aggregates, with separation of coarse-grained aggregates. Total production of aggregates in the plants of Haldex S.A. reached 1.8 Mt in 2008, including around 30% of aggregates >31.5 mm (Koperski et al. 2008), and – after commencement of the Z-12 Panewniki plant – their total capacities exceeded 3.0 Mt per year in 2013. The second application is ***shale gravellite*** is artificial, lightweight aggregate obtained in the course of thermal processing (sintering) of raw coal shale, or from the mechanical processing of self-burnt coal shale from old dumps.

Table 28: Extractive waste generation and recovery by hard coal mines presented in the Provincial (voivodship) report 2017 – Waste management database (Lubelskie Voivodship, 2017, Śląskie voivodship, 2017)

No	Waste generation in 2017		Recovery in installations and devices in 2017	Recovery outside installations and devices in 2017	Disposal of waste in installations and equipment	Waste transfer to persons or organizational units, not entrepreneurs, for their own needs
	Waste holder	Waste generated	Waste recovered [Mg]	Waste recovered [Mg]	Waste recovered [Mg]	Waste recovered [Mg]
01 Wastes from mineral excavation						
01 01 02 Wastes from mineral non-metalliferous excavation						
1.	ZAKŁAD GÓRNICZY ZAGŁĘBIE Sp. z o.o.	2.371		2.371		
2.	POLSKA GRUPA GÓRNICZA Sp. z o.o.	133.234	28.008	16.507		
3.	Katowicki Holding Węglowy S.A.	6.949				
4.	Jastrzębska Spółka Węglowa S.A.	120.428		98.654	20.327	
5.	PRZEDSIĘBIORSTWO GÓRNICZE "SILESIA" Sp. z o.o.	7.757	7.757			
01 04 12 Washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11						
1.	POLSKA GRUPA GÓRNICZA Sp. z o.o.	7.984.688	1.580.765	845.490		
2.	Katowicki Holding Węglowy S.A.	6.949	940	2.769		
3.	Jastrzębska Spółka Węglowa S.A.	10.199.544	347.629	5.356.879	3.773.820	
4.	Lubelski Węgiel "BOGDANKA" S.A.	5.693.662			3.010.924	24.457
01 04 81 Waste from coal flotation enrichment						
1.	POLSKA GRUPA GÓRNICZA Sp. z o.o.	302.875	2.186	78.539		
2.	Jastrzębska Spółka Węglowa S.A.	784.680	66.461	387.870	242.209	
01 04 99 Waste not otherwise specified						
1.	POLSKA GRUPA GÓRNICZA Sp. z o.o.	1				

2. Production of raw materials for building materials – cement, building ceramics – It is estimated that total utilization of such material in building ceramics' production in Upper Silesia does not exceed a level of 50,000 t per year., but The Ekoklinkier plant near the Bogdanka hard coal mine in the Lublin Coal Basin is an example of the successful implementation of building ceramic production exclusively from clayey coal processing waste. This highly automated factory of yellow-brownish I bricks (annual capacity 20 million units), built on the basis of a license granted by the French company Occidental Industries, was opened in 1996. Coal shale (grain size 20–80 mm) from the coal processing plant in the Bogdanka coal mine is applied in this plant.
3. Recovery of coal and production of low calorific materials for power plants – coal is mainly recovered from coal mining wastes by Haldex S.A. Coal produced in Haldex S.A. processing plants is recovered as fine coal (0–20 mm) and pea coal (20–45 mm). It is a steam coal (type 31.1 and 31.2), with an average calorific value of 22–23 MJ/kg, ash content of 18–20%, sulfur content 0.7–0.8%, and moisture 8–12%. The annual coal production in Haldex S.A. plants varies between 120,000 and 170,000 t per year. During the last 50 years Haldex S.A. recovered some 17 Mt of such coal. Besides Haldex S.A., coal recovery is also a component of activity of a few other, smaller companies in the Upper Silesia region, such as Gwarex Polska in Świętochłowice (2 Mt of coal recovered since 1991), and Polho in Czerwionka which, since 1993, has recovered coal from the Dębieńsko coal mine dump site.
4. Use of such wastes as material for filling underground voids resulting from mining activities, thus increasing the recovery of coal and reducing the potential for acid mine drainage generation in open and collapsing mine works.

The Polish coal mining industry generates approximately 30 Mt of mining waste per year, which represents the largest amount of industrial waste in Poland. The coal mining waste facilities are spread over an area of over 4,000 ha with more than 220 individual sites, where over 760 Mt of wastes from hard coal mining have been disposed. The majority of mining wastes, however, are utilsed in civil engineering for, e.g. construction of dykes and polders, railway and highway embankments, ground leveling and reclamation of areas prone to subsidence or impacted by industry. The highest concentration of extractive waste facilities occurs in the central part of the Upper Silesian Coal Basin (USCB), i.e. in Bytom (21 sites), Ruda Śląska (12 sites) and Zabrze (34 sites), as well as in the south-western part of the USCB, i.e. in Rybnik (13 sites) and Jastrzębie-Zdroj (4 sites). The largest facilities cover an area of up to 250 ha. The largest coal mining waste dumps are (Gawor, 2014):

- Central waste facility Knurow 255.10 ha, Kościelniok (Pniowek/Krzyżowice mine) 193.60 ha, Waste Facility Number 1 (C Sośnica/Gliwice mine) 160.90 ha, Waste Facility Przezchlebie 150.00 ha,
- Central waste facility Smolnica 138.83 ha, Pochwacie (Zofiowka/Mszana mine) 137.10 ha, Waste Facility Panewniki (Halemba/Mikołow mine) 118.40 ha.

Czech Republic

Czech Republic hard coal production amounted to 5.5 Mt in 2017 with OKD as the only producer. Brown coal production amounted to 39.3 Mt in 2017. Production came from four companies: SD (21.7 Mt), VUAS (7.5 Mt), SU (6.9 Mt) and Sev.en (3.2 Mt). An overview of reported waste generation is given in Table 29.

Table 29: Generation of waste (in tons) in the extraction and processing of coal (CSA mine and Komorany coal preparation plant, Centrum mine, Sev.EN WT. SA)

	2013		2014			2015		
	Severni energeticka t	Dul Kohinoor t	Severni energeticka t	Dul Kohinoor t	Umeco (1.07-31.12.214) t	Severni energeticka t	Dul Kohinoor t	Sev.en WT (Former Humeco) t
Total amount of waste generated:								
Hazardous waste	358,5	1,67	167,56	1,2	0,172	184,04	2,1	0,896
Other waste	5953,3	215,19	38633,05	154,8	874,05	880,652	288,25	778,635
Wate management method:								
Total quantity of waste intended for re-use	6247,5	204,76	38747,33	81,6	902,511	916,248	230,01	755,106
Total quantity of waste delivered to other companies for disposal	64,3	12,1	53,28	74,4	29,234	148,444	60,34	47,461

→ Lignite

Lignite mining is an industry that over the years has developed very good techniques and technologies for mining and rehabilitation of mined-out areas, as well as applying optimal management and organisation systems. Based on the example of lignite management (Figure 37) different possibilities of waste management and classification can be presented.

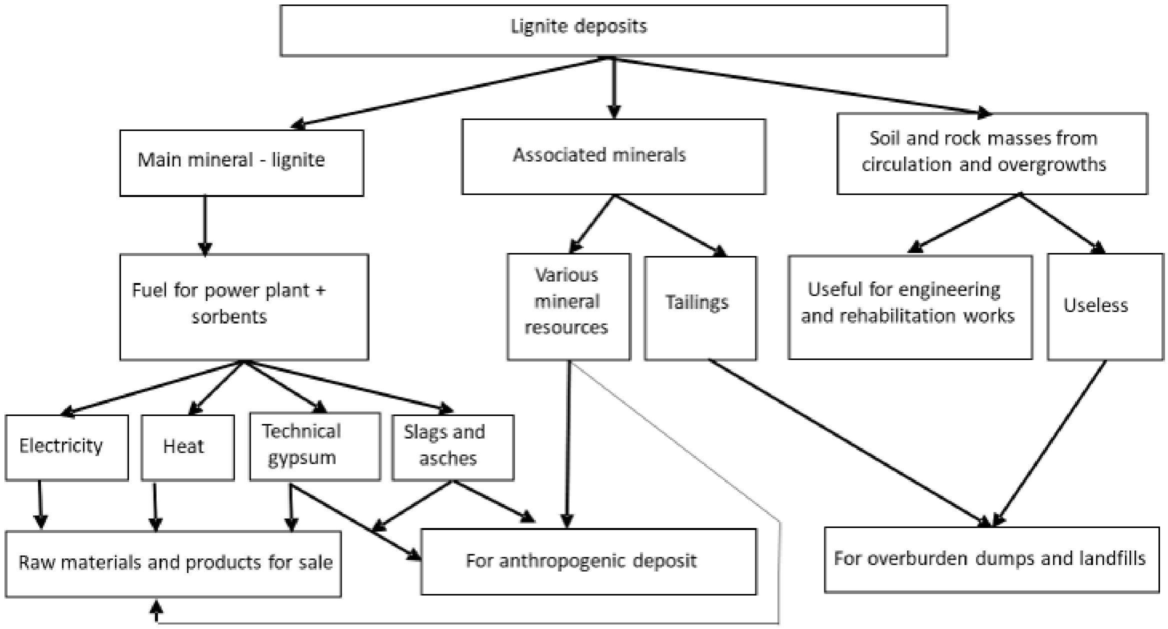

Figure 37: Scheme for the management of raw minerals and products in the Polish lignite-based mining-energy sector (From Uberman, 2017)

Poland

At present, in Poland there are four lignite mines operating, of which the largest is KWK Bełchatów with a production of 42,6 Mt and an overburden 127,7 Mm^3 (Figure 38 and Figure 39).
Figure 40 and Figure 41 illustrate respectively the extraction of lignite and the removed overburden for the whole life of the mines (Mt). During the establishment of the Bełchatów mine, until 2017 4,510.5 Mm^3 of overburden have been removed to mine 1,168.7 Mt of lignite (N:W = 3.86).

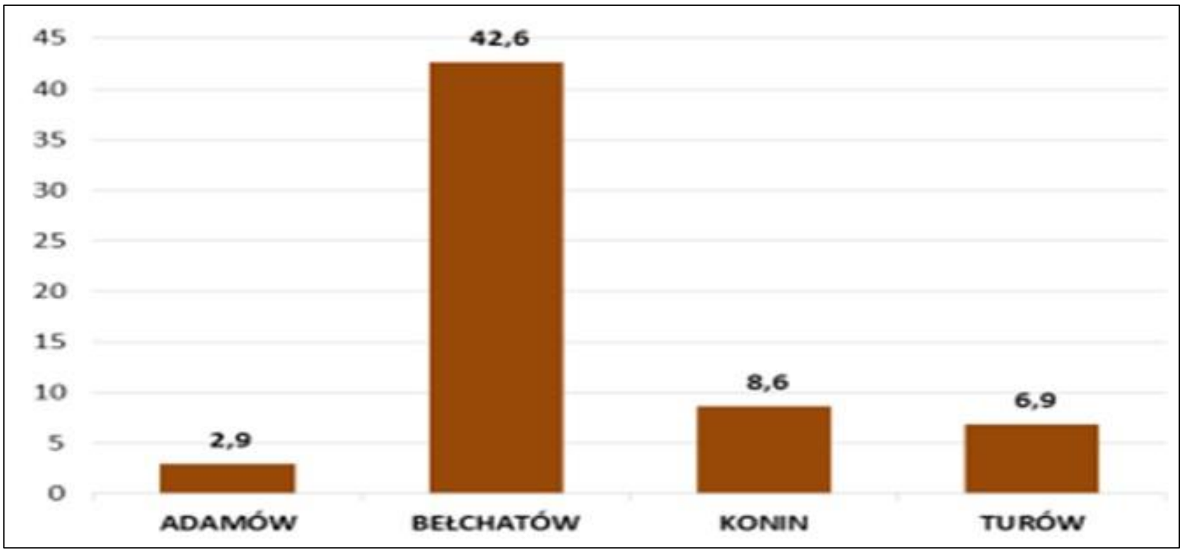

Figure 38: Extraction of lignite in 2017 in Poland (Mt)

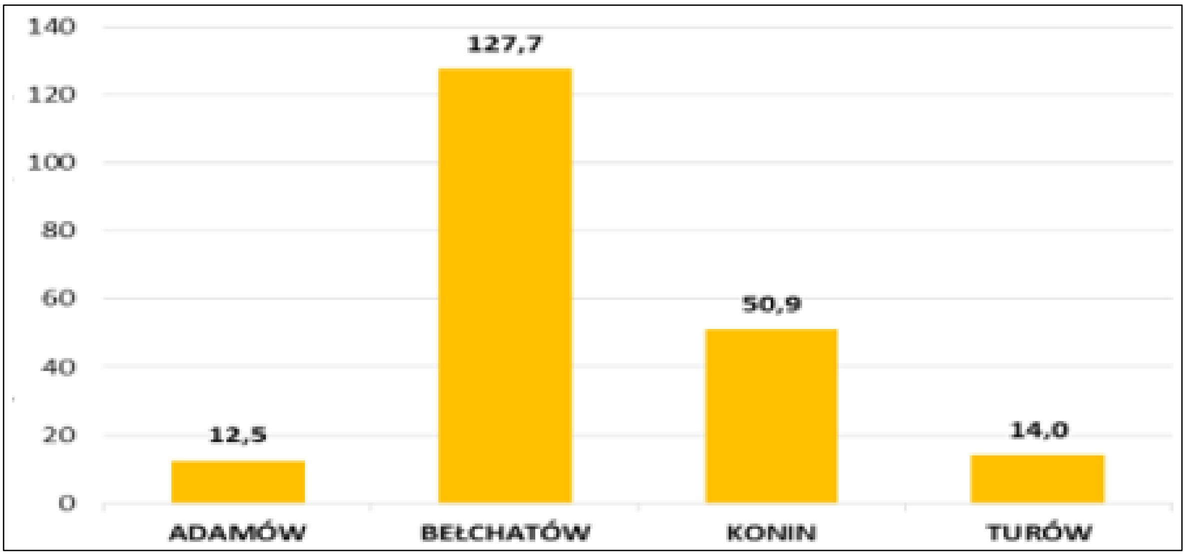

Figure 39: Overburden removed during extraction of lignite in Poland in 2017 (Mt)

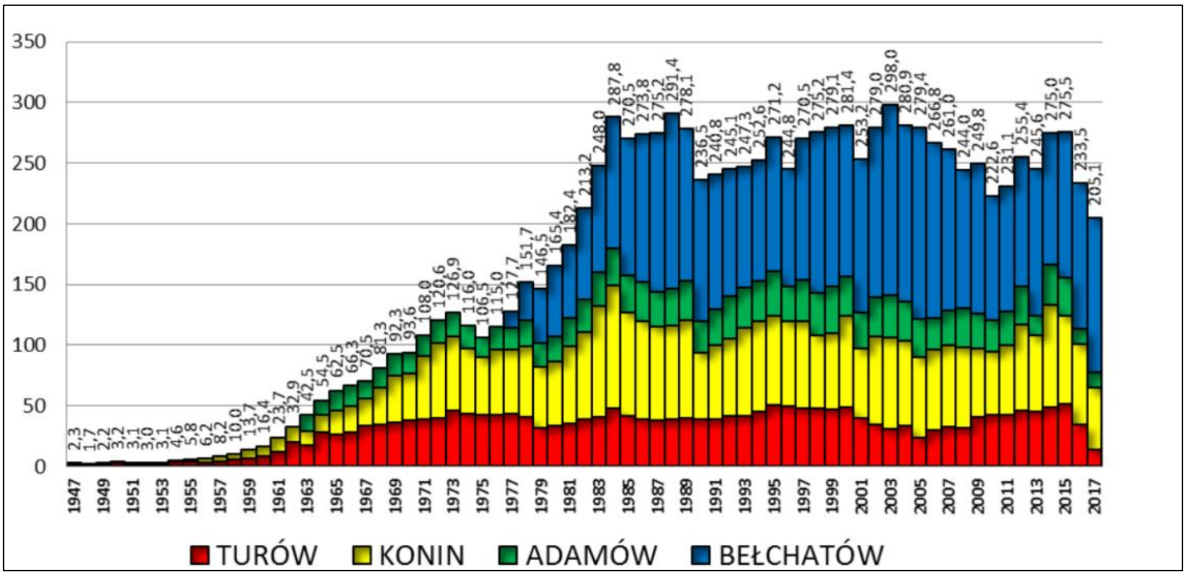

Figure 40: Removing the overburden for 2017 (Mm^3): Extraction of lignite from the whole life of mines (Mt) (Kasztelewicz, Z., 2018)

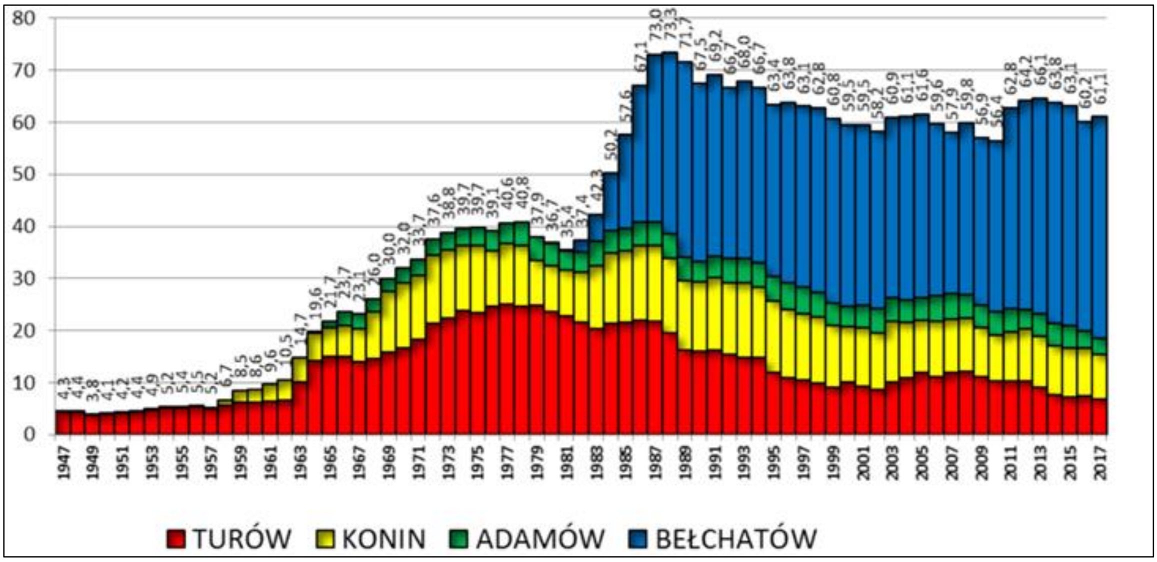

Figure 41: Removing the overburden for the whole life of mines (Mm3) (Kasztelewicz, 2018)

The stripping ratio defining the volume of overburden (or waste material) required to be handled in order to extract some tonnage of ore by individual mines is presented on Figure 42.

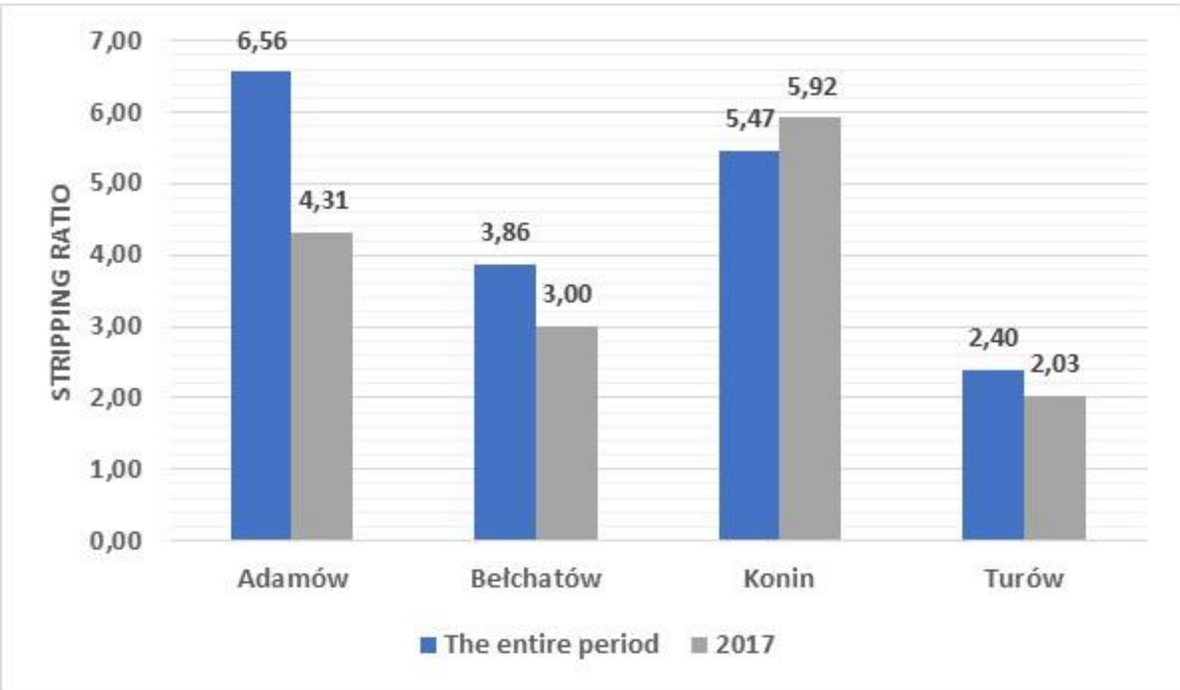

Figure 42: The stripping ratio in Poland (Kasztelewicz, 2018)

Since overburden consists of earth or rock masses removed from the deposit in order to enable the extraction of a useful mineral and placed in the mining area it can be used for rehabilitation or restoration. Therefore, overburden is not classified as waste if stored in the mining area and managed according to the Geological and Mining Law, there are nearly no extractive wastes from lignite mining in Poland. Selective mining techniques are used and produce accompanying minerals, minerals (by-products) which are sold or to be sold in the future. Hence, gravel and sand are not classified as waste, and only small amounts of EW are registered, mainly from the processing of accompanying minerals.

Soil and rock mass moved within an excavation is not classified as extractive waste, if a proper document (concession or local plan for mining area or mining plan) defines the conditions for its management and further use. Moreover, intergrowth/interlayer in deposits is treated as overburden.

Limestone is one of the accompanying minerals in the Bełchatów lignite deposit and is used for the production of SO_2 sorbents and desulfurication in the Bełchatów conventional power plant, which is located in the immediate proximity of the deposit. The Jurassic limestone occurs in the slopes of the open-cast mine. They are gradually uncovered as a result of lignite mining. In order to ensure the stability of slopes during the extraction of lignite, it is necessary to form them to the desired dip angle. This involves the need to extract up to 70 Mt of limestone. Limestones from the Bełchatów deposit are characterized by a high lithological variability, numerous marl interbeddings and marl rocks, and various secondary mineralisations. This results in a high variability of physico-chemical and physico-mechanical parameters, forming the basis for their suitability for numerous economic applications (Hycnar et al., 2018).)

Lignite mines do not report extractive waste, only PGE Górnictwo I Energetyka Konwencjonalna S.A. in Bełchatów reported small amounts of waste with code 01 04 12 (Table 30), which was reported in the Provincional (voivodship) report 2017.

Table 30: Extractive waste generation and recovery by Bełchatów presented in the Provincial (voivodship) report – Waste management database (Łódzkie Voivodship, 2017)

Waste generation in 2017			Recovery outside installations and devices in 2017			
Waste holder	REGON	Waste generated [t]	Waste holder	Symbol	Recovery process	Waste recovered [t]
01 04 12 washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11						
PGE Górnictwo i Energetyka Konwekcjonalna SA, Bełchatów	000560207	19 000	PGE Górnictwo i Energetyka Konwekcjonalna SA, Bełchatów	R5	Recovery and recycling of other non-organic materials	21 001

Any reported extractive waste generation comes from the Aggregate Production Plant (accompanying minerals out of a mining area).

Germany

Germany is a leading producer of lignite with the extraction of ca. 18% of the world production. Currently mining is carried out in ten open-cast mines from three major basins (the Rhine, Central German, Lusatian and the closed Helmstedt district). The list of mines located in the three regions: Rhineland-Westphalia, Central Germany and Lusatia is given in (*Table 31*).

Table 31: Overview of lignite mines in Germany

The Rine	Central German	Lusatian
Garzweiler	Amsdorf	Welzow-Sud
Inden	Profen	Jänschwalde
Hambach	Vereinigtes Schleeeinbain	Nochten
		Reichwalde

In 2016, the total extraction of lignite from the ten mines amounted to over 170 million t with over 850 million m^3 of overburden. The largest amount of lignite was extracted in the Rhine basin with over 90 million t and the Lusatian basin with over 60 million t. The average stripping ratio for all mines was around to 5:1 (Table 32).

Table 32: Production parameters of German lignite mines

Region	Overburden (mln m^3)	Lignite extraction (mln t)	Stripping ratio
Rine (Rheinisches Revier)	428,24	90,45	4,7 : 1
Lusatia (Lausitzer Revier)	372,71	62,29	6,0 : 1
Central Germany (Mitteldeutsches Revier)	50,90	17,73	2,9 : 1
Helmstedt	0,04	1,07	
Total	**851,90**	**171,55**	**5,0 : 1**

Bulgaria

In Bulgaria Mini Maritsa Iztok EAD operates in the Maritsa Iztok basin where coal reserves are located relatively low at 6-10 m to 110-120 m below the surface. The total thickness of the lignite complex is some 35-40 m, divided by clay layers into three seams. The medium (second) seam is the main lignite-bearing one with an average thickness of 15-25 m. The first seam has no economic significance with its thickness of only 0.5 to 1 m. The deposit is operated by three opencast mines, nl. Troyanovo-1, Troyanovo-North and Troyanovo-3. This allows a significantly better extraction of the reserves in the basin and the implementation of state-of-the-art equipment and technology. The ratio of the volume of overburden deposited into the internal and the external dumps is 1:1, and the trend is to increase the volume stored into the internal sites and thus shorten the transportation distance (Mini Maritsa Iztok (MMI).

From the beginning of the operation in 1962 until the end of 2013 a total of over 1,038 million tons of lignite had been extracted, with 4,279 mln m^3 of overburden removed (MMI report, 2013). The stripping ratio = 4,12 cubic meters per ton. In the EWMP the status of the waste corresponds to non-hazardous.

Lignite mining in the basin has generated a large volume of materials, neither overburden nor waste, but that have the potential to lead to environmental problems which was analysed by Markova et al. (2016)

Greece

In Greece, lignite is the main energy mineral that is extracted for consumption in electricity power stations of the Public Power Corporation (PPC). Greece is being both one of the largest producers and depositors of that type of coal in Europe, with around 55-60 million tons of annual production, and more than 7 billion tons of reserves (Greek Ministry of Environment and Energy, 2016). The most important deposits (Figure 43) are located in the north of the country at Ptolemais-Amynteon and Florina (1.6 billion tons) which contribute around 80% of production. Other deposits lie at Drama (900 million tons) and at Elassona (170 million tons), as well as in the south at Megalopolis (132 million tons).

The main lignite mines in Greece are:

- Ptolemaida - Amideo lignite centre (includes Kardia Field, Main Field, South Field, Amideo Field) (Operator: Public Power Corporation),
- Megalopolis Lignite Centre[11] (Operator: Public Power Corporation),
- Servion Lignite mine[12] (Operator LARCO).

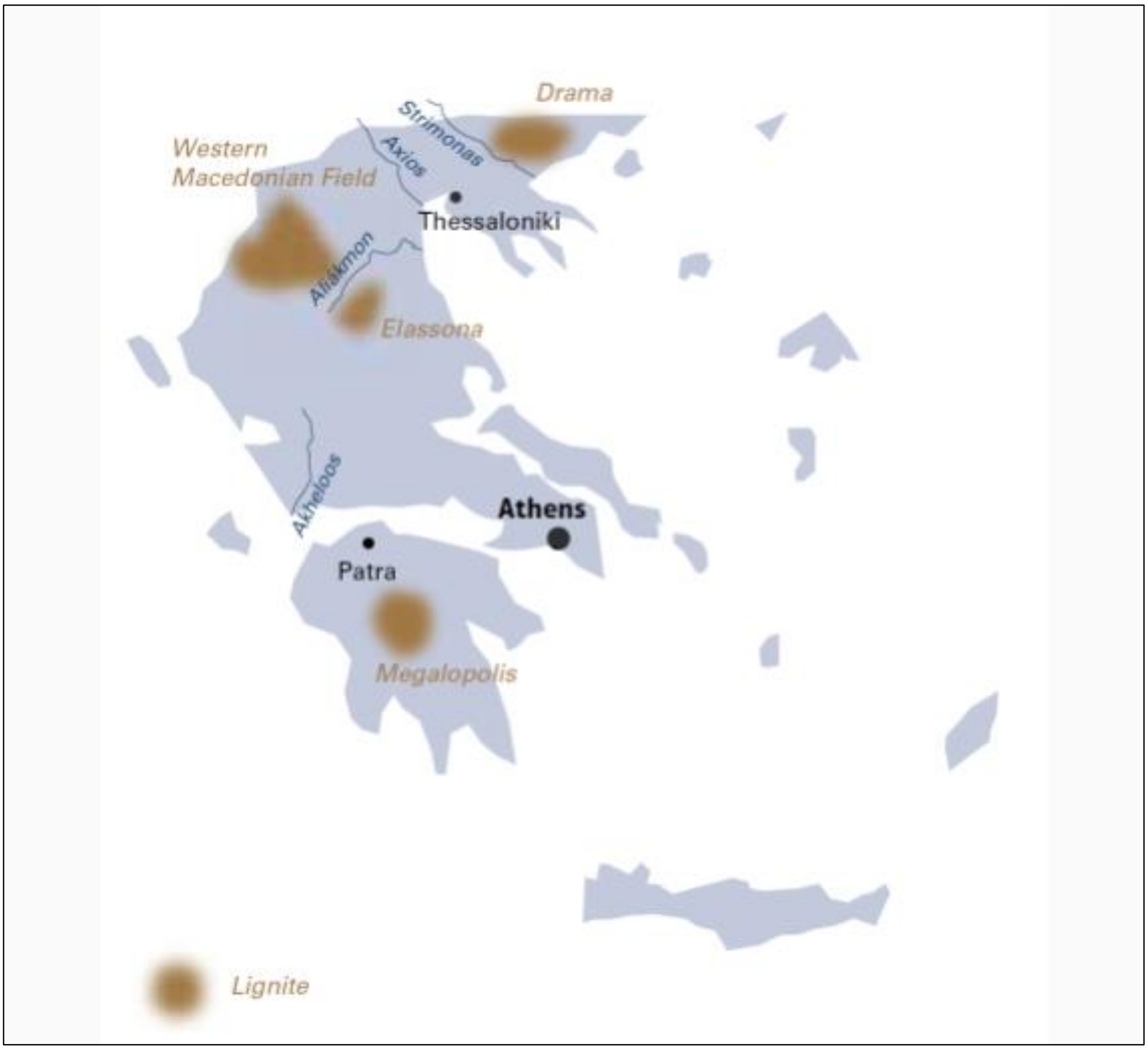

Figure 43: Lignite deposits in Greece (Source: www.euracoal.eu)

For the Period 2015-2017 the production of lignite, after a continuous decline in recent years due the economic crisis in Greece in 2017, a 15% increase was showed. Greece is making efforts to implement the most ambitious decarbonisation strategy in Europe, aiming to close all of its existing lignite mines by end 2023 and to mothball one plant currently under construction by 2028 (EBRD, 2020). Moreover, the Greek government announced the abolition of lignite-based electricity generation by 2028. (Pavloudakis at al. 2020).

Table 33 sets out the exploitable lignite reserves, stripping ratio (Kavaroudis, 2008), average ash content and the heating value of the main Greek lignite deposits.

[11] LIGNITIKI MEGALOPOLIS SA, a 100% owned subsidiary of PPC, also operates an opencast site in the Peloponnese region of southern Greece, in the Megalopolis Field (www.euracoal.com)

[12] The extraction of lignite is related to the needs of the Metallurgical Plant of the company

Table 33: Basic characteristics of Greek lignite deposits

Deposit	Exploitable reserves (Mt)	Stripping ratio (m^3/ton)	Ash content (dry basis, %)	Heating value (MJ/kg)
Ptolemais - Amynteon	1 595	5,8	29,2	5 650
Florina	325	7,8	39,6	8 180
Megalopolis	237	2,3	32,6	4 350
Elassona	169	5,0	34,8	8 300
Drama	900	6,0	39,0	4 370
Total	**3 226**	**5,4**	**35,0**	**6 170**

The development of a specific extraction technology "selective mining of multiple-layered lignite deposits, solved the problem of lignite seam morphology (lignite layers intercalated with barren layers). Using this method, co-extraction and dilution of lignite with barren material is minimised (Galetakis and Roumpos, 2015).

According to the newest publication from Pavloudakis et al. (2020) the decision to intensify the exploitation of domestic lignite deposits has been a central political option, supported by all Greek governments over the years. Up to now, 1.7 billion tons of lignite have been produced and more than 8.5 billion m^3 of rocks have been excavated from four surface mines.

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3.2.6. METALLIC MINERALS

The aim of this part of the study was to develop a coherent description of the metallic mineral mines with plausible and matching figures on the amounts of extractive waste generated. Therefore, this section aims at developing a wider picture of the metallic mineral extractive sector focusing only on active mines and on the investigation for each MS of the total amounts of extractive waste, structured by categories appropriate for each commodity.

Nearly every metal mine is unique and, therefore, the type, the amounts and the characteristics of the extractive waste differ, depending on the deposit, the geology, the choice of mining technique (open-pit vs. underground) and the technology applied for the mineral processing. The potential environmental impact of extractive waste management depends on its type and its composition, which vary considerably with the commodity being mined, host-rock geology, type of ore, and techniques used to process the ore. An important condition for proper waste management is sufficient knowledge on the geochemical and physical properties of the extractive waste. Such knowledge is obtained through adequate characterisation of the waste.

Some case studies are presented below:

- Boliden Mining Area in Finland: today the area is home to the Renström, Kristineberg and Kankberg underground mines, as well as the Maurliden open pit mine. These sites are considered as one mine, under one management, operating multiple sites.
- Svappavaara mine in Sweden: Svappavaara comprises three open-pit sites, two of which are currently in production - the Gruvberget and Leveäniem sites. The company provides production information for the Svappavaara mine as a whole. As a consequence, for the purposes of this study, the wider area of Svappavaara is considered as a single mine.
- In Greece, the most important known bauxite deposits are located in the Mountain (Mt) Helikon – Mt Parnassus – Mt Giona zone. Two companies operate In this area: Mytilineos (DELPHI-DISTOMON S.A.) and Imerys. The companies are licensed to operate over 10 extraction sites each. However, the area is generally considered as two operating mines: the Gkiona Mine and the Mount Parnassos mine.

As it is already stipulated in sub-chapter 2.2.1 the current study presents a specific picture of the active metal mines in EU-27. Specifically, the MWEI BREF (Garbarino et al., 2018) provides an idea of the main European regions where extraction of mineral resources is carried out, indicating 247 metallic mineral ore sites, as well as uranium mines (thoriumis currently not mined in Europe). This study shows that there are 70 active metal mines, taking into consideration mining areas, that may include multiple sites in one municipality, under one operating management. Based on the information provided by Cherrier et al. (2017) the number of permits for metallic mines is estimated to be 201 across the EU as of July 2017[13]. It is thus considered likely that the 70 active metallic mineral mines identified in this study are holders of multiple permits.

The estimates of the amounts of Extractive Waste (EW) for each of the 70 mines are based on the hypothesis that there are generally six material streams arising from the production of a metal concentrate when both a mine and a beneficiation plant are present and operating, namely:

1. *Total excavated material:* that is the volume generated in order to access and extract valuable mineral resources, which was assumed to equal the sum of the streams *Rock* and *Ore* (see below)
2. *Rock* stream: This term is used for the purposes of the current study as an “umbrella” to cover three material streams:

[13] Based on information returns from Member States, 3,754 extractive waste permits were recorded across the EU as of July 2017. Of which 3,228 (86%) were recorded as being operational, 460 (12%) in the closure / post closure phases and 66 (2%) were reported as not operational or unknown. Regarding products, of the 2,013 permits for which information was available, the majority (79%) related to non-metallic minerals and 10% to metallic minerals.

(a) Overburden: "The material that extractive operations move during the process of accessing an ore or mineral body, including during the pre-production development stage: layer of natural soil or massive rock on top of an orebody" (Garbarino et al., 2018);
(b) Waste-rock: "The material that extractive operations move during the process of accessing an ore or mineral body, including during the pre-production development stage: part of the orebody, without or with low grades of ore, which cannot be mined and processed profitably" (Garbarino et al., 2018);
(c) Gangue: "The part of an ore that is not economically desirable but cannot be avoided in mining" (Garbarino et al., 2018).

The *Rock stream* is the amount of excavated material that are left over after accessing and extracting the *Ore* stream from the *Total excavated material*. This stream in some cases is not considered as a waste stream, but as a material that partly or totally may be utilised by the operator for (a) filling the excavation voids for rehabilitation and construction purposes, (b) construction purposes outside the mine, and (c) landscaping. It is often unclear which percentage of rock may be fed to EWFs and which is utilised for the aforementioned uses. For this reason the Rock stream is presented as the amount that was initially intended to be mined, without characterising it as waste or non-waste.

3. Ore stream:"Mineral or variety of accumulated minerals of sufficient value as to quality and quantity that it/they may be mined at a profit. Most ores are mixtures of extractable minerals and extraneous rocky material described as gangue" (Garbarino et al., 2018). For the purposes of the present study it is assumed that the ore stream is equal to the sum of the streams Concentrate, By-product and Tailings (see below).

4. *Concentrate* stream: "Marketable product after separation in a mineral processing plant with an increased grade of the valuable mineral" (Garbarino et al., 2018);

5. Secondary concentrate stream: there are cases such as in the mixed sulfide oxide ores, which are treated using two or more distinct circuits and produced a corresponding number of concentrates. So this stream presents the secondary commodity of marketable products including concentrates of additional valuable minerals

6. *Tailings*:"The waste solids or slurries that remain after the treatment of minerals by separation processes (e.g. crushing, grinding, size-sorting, flotation, and other physicochemical techniques) to remove the valuable minerals from the less valuable rock" (Garbarino et al., 2018). For the purposes of the present study, it is assumed that the tailings are the remaining material after the beneficiation process that leads to the production of *Concentrate* and *By-product* from *Ore stream*.

In addition, there are cases, where bauxite ores are imported into the EU and their processing results in the generation of extractive waste (typically 'red muds'). Since the bauxite residues are covered according to Decision 2014/955/EU (List of Waste-LoW, EC, 2014a) under the chapter 1 "Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals", they were also examined for the purposes of this study. Examples are the Gardanne plant (France), Aughinish Alumina (Ireland), San Ciprian (Spain), Stade (Germany) and ALUM Tulcea (Romania). There is also the case of Aluminum of Greece, which use bauxite from the nearby mines, that was also included in the assessment. For all these cases only the concentrate stream and the tailings stream (as the waste from the Bayer Process) were estimated.

The first step for estimating the amount of extractive waste was to define for each mine the ore production for the years 2015-2016-2017. Hence data on the yearly ore production per operating activity were collected. There was a limited number of cases for which data were publicly available from the companies themselves. These data, as well as the published annual reviews of statistical data on mineral commodities were the basis for the calculations. The data collected included for each active metallic mine the mining technique used (e.g. underground versus surface extraction). In principle, the relative amount of *Rock* that is generated is linked to a stripping ratio, which generally refers to the units of materials that are necessary to remove in order to extract one unit of ore. According to MWEI BREF (Garbarino et al., 2018), the stripping ratio for underground mining usually would be less than 0.5:1 (in the the original reference of the World Bank[14] this ratio is for base metals and iron ore mines). The amount of waste-rock or overburden that must be removed to gain access to a unit of ore is generally expressed in cubic meters of *Rock* per tonne of raw ore. The complication that this proportion creates is, that the units of *Rock* are different from those of ore, so an estimation for the *Total Excavated Material* is not possible. Furthermore, as the geometry and mineralogy of each deposit is unique, it is not possible to derive a density that is valid for all cases. To overcome this obstacle, it was decided to roughly assume a ratio of 0.5:1 as tonnes of *Rock* to tonnes of *Ore*. This assumption was 'ground-truthed' to a limited extent against available data from an underground mine in Greece. Table 35 presents this approach, showing that the assumption provides estimates close enough to the reported data for the purposes of this study. However, there are cases where the assumption of astripping ratio 0.5:1 for underground mines resulted clearly in unrealistic estimates and the calculations were improved using data provided directly by the mine operator (e.g. Mittersill mine).

Table 35: Calculated extractive residues generated during excavation versus the real one (as the company has reported)

Year	Bauxite Production (t)	Reported Rock (t)	Calculated Rock (stripping ratio 0.5:1) (t)
2015	649,364.88	251,144.00	324,682.44
2016	629,741.84	368,268.00	314,870.92
2017	630,093.16	330,698.00	315,046.58
Average	636,399.96	316,703.33	318,199.98

As far as surface extraction is concerned, there are 19 active open-pit metal mines in EU-27 in the following MSs: Austria, Bulgaria, Finland, Greece, Hungary, Romania, Spain, and Sweden. There are an additional nine mines where both, underground and surface extraction take place (Finland, Romania, and Sweden). According to MWEI BREF, for surface extraction of base-metal-bearing ores, stripping ratios vary from 2:1 to 8:1[15], depending primarily on the geometry of the deposit. In most cases, this ratio will vary significantly over the life of the mine. Every deposit has its own characteristics and prolonged use of a literature-based stripping ratio may lead to results that are inaccurate and misleading – especially over time. For example, according to data published for the Atalaya (Rio-Tinto) open-pit (Atalaya Mining, 2018) for 2017, the ore mined was reported as 9.3 Mt and the waste extracted as 19.8 Mt (Figure 44). However, another parameter that influences the waste generation is the length of time a mine has been in operation. New open-pit mining operations typically produce larger amounts of waste, than those where the mine is approaching the closure phase.

[14] https://elibrary.worldbank.org/doi/abs/10.1596/0-8213-3638-X

[15] expressed in cubic meters of waste-rock/overburden to tonnes of raw ore

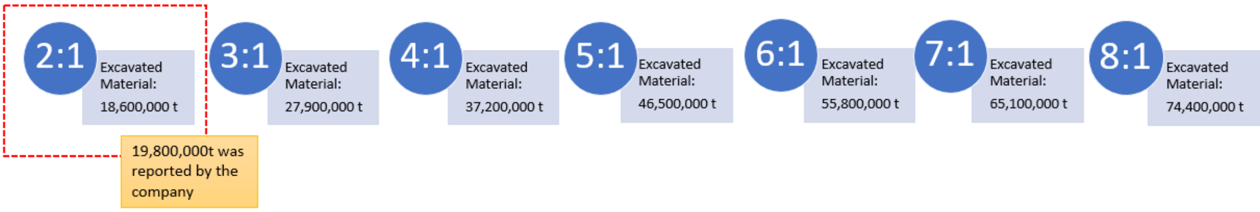

Figure 44: Calculation of excavated material according to bibliographic stripping ratios versus real value

This study focused on collecting data from the companies themselves and only in cases where this was not possible, aggregatied figures for each type of ore in correlation with the year that the mine started operating were used to estimate a plausible stripping ratio. As was mentioned before, the calculations for *Rock* were based on the assumption that the stripping ratio is expressed in tonnes of rock to tonnes of ore. There were cases, such as the open-pit mine at Erzberg (Austria), where some data for calculations were available on the mine's official website (www.abenteuer-erzberg.at). For example, it was published that "*12 million tons of stone are processed and, thus, 3 million tons of grain-sized iron ore can be produced in one year*". With this information, a *Rock* production of around 8 to 9 million tonnes can be calculated, leading to a stripping ratio of 3:1.

In Finland, according to MWEI BREF (Garbarino et al., 2018), the stripping ratio for metalliferous ore extraction was on average 1.7:1 (ranging from < 0.1:1 to 6:1) in 2011, based on data provided by a Finnish representative for 12 sites. The data available to this study show that there are three open-pit mines (Talvivaara, Kemi, and Laiva) and five mines where both, underground and surface extraction takes place (Jokisivu, Pampalo, Pyhasalmi, Kemi, and Pahtavaara). According to available data, the *Rock* stream for the Kevitsa Mine, which started operation in 2012 at a depth of over 500 m (Boliden, 2017), was estimated using a stripping ratio of 3 t of *Rock* produced for 1 t of *Ore* (for the period 2015-2017). Another example is the Kemi mine, which produces chromite ore. As illustrated in Figure 45, the mine area includes four open pits and beneath these operations, extraction continues underground. As a consequence, the calculated stripping ratio is influenced by both mining techniques. So, even if surface extraction takes place, the stripping ratio that is used for the estimation of the *Rock* stream is quite low.

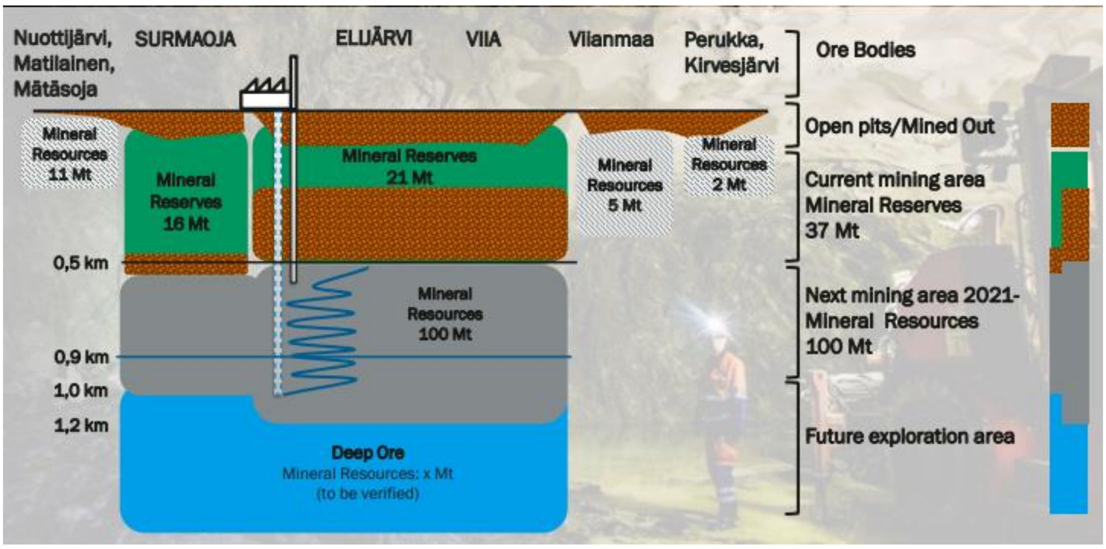

Figure 45: Example of open-pit and underground extraction (Source: Presentation Kemi Mine: Kemi mine 50 million tons chromite ore, 50 years of production)

The desk research for this study also covered the extractive waste generated during mineral processing (for the purpose of the present study this stream is called *Tailings*). There are cases, where the ratio of tailings to ore are known from the literature, such as for the extraction of alumina from bauxite (1:1 to 2:1). However, the relative amount of tailings from the treatment of minerals differs according to the type of mineral resource processed, the processing technique, and the ore grade. For this reason, data for the yearly concentrate production per operation were collected. There was a limited number of cases for which data were publicly available from the companies themselves. These data, as well as the published annual reviews of statistical data on mineral commodities, were the basis for the calculations.

This study initially set out to estimate total amounts of extractive waste by categories appropriate for each commodity. However, this approach would have produced inaccurate results for polymetallic minerals. An example is presented in the following scheme, which has been designed taking into consideration published data for the Garpenberg site (Boliden, 2017). As illustrated in Figure 46 , the Garpenberg site produced 2,634,000 t of milled ore in 2017 and three concentrates:

1. Lead Concentrate 55,000t
2. Zinc 201,000t
3. Copper Concentrate 5,000t

If the calculations are structured by commodity, copper produces large amounts of extractive waste, since the ore grade typically is very low. Yet, this estimation of waste is not realistic since the extractive waste should rather be calculated taking into consideration all the concentrates and it is not accurate to distribute the waste by way of analogy.

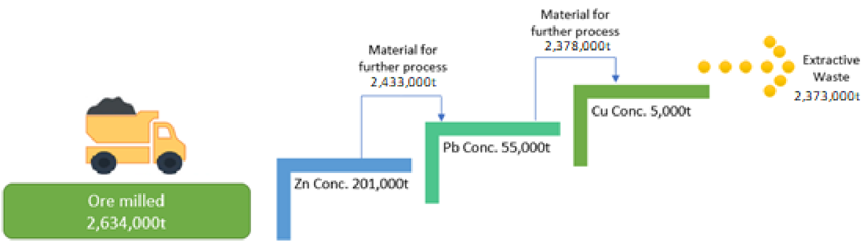

Figure 46: Processing of polymetallic minerals. The Garpenberg plant produces a combined waste stream that cannot be attributed to single metals (Boliden, 2017).

The table of results presented in Annex H is structured by MS and identifies each active metal mine by name, mining method (U for underground and O for open-pit), and main commodity produced. The collected data were examined in collaboration with the extractive industries and the country's competent authorities. For this reason, there are some cases where the data were corrected by information provided by the extractive industries itself.

After data collection and estimation of the extractive waste quantities, the classification of each extractive waste stream was undertaken. An initial step to classify the extractive waste is according to the relevant category in Decision 2014/955/EU (EC, 2014a), based on Annex II of the Extractive Waste Directive 2006/21/EC. According to Commission Decision 2014/955/EU (European LoW; EC, 2014a), the different types of extractive waste are fully defined by six-digit codes under the code group 01 – "wastes resulting from exploration, mining, quarrying, and physical and chemical treatment of minerals" (Table 36).

Table 36: Overview of the specific waste streams originating from the extraction of metallic mineral ores (EU Decision (EU) 2014/955)

Code	Waste
01 01 01	Wastes from mineral metalliferous excavation
01 01 02	Wastes from mineral non-metalliferous excavation
01 03	Wastes from physical and chemical processing of metalliferous minerals
01 03 04*	Acid-generating tailings from processing of sulfide ore
01 03 05*	Other tailings containing hazardous substances
01 03 06	Tailings other than those mentioned in 01 03 04 and 01 03 05
01 03 07*	Other wastes containing hazardous substances from physical and chemical processing of metalliferous minerals
01 03 08	Dusty and powdery wastes other than those mentioned in 01 03 07
01 03 09	Red mud from alumina production other than the wastes mentioned in 01 03 10
01 03 10*	Red mud from alumina production containing hazardous substances other than the wastes mentioned in 01 03 07
01 03 99	Wastes not otherwise specified

These six-digit codes divide the waste streams into two groups. The six-digit codes that are marked by an asterisk (*) are for wastes classified as hazardous. All the other entries are for non-hazardous wastes. The hazard assessment of a waste is based on the 15 hazardous property criteria (HP1 to HP15) listed in the Annex to Regulation (EU) 1357/2014 (EC, 2014b). The assessment starts with the investigation and identification of potentially hazardous constituents in the waste and compares their content to the threshold values defined in Regulation 1357/2014/EU (EC, 2014b).

For classification of extractive waste as inert according to Article 3(3) of the EWD (EC, 2016) "... 'inert waste' *means waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater*." The classification of waste as inert is based on Commission Decision, 2009/359/EC (EC, 2009b) completing the definition of inert waste in implementation of Article 22(1)(f) of Directive 2006/21/EC (EC, 2016).

For the purposes of this study the following assumptions were made:

- The material streams from mineral excavation, according to the LoW, corresponds only to two possible codes (*01 01 01* and *01 01 02)*, which are both non-hazardous waste codes. According to the Commission notice on technical guidance on the classification of waste (2018/C 124/01) "*Wastes which are assigned to absolute non-hazardous ANH entries cannot be allocated to hazardous entries and should be classified as non-hazardous without any further assessment. In case an ANH entry is assigned, the waste will be classified as non-hazardous and no further assessment is needed in order to decide whether the waste has to be classified as non-hazardous*". As a consequence, the stream that is arising from mineral excavation (for this study termed *Rock*) is classified as non-hazardous. However, a further distinction between inert and non-hazardous has not been possible within this study since the available data are insufficient to assess the material streams according to Decision 2009/359/EC (EC, 2009b).
- The *Tailings* streams were characterised through a rough analysis of their main constituents according to the following commodity groups:

- Extractive waste from sulfide minerals (e.g., for copper, zinc, gold, silver): *Tailings* from processing of sulfide minerals may be preliminarily assigned to one of four waste codes:
  - 01 03 04* acid-generating tailings from processing of sulfide ore
  - 01 03 05* other tailings containing hazardous substances
  - 01 03 06 tailings other than those mentioned in 01 03 04 and 01 03 05
  - 01 03 07* other wastes containing hazardous substances from physical and chemical processing of metalliferous minerals.

  Chemical and mineralogical analysis data from companies or MSs were not available to this study for an in-depth evaluation of such *Tailings* streams. According to Annex VI of the CLP Regulation (EC, 2014a) the existence of 0.3% of lead compounds in the waste sample, for example, may classify the waste as hazardous. However, taking into consideration that each mineral (from galena to cerussite) has different hazard properties this can alter the final classification through a tiered assessment (Verougstraete, 2018), it was decided to classify the waste based on its acid-generation potential due to sulfide content. In some cases the company/MS provided confirmation that the *Tailings* streams were non-hazardous (e.g., Hellas Gold S.A. in Greece, the Boliden Tara Mine in Ireland, and Polish polymetallic mines[16] – see Annex L.1).
- Extractive waste from processing of nickel minerals: In EU-27 there are five operating mines for nickel, two in Finland (the Boliden Kevitsa mine and Talvivaara mine of Terrafame Ltd.) where the ore type is sulfidic, and three in Greece (Larco GMMSA) where nickel deposits are lateritic. For the Greek nickel mines, the estimated waste streams in this study belong only to the *Rock* stream, which is assigned by the LoW as non-hazardous (EC, 2018). The laterite ores are transported directly from the mine to a smelting plant, where the laterite is processed by pyrometallurgy.
- Extractive waste from mineral processing of bauxite (bauxite residue or red mud): According to the International Aluminium Institute, the chemical and physical properties of bauxite residues are determined by the nature of the bauxite and the effect of the Bayer process (IAI, 2010). The technology and operating procedures at individual refineries will impact the water content and pH value of the material being discharged – two key factors in bauxite residue management. For the purposes of this part of the study, the bauxite residues were considered as not hazardous and assigned to the waste code '*01 03 09 red mud from alumina production other than the wastes mentioned in 01 03 10*'.
- Extractive waste from mineral processing of tin, tungsten, iron and chromate ores: These were considered as non-hazardous on the basis of their typical mineralogical phases and were assigned to the waste code '*01 03 06 tailings other than those mentioned in 01 03 04 and 01 03 05*'.

[16] According to available information from the MS, the waste code that is being used for the tailings produced from the mixed sulfide ores in Poland is the waste code 01 03 81 Wastes from flotation enrichment of non-ferrous metal ores other than those mentioned in 01 03 80. However, this waste code is not included in the List Of Waste (Decision 2014/955/EU)

3.3. EXTRACTIVE WASTE FACILITIES (EWF)

3.3.1. GENERIC SECTION ON EWD ANNEX III CATEGORISATION OF CATEGORY A FACILITIES

According to Annex III of the Directive 2006/21/EC, the criteria for determining the categorisation of waste facilities are specified as:

*A **waste facility** shall be classified under **category A** if:*

- a failure or incorrect operation, e.g. the collapse of a heap or the bursting of a dam, could give rise to a major accident, on the basis of a risk assessment taking into account factors such as the present or future size, the location and the environmental impact of the waste facility; or
- it contains waste classified as hazardous under Directive 91/689/EEC above a certain threshold (EC, 1991); or
- it contains substances or preparations classified as dangerous under Directives 67/548/EEC (EC, 1967) or 1999/45/EC (EC, 1999) above a certain threshold (EC, 2006a).

The COMMISSION DECISION 2009/337/EC (EC, 2009c), on the definition of the criteria for the [categorisation] of waste facilities in accordance with Annex III of Directive 2006/21/EC, sets out in detail the following criteria:

(a) non-negligible potential for loss of life due to loss of structural integrity or a major accident;
(b) serious danger to human health due to loss of structural integrity or a major accident;
(c) serious danger to the environment due to loss of structural integrity or a major accident.

Regarding (a), the potential for loss of life shall be considered to be negligible or not serious if people other than workers operating the facility that might be affected are not expected to be present permanently or for prolonged periods in the potentially affected area. Human lives shall be deemed to be threatened where water or slurry levels are at least 0,7 m above ground or where water or slurry velocities exceed 0,5 m/s. Any waste-mass in movement shall be deemed likely to threaten human lives if people are staying within range of the moving waste-mass.

Regarding (b), injuries leading to disability or prolonged states of ill-health shall count as serious dangers to human health.

Regarding (c), the potential danger for the environment shall be considered to be not serious if:
(i) the intensity of the potential contaminant source strength is decreasing significantly within a short time;
(ii) the failure does not lead to any permanent or long-lasting environmental damage;
(iii) the affected environment can be restored through minor clean-up and restoration efforts.

The Article 1 of the Decision 2009/337/EC is based on risk and its management. In general, risk assessment is concerned with features, properties, and events that can lead to undesirable out-comes in the shorter or longer term. Risk is a human-defined concept and based on values that individuals or societies would like to see protected, namely lives, health, and environment. It is helpful to visualise risk in a source-pathway/vector-receptor model (Eco-Efficiency et al, 2019). Based on risk management approach, if there is no pathway between the source and the receptor, the risk is reduced or eliminated so the facility concerned may not be categorised as Category A on the basis of failure due to loss of structural integrity. EWFs with an expected ratio of hazardous waste at the end of the planned period of operation of less than 5% according to the Decision 337/2009/EC are not to be classified as Category A on the basis of the contents of hazardous waste.

3.3.2. IMPORTANCE OF WASTE CHARACTERISATION

The categorisation of EWFs depends on the characterisation of the contained waste. In practice, correct waste characterisation informs all management options, including adequate management of risks posed by reactive wastes (see below), and ensures compliance with rules for permitted use of the materials as by-products in excavation voids. According to Annex II of the EWD, the waste that is to be deposited in an extractive waste facility (EWF) shall be characterised in such a way as to guarantee the long-term physical and chemical stability of the structure of the facility and to prevent major accidents. The assessment of the waste characterisation includes the stability of waste under surface atmospheric conditions, taking account of the type of mineral or minerals extracted and the nature of any overburden and/or gangue minerals.

Figure 47 illustrates the complexity of waste management in the extractive sector. Parameters such as site-specific conditions, including the technical characteristics of the Extractive Waste Facility (EWF), its geographical location and the local environmental conditions, behaviour and characteristics of the extractive waste and geological background of the deposit are some issues that are described in the following Commission Decisions:

- Commission Decision 2009/360/EC completing the technical requirements for waste characterisation laid down by the EWD;
- Commission Decision 2009/359/EC completing the definition of inert waste in implementation of Article 22(1)(f) of the EWD (EC, 2009b);
- Commission Decision 2014/955/EC amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC (EC, 2008a);
- Commission Decision 2009/337/EC (EC, 2009c) on the definition of the criteria for the classification of waste facilities in accordance with Annex III of the EWD.

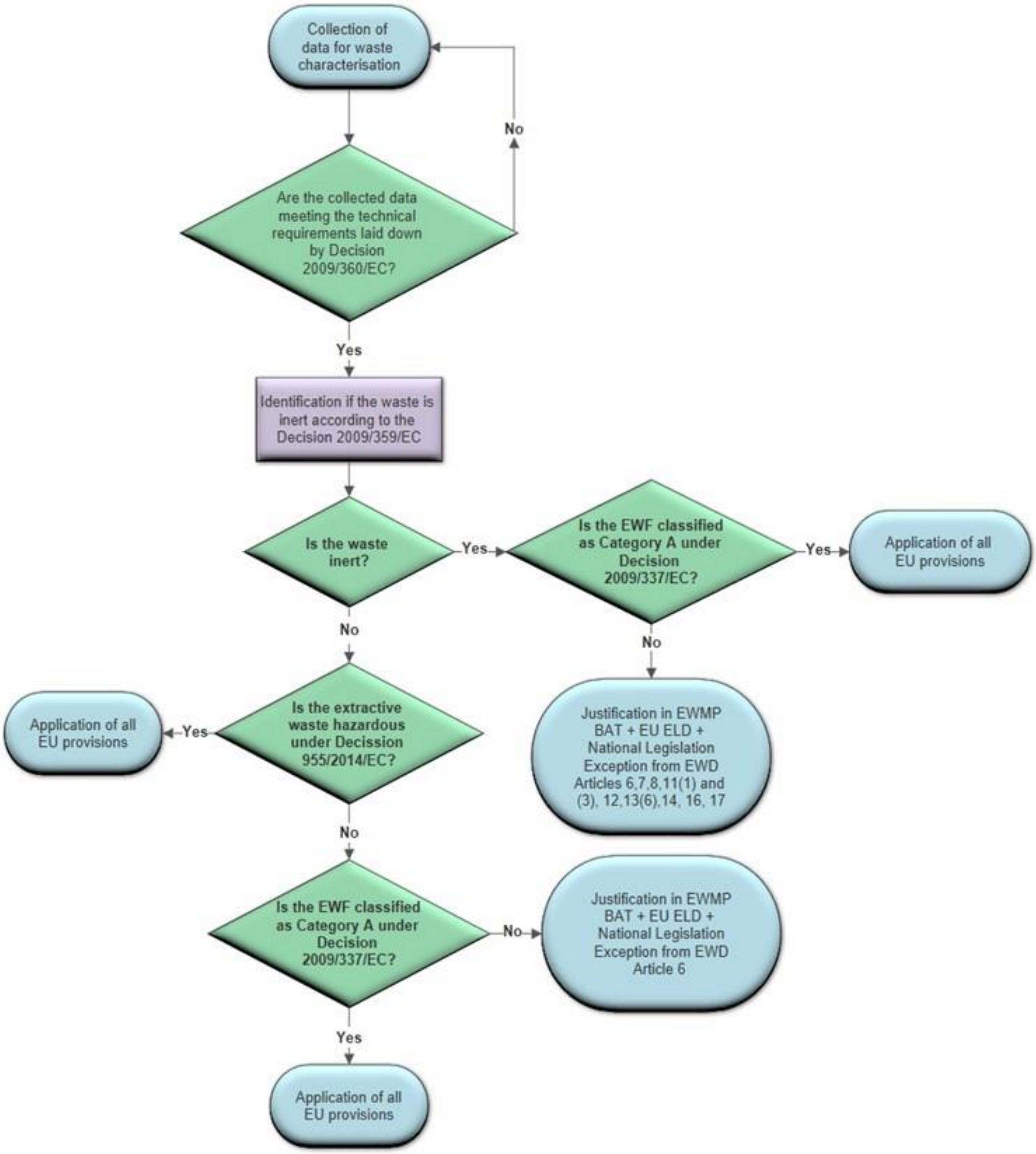

Figure 47: Decision tree for waste characterisation under the provisions of COM Decisions (Eco-Efficiency et al, 2019)

→ **Reactivity of waste**

Several MSs have stressed the importance of a proper consideration of the first indent of Annex III of the EWD (regarding "incorrect operation") and related it to non-hazardous non-inert extractive waste (or "reactive waste"). In 2015, the majority (66%) of Category A facilities had been categorised based on the EWD's Annex III first indent regarding the potential for a failure or incorrect operation, potentially giving rise to a major accident.

DHI, SGI & AGH (2007) developed a classification of mining waste facilities and first coined the issue of the term "reactive waste", a term which is not defined or presented in the EWD. Subsequently, in 2009 the term "reactive waste" was presented in the Decision 2009/337/EC (EC, 2009c) on the definition of the criteria for the categorisation of waste facilities in accordance with Annex III of EWD requiring an assessment of potential hazards related to reactive waste. Specifically, Article 3(2) of this Decision mentions "*An assessment of the release of contaminants resulting from incorrect operation shall comprise the effects of short-term pulses as well as of the long-term release of contaminants. That assessment shall cover the operational period of the facility and as well as the long-term period following closure. It shall include an evaluation of the potential hazards constituted by facilities containing reactive waste, regardless of the classification of the waste as hazardous or non-hazardous under Council Directive 91/689/EEC*."

The CEN/TR 16376:2012 guidance (CEN, 2012) defines reactive waste as "*thermodynamically unstable under present or expected future conditions and therefore may react (for example oxidize) and cause the release of significant amounts of contaminants or heat*". "Thermodynamically unstable" is not really the most helpful phrase, because even limestone is thermodynamically unstable on geological timescales. The proposed strategy for an environmentally sustainable management of mining waste, which was developed by the Swedish Environmental Protection Agency (S-EPA) and the Geological Survey of Sweden (SGU) in 2017. They refer to reactive waste by explaining, that during mining, rock is broken down into smaller particles that are then brought to the surface, where they are exposed to the action of ice, air, water and biological activity. When sulfide minerals are exposed to oxygen contained in air or water, they are no longer stable, but oxidise (weathering), a reaction that produces acidity and, hence, can result in acid rock drainage.

Standard CEN/TR 16376:2012 (CEN, 2012) suggests to undertake an analysis of total chemical composition (incl. sulfur content), an assessment of self-ignition properties, and of the potential for acid and neutral drainage production. It should be noted that "reactive" is not the same as "hazardous". Irrespective of hazard classification, reactive waste can affect the structural integrity and/or consequences of 'failure'. In Sweden, most reactive waste tends to be acid generating, but in other MSs they may be reactive in other ways. Reactive waste can be either hazardous or non-hazardous. Indeed, COM DEC 2009/337/EC (EC, 2009c) states, that the potential hazard of EWFs containing reactive wastes "regardless of the classification of the waste as hazardous or non-hazardous". Even non-hazardous wastes can give rise to environmental issues in the field, so the "reactive" definition does not concern itself with hazard-classification.

A significant guide to interpretation of what constitutes of reactive wastes can be found by considering the consequences of Category A Categorisation under the EWD.

Essentially, the additional requirements imposed on a Category A facility are:

- Art. 6§2: Major-Accident Hazard Identification in
    - Design & Construction,
    - Operation & Maintenance,
    - Closure & After-care.
- Art. 6§3: Emergency Planning and a Safety Management System

These additional requirements will not provide extra protection against long-duration, low-intensity effects (such as ARD or leakage of environmental contaminants). They are clearly designed to enhance efforts to prevent short-duration, high intensity effects (such as the dam collapses seen in Spain, Hungary, Canada, and Brazil) that could then subsequently give rise to a long-term release of contaminants.

This is now reflected in Article 3 of Commission Decision 2009/337/EC (EC, 2009c) on the definition of the criteria for the [categorisation] of waste facilities in accordance with Annex III of the EWD (See above), which speaks of "assessment of the release of contaminants resulting from incorrect operation" given that "incorrect operation of the waste facility shall mean any operation which may give rise to a major accident".

→ **Hazard classification**

According to Decision 2014/955/EU (EC, 2014a) when assessing the hazardous properties of wastes, the criteria laid down in Annex III to Directive 2008/98/EC (EC, 2008a) shall apply (even though extractive waste is out of scope of 2008/98/EC). The hazardous properties that should be assessed are presented in Table 37. The hazardous property listed last is HP 15 “Waste capable of exhibiting a hazardous property listed above not directly displayed by the original waste”, for which the legislation focuses on substances assigned to one of the hazard statements or supplemental hazards:

- Mass may explode in fire (hazard statement H205 according to CLP Regulation)
- Explosive when dry (hazard statement EUH001 according to CLP Regulation)
- May form explosive peroxides (hazard statement EUH019 according to CLP Regulation)
- Risk of explosion, if heated under confinement (hazard statement EUH044according to CLP Regulation).

Furthermore, Regulation 1357/2014 (EU) (EC, 2014b) adds that “Member States may characterise a waste as hazardous by HP 15 based on other applicable criteria, such as an assessment of the leachate”. The question of whether an extractive waste that is potentially acid generating should be assigned under HP 15 is discussed in Section 3.2.5 above.

Table 37: Hazardous Properties for the classification of waste according to Regulation 1357/2014/EU (EC, 2014b)

HP	Hazardous Property
HP 1 “Explosive”	Waste which is capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic waste, explosive organic peroxide waste and explosive self-reactive waste is included.
HP 2 “Oxidising”	waste which may, generally by providing oxygen, cause or contribute to the combustion of other materials
HP3 “Flammable”	• flammable liquid waste: liquid waste having a flash point below 60 °C or waste gas oil, diesel and light heating oils having a flash point > 55 °C and ≤ 75 °C; • flammable pyrophoric liquid and solid waste: solid or liquid waste which, even in small quantities, is liable to ignite within five minutes after coming into contact with air; • flammable solid waste: solid waste which is readily combustible or may cause or contribute to fire through friction; • flammable gaseous waste: gaseous waste which is flammable in air at 20 °C and a standard pressure of 101.3 kPa; • water reactive waste: waste which, in contact with water, emits flammable gases in dangerous quantities; • other flammable waste: flammable aerosols, flammable self-heating waste, flammable organic peroxides and flammable self-reactive waste.
HP 4 “Irritant-skin irritation and eye damage”	waste which on application can cause skin irritation or damage to the eye
HP 5 “Specific Target Organ Toxicity (STOT) /Aspiration Toxicity”	waste which can cause specific target organ toxicity either from a single or repeated exposure, or which cause acute toxic effects following aspiration.

HP	Hazardous Property
HP 6 "Acute Toxicity"	waste which can cause acute toxic effects following oral or dermal administration, or inhalation exposure.
HP 7 "Carcinogenic"	waste which induces cancer or increases its incidence.
HP 8 "Corrosive"	waste which on application can cause skin corrosion.
HP 9 "Infectious"	waste containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms.
HP 10 "Toxic for reproduction"	waste which has adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in the offspring
HP 11 "Mutagenic"	waste which may cause a mutation, that is a permanent change in the amount or structure of the genetic material in a cell.
HP 12 "Release of an acute toxic gas"	waste which releases acute toxic gases (Acute Tox. 1, 2 or 3) in contact with water or an acid.
HP 13 "Sensitising"	waste which contains one or more substances known to cause sensitising effects to the skin or the respiratory organs.
HP 14 "Ecotoxic"	waste which presents or may present immediate or delayed risks for one or more sectors of the environment.
HP 15 "Waste capable of exhibiting a hazardous property listed above not directly displayed by the original waste"	When a waste contains one or more substances assigned to one of the hazard statements or supplemental hazards: • May mass explode in fire; H205 • Explosive when dry; EUH001 • May form explosive peroxides; EUH019 • Risk of explosion if heated under confinement; EUH044 the waste shall be classified as hazardous by HP 15, unless the waste is in such a form that it will not under any circumstance exhibit explosive or potentially explosive properties.

In 2015, the second Indent of Annex III regarding waste classified as hazardous under Directive 91/689/EEC (EC, 1991) above a certain threshold was included in reasons for 24% of Category A categorisations, and 10% noted the third indent regarding containing substances or preparations classified as dangerous under Directives 67/548/EEC (EC, 1967) or 1999/45/EC (EC, 1999) above a certain threshold. These 'certain thresholds' are now unambiguously provided by Commission Decision 2009/337/EC (EC, 2009c) (See also Section 3.2.5 above).

3.3.3. Categorisation of EWF for metallic mineral ores

One of the objectives of this study was the estimation of the number of operating EWFs, based on the assumption, that a given waste facility receives waste only from one mine. The reality is different in the extractive industries. Often enough, there are a number of mines of the same extractive industry using one sole EWF classified as Category A or there are mines using each of them more than one EWF classified as Category A.

Assessment of the potential failure of existing EWFs due to loss of structural integrity or incorrect operation could not be performed by desk research alone, because no centralized database describing the structural stability of each and every EWF could be made available to this study.

As a consequence, this study focused on the second criterion of Annex III of the EWD "it contains waste classified as hazardous under Directive 91/689/EEC above a certain threshold (EC, 1991)". In Annex L processing wastes (tailings streams) were estimated and they were assigned to waste codes taking into consideration bibliographic data on what may render the tailings stream (according to data related to the main commodity) as hazardous (see also Section 3.2.7).

According to Article 7 of COM Decision 2009/337/EC (EC, 2009c): "*The threshold referred to in the second indent of Annex III of Directive 2006/21/EC shall be determined, as the ratio of the weight on a dry matter basis of:*

(a) all waste classified as hazardous in accordance with Directive 91/689/EEC (EC, 1991) and expected to be present in the facility at the end of the planned period of operation, and

(b) *waste expected to be present in the facility at the end of the planned period of operation.*

(1) *Where the ratio referred to in paragraph 1 exceeds 50 %, the facility shall be classified as Category A*
(2) *Where the ratio referred to paragraph 1 is between 5 % and 50 %, the facility shall be classified as Category A. However, that facility may not be classified as Category A where it is justified on the basis of a site specific risk assessment, with specific focus on the effects of the hazardous waste, carried out as part of the classification based on the consequences of failure due to loss of integrity or incorrect operation, and demonstrating that the facility should not be classified as Category A on the basis of the contents of hazardous waste.*
(3) *Where the ratio referred in paragraph 1 is less than 5 %, then the facility shall not be classified as Category A on the basis of the contents of hazardous waste."*

The expected number of EWFs in operation was estimated based on the number of active mines. The task was based on the assumption that a given facility receives waste only from one mine focusing on the management of tailings and not on the material that may be assigned under the waste code 01 01 01 "wastes from mineral metalliferous excavation". The material that is generated after accessing and extracting the ore (for the purposes of the current study this stream is named *Rock*) in some cases is not considered as a waste stream, but as a material that partly or totally may be utilised by the operator for (a) filling the excavation voids for rehabilitation and construction purposes, (b) construction purposes outside the mine, and (c) landscaping. It is often unclear which percentage of Rock may be disposed to EWFs and which is utilised for the aforementioned uses. For this reason, the Rock stream is presented as the amount that was initially intended to be mined, without characterizing it as waste or non-waste. This methodology led that 58 EWFs are operating in EU-27 (theoretically this number reflects mainly the operating beneficiation plants).

As far as the classification of the EWF is concerned it was assumed that if an EWF receives hazardous extractive waste then the threshold 50% according to Article 7 of the Decision 337/2009/EC is fullfilled and the EWF is classified as CAF (worst case scenario).

Data gathered directly from companies and MSs (e.g., Hellas Gold S.A. in Greece, the Kemi mine in Finland, the Boliden Tara Mine in Ireland, and Polish polymetallic mines) confirmed, however, that the concerned wastes are not hazardous and that the EWFs have been categorised as Category A for other reasons[17] (Annex K).

Member States have provided a list of extractive waste facilities located on their territory to the Commission. Taking into consideration the assessment of the current study and the list of EWFs provided by each MS,the following observations can be made:

- **Austria**: The list of extractive waste facilities provided by the MS to the Commission is not presenting the two metal mines in Austria. Therefore, there are no data to compare. Taking

[17] according to available data (Kaivosvastuu, 2015) the Kemi mining area includes eight dams that are classified under Class 2 according to the Dam Safety Act 494/2009 (Ministry of Agriculture and Forestry, Finland), which is describe as possibly causing "... danger to health or greater than a minor danger to the environment or property" in the event of failure.

into consideration the information provided by the MS, it is concluded that there are no not Category A Facilities in Austria.

- **Bulgaria**: The list of extractive waste facilities presents three Category A Facilities, two of them of them operating at one mine:
    - Ellatzite mine operates two Category A Facilities (Benkovski Tailing Facility and Mining Waste Heaps)
    - Chelopech mine has one EWF classified as category A Facility

  The current study counted ten active metal mines in Bulgaria and nine of them process mixed sulphides ores. Based on the assessment method described above, this study estimates that there should be nine Category A Facilities in this MS.
- **Cyprus**: The list of extractive waste facilities does not contain the Skouriotissa mine, which is the only operating mine in Cyprus. Based on exchange of information with the MS, it was concluded that Cyprus has one operating Category A Facility at the Skouriotissa mine.
- **Czech Republic**: according to the list provided by the MS there are four operational EWFs, two of which are classified as CAF. These EWFs are linked to uranium operations, which are under remediation programs. Since there is no active mine and thus no production these EWFs are not included in Annex M.
- **Germany:** According to the list provided by the MS there are three operational EWFs, two of them classified as CAF. These EWFS are linked to the company Wismut GmbH. According to the official website the uranium ore mining have been rehabilitated since 1991 and the renovation work will be completed at all locations over the next 10 years (close to 2030). Since there is no active mine and thus no production these EWFs are not included in the Annex M.
- **Greece**: The list of extractive waste facilities does not contain the operational extractive waste facilities. Based on the exchange of information with the MS, Greece has one operating Category A Facility.
- **Spain**: The list from the MS is in agreement with the present assessment, presenting that four mines have Category A Facility.
- **Finland:** The list with the EWF from the MS provide information for seven out of 10 active mines that the current study assessed. The information provided by the MS indicates that in Finland seven EWFs classified as Category A facility are operating. The current assessment concludes that the tailings generated by the 9 mining operations would be accommodated into a corresponding number of CAFs.
- **France:** The MS has indicated that the generated bauxite residue are deposited into a non Category A Facility.
- **Ireland:** MS informed that there are two operating CAF.
- **Poland:** The list of extractive waste facilities indicates one operating Category A Facility "Żelazny Most", which receives extractive waste from three mines.
- **Portugal:** The list of extractive waste provides data only for one extractive waste facility the *Aljustrel - IR "Aterro Temporário de Feitais* (non-CAF). Taking into consideration the available information from the exchange of information with the MS, in Portugal there should be two CAF and one non-Category A Facility
- **Romania:** The MS have indicated that there is one licenced CAF for the mine *Rosia Poieni*. However, until now the mines *Rosia Poieni* and *Manaila Polymetallic Mine* are not operating. As far as the processing plant for alumina Tulcea – Alumina Refinery is concerned, the current assessment concludes that the Bauxite Residue can be deposited in a non-CAF.
- **Sweden**: The MS provided information for eight (8) out of nine (9) active mines that the current study assessed. According to the data sent by the MS, in Sweden there are 9 Category A Facilities.

- **Slovakia**: There in one non Category A Facility the "Horná Ves" that belongs to Kremnica mine according to the information provided by the MS in the list.

A detailed overview of the results of the current study that are based on the assumption that a given waste facility receives waste only from one mine is given in Annex M. The classification of an EWF is based on the characterization of the tailings as hazardous or non-hazardous according to LoW (see also chapter 3.3.5). The table also presents the real classification of the examined active mines based on information provided by MS, EC list, operators, and literature review.

Table 38 presents the results of the current study that are based on the assumption that a given waste facility receives waste only from one mine focusing on the management of tailings and not the material that may be assigned under the waste code 01 01 01 "wastes from mineral metalliferous excavation". As has been stipulated in the chapter 3.2.6 the material that is generated after accessing and extracting the ore (for the purposes of the current study this stream is named Rock) in some cases is not considered as a waste stream, but as a material that partly or totally may be utilised by the operator for (a) filling the excavation voids for rehabilitation and construction purposes, (b) construction purposes outside the mine, and (c) landscaping. It is often unclear which percentage of rock may be fed to EWFs and which is utilised for the aforementioned uses. For this reason, the Rock stream is presented as the amount that was initially intended to be mined, without characterising it as waste or non-waste.

Furthermore, Table 38 shows data on the classification of EWFs that were gathered through (a) communication with MS and operators and (b) from the list of EWFs provided by each MS to EC. The total number of operating EWFs differs because the present investigation does not present EWFs that may accommodate waste that are assigned under the waste code 01 01 01. Furthermore, the difference in the findings stand also because MSs count the number of the EWF licences which in some cases refer to one facility (e.g. one facility may have more than one licences to operate[18]). So, the attempt of this table is not to compare data but only to provide a general idea on the EWFs in the EU-27. Details are given in Annex M.

Table 38: Metallic minerals, results of the present investigation which was focused on the EWFs that accommodate tailings and the findings of the data collection process on the classification of EWFs from MS, EC list and operators

MS	**Estimation for the classification of EWF as CAF or non-CAF based on the characterisation of the tailings as hazardous or non-hazardous**		**Classification of EWF as CAF or Non-CAF based on information provided by MS, EC list and operators**	
	CAF	Non-CAF	CAF	Non-CAF
AT	0	2	0	2
BG	9	1	3[a]	n.d.
CY	1	0	1	0
CZ[b]	-	-	2	2
DE	0	1	2[c]	2
EL	0	3	1	7
ES	4	4	8	15
FI	9	1	7	25
FR	0	1	0	1

[18] An example is for the metal mine Minas de Aguas Teñidas (MATSA). According to available data there is one CAF that is operating. However, according to the data provided by the MS for this mine the following EWFs are operating (i) *Presa (Waste Code 01 03 04*) (CAF) and (ii) Escombrera (Waste Code 01 01 01) (CAF)*

IE	0	2	2	0
PL	0	4	1	1
PT	2	1	2	1
RO	2	1	2[d]	1
SE	6	3	9	3
SK	1	0	0	1
Total	**34**	**24**	**40**	**61**

[a] Limited available data
[b] For Czech Republic according to the list provided by the MS there are four operational EWFs, two of which are classified as CAF. These EWFs are linked to uranium operations, which are under remediation programs. Since there is no active mine and thus no production these EWFs are not included in the estimation for the classification of EWF that are operating in active mines
[c] The CAF EWFS are linked to the company Wismut GmbH. According to the official website the uranium ore mining have been rehabilitated since 1991 and the renovation work will be completed at all locations over the next 10 years (close to 2030). Since there is no active mine and thus no production these EWFs are not included in the table
[d] Not operating

3.3.4. CATEGORISATION OF EWFS NOT LINKED TO THE EXTRACTION OF METALLIC MINERAL ORES

The previous study (EC, 2016) on the implementation of the Directive identified an incomplete and inconsistent set of data as a major obstacle to assess the implementation of the Directive. The figures on extractive waste facilities do not seem plausible in many cases when compared to the figures for extractive waste as reported to Eurostat. Specifically, taking into consideration the total number of the operating Category A facilities (CAF) versus the total number of the operating EWF it seems that in some of the MS this ratio is considerable different than in others. For example, in Spain according to the previous study 1558 EWFs were operating, from which 25 were classified as Category A Facilities. Some other “mining countries” have far less Category A facilities. Also, errors can be assumed in cases such as Italy where 126 operating Cat A facilities had been declared. The total counted Cat A facilities in operation in MSs in 2012 were 202.

For the Amec-Foster-Wheeler study on behalf of the EU Commission (Cherrier et al., 2017) Member States have provided a list of 3735 extractive waste facilities located on their territory to the Commission, from which 88 were classified as Cat A Facility. 16 of these Cat A facilities contained extractive waste from non-metallic minerals (of which 3 EWD are situated in UK). According to the same study there are 3381 Non-Cat A facilities that contain non-metallic extractive waste.

This study tried to recover and use more recent data on Cat A and non-Cat A facilities per MS. To obtain a comprehensive list of Category A facilities in the EU, this study also tried to identify, where possible, waste facilities associated with the extraction of aggregates, other construction minerals, industrial minerals and energy minerals that should have Category A categorisation, but do not have such permit or are permitted by to other legislation and standards.

There are 2 main differences between the waste facilities of the metallic ore extraction and the non-metallic ore extraction. Almost all the industrial minerals wastes are non-hazardous. The non-hazardous or inert waste can easily be used in many applications for filling excavation voids. For example, it is presented in some Greek EWMPs that for non-metallic extractions the license of an EWF is only to be used in case of lack of space for fillings excavation voids. Additionally, most of the industrial mineral extractive installations in Europe are old enough to have many excavations voids for filling.

For those reasons it can be expected that there are less industrial mineral Category A facilities than metallic mineral Category A facilities; neither for chemical hazardous reasons nor for considerable amounts of waste (stability issues). However, a (risk-based) methodology that helps defining objectively if an EWF for industrial minerals can be labelled as Cat A or not, was therefore part of the objectives of this study.

Based on the relevant statistics for the non-metallic minerals, checks of interpretation of the Category A criteria were focused on Austria, Croatia, Czech Republic, Estonia, Ireland, Italy, Latvia, Lithuania, the Netherlands, and Spain. Checks of the interpretation of the hazardous waste classification were focused on Bulgaria, Estonia, Finland, Greece, Poland, Romania, and Sweden.

Taking into consideration the information given in the country fact sheets the following comments can be made:

- Croatia, Netherlands, Latvia, and Lithuania do not have extractive waste facilities under EWD.
- Ireland, Czech Republic, Austria, Spain, Sweden, and Estonia have extractive waste facilities linked to non-metallic ore extraction, but none of them is classified as Category A facility. On the other hand, Italy and Finland have three and two respectively in operation Category A facilities linked to non-metallic ore.
- For Greece, Bulgaria, and Poland the EWF that are reported by the MS are not further divided into metallic ore or non-metallic ore EWF (only a total number of EWFs was provided). However, during further review of additional sources in these member states it was found that the Category A Facilities are linked to metallic ores only.
- Finland had according to the inventory given in Cherrier et al. (2017) 4 non-metallic extractive waste Category A facilities and Hungary had 2. More recent data show that according to the 2020 EWMPs Finland has 2 non-metallic Cat A facilities and Hungary has (MBSFZ, 2019) 3 energy mineral Cat A facilities.

EWF that contain *non-metallic* extractive waste shall be classified under category A if (identical to the classification under paragraph 3.3.1):

- a failure or incorrect operation, e.g. the collapse of a heap or the bursting of a dam, could give rise to a major accident, on the basis of a risk assessment taking into account factors such as the present or future size, the location and the environmental impact of the waste facility; or
- it contains waste classified as hazardous under Directive 91/689/EEC above a certain threshold (EC, 1991); or
- it contains substances or preparations classified as dangerous under Directives 67/548/EEC (EC, 1967) or 1999/45/EC (EC, 1999) above a certain threshold (EC, 2006a).

To obtain a more complete data set of the characteristics of an existing EWF (operative, closed, abandoned, and in transition for closure) and to assess the type of Extractive waste which they contain, a set of recommendations for additional data gathering have been proposed in paragraph 4.6 of this report. With this extra dataset a more inclusive evaluation can be made to define whether a non-metallic EWF might be labeled as a Cat-A facility or not. To facilitate and improve the identification of Category A facilities for the non-metallic extractive materials and their waste facilities that should have Category A classification, but have not been permitted as such, the following steps are proposed:

1. Additional data gathering and data assessment
2. Risk assessment
3. Decision on Cat A/non-Cat A facility via decision-tree.

→ **Additional data gathering and data assessment**
After revision of the current list(s) of operating and non-operating EWF per Member State, a division is made between metal and non-metallic extractive waste facilities. In case of indications that a EWF is containing both metallic as non-metallic extractive waste, the site is defined as being a metallic EWF. The non-metallic EWF are further divided into: Closed & Abandoned, In transition, and Operative EWF. Proposed general steps are listed below for operative and non-operative (closed, abandoned, or in transition) EWF.

For operating non-metallic EWF:

- Apply checklist given in Table 46 for future EWD Annex III risk evaluation.
- Revise existing documentation of EWF, including permits, descriptive research reports (such as soil, groundwater or geophysical investigations) and EWMP.
- If needed, gather additional data through a site visit together with operator and competent authorities. If needed, take samples (such as soil, soil vapor, groundwater, rock) and perform additional tests including acid rock drainage testing (ARD),- hydrogeological or geophysical tests etc.).
- Revise potential for Acid Rock Drainage.
- Revise physical & chemical stability of EWF.

For EWF that have been closed, abandoned or are in transition towards closure:

- Review existing inventory reports and revise (accuracy of) any existing risk assessments that were done in the past.
- Obtain former and current permits and EWMP through (local) authorities.
- Interpret Google Earth images of extractive waste sites. Through polygons the presence of possible old tailings, ponds, waste rock facilities, or dams is examined. Through topography height/depth of waste facility is roughly estimated. Figure 48 presents an example of the application of satellite images for identifying mining features (https://www.fineprint.global/publications/briefs/satellite-earth-observations/).
- If needed, gather additional data through a site visit together with operator and competent authorities. If needed, take samples and tests (ARD, hydrogeological or geophysical tests etc.) in same or another site visit.
- Revise potential for Acid Rock Drainage.
- Revise physical & chemical stability of EWF.

Based on the data review a site can be preliminary characterized as suspicious or non-suspicious for being a potential Cat A facility.

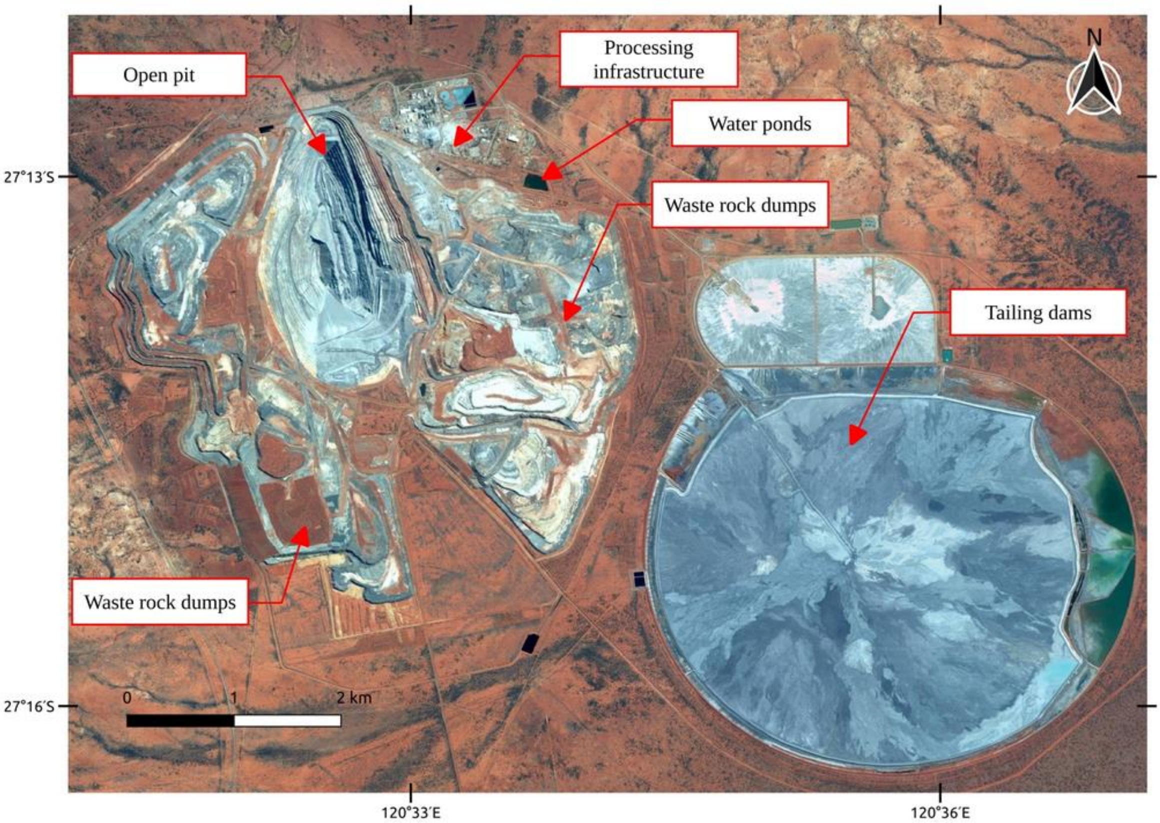

Figure 48: Example of applying satellite images for identifying mining features. Mount Keith mine, Wiluna, Western Australia, visualised from Google Earth imagery (https://www.fineprint.global/publications/briefs/satellite-earth-observations/)

→ Risk Assessment

According to MWEI BREF (Garbarino et al., 2018; Table 4.5 "Example of risk-specific objectives and potential hazards and risk/impact elements from the management of extractive waste") there are three (3) main risk specific objectives for the EWFs (a) Safety (structural stability and physical and chemical stability of the extractive waste), (b) Prevention and minimisation of water status deterioration, air and soil pollution and (c) Prevention and minimisation of any other adverse effects on human health, flora and fauna. The parameter "safety" is the first criteria in Annex III of the EWD concerning the classification of waste facilities. According to a previous study conducted for EC (Ecoefficiency et al, 2019) assessing the parameter safety (short and long-term) revealed that the majority of the EWMPs satisfy the criteria for waste characterization and hazardous ingredients, but for the safety criteria it is declared "*it appears that in most cases some sort of 'differential diagnosis' approach is used in order to determine, whether a waste facility belongs into Category A or not. In most cases the dominant risk is that of geotechnical instability, but in most cases the risks are more chronic (erosion) than acute (collapse of impoundments), so that no particular accident scenarios beyond what would be needed to obtain the construction permission by the competent authorities were investigated.*"

The short-term and long-term safety of an EWF should be based on a case-by-case and site-by-site basis and not horizontally. For this reason, the risk assessment can be used as a decision aiding tool for each specific case and "predicting" the risk. Many operators are already running an overall risk assessment to find out the risk of the operation for internal use. However, in this approach the focused EWF risk assessment would be applied for external licensing procedures.

Taking into consideration that in most cases the non-metal sector characterized the waste as inert the risk assessment for short- and long-term safety should need extra input. Extra risk assessment parameters should be (a) the annual deposit of extractive waste, (b) the climatic condition (risk Flooding Failure of drainage and seepage water treatment systems), (c) distance to local community.

→ Decision on Cat A/non-Cat A facility

Finally, through the decision tree (Figure 49) a decision is made whether the non-metallic extractive waste facility must be defined as a non-Category A or a Category A facility.

→ EWF non-metallic minerals per MS

Table 39 presents a resume per Member State of the number of EWF that are characterized as Category A facilities and contain non-metallic extractive waste. The main source of information for Table 39 was the Amec-Foster Wheeler study (Cherrier et al., 2017). Only for Finland and Hungary more recent information was provided on the number of Cat A facilities for non-metallic extractive waste. The total number of non-metallic Cat A facilities based on available information is 12.

Table 39: Resume number of Cat A facilities containing non-metallic EW

	Amec Foster Wheeler study Cherrier et al. (2017)			**Update with available/provided information (2019, 2020)**		
MS	**Number of non metallic Cat A facilities**	**Products**	**MS**	**Number of non metallic Cat A facilities**	**Products**	**Reference**
BE	1	Limestone + Dolomite	BE	*no new data provided/available*		
DE	1	Oil, Natural gas	DE	*no new data provided/available*		
Fi	2	Apatite	Fi	2	Apatite	Review EWMPs 2020 Finland
	1	Aggregates				
	1	Other (from washing/cleaning minerals)				
Fr	1	Geothermal (energy)	Fr	*no new data provided/available*		
	1	Sandstone				
Hu	1	Gas	Hu	3	Energy minerals	Review by MBSFZ, 2019
	1	Oil				
Pl	1	Not defined	Pl	*no new data provided/available*		
Sk	1	Barytes	Sk	*no new data provided/available*		
	1	Limestone				
TOTAL	**13**		**TOTAL**	**12**		

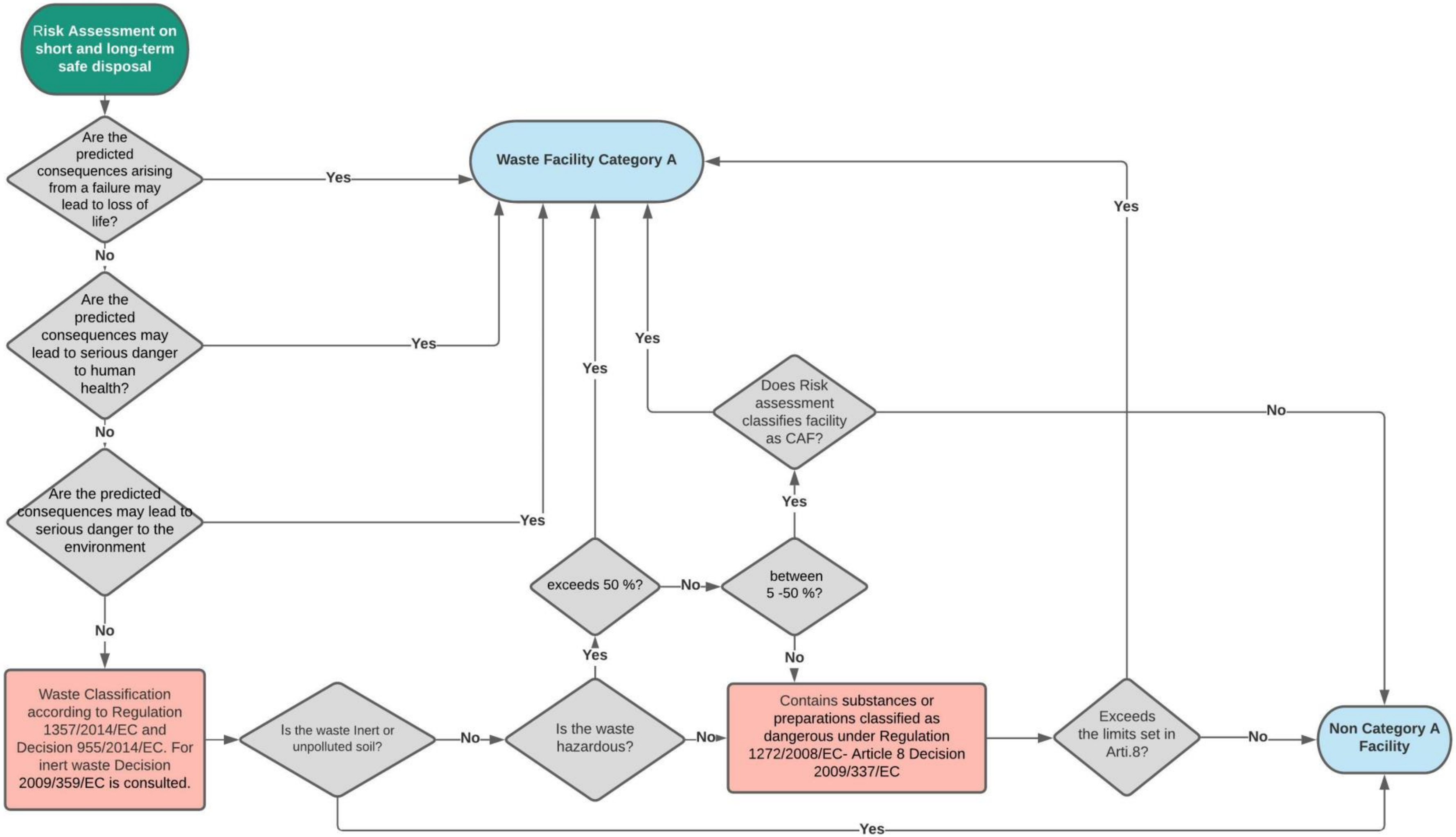

Figure 49: Decision-tree for the identification of non-metallic Category A facilities

3.3.5. TAILINGS MANAGEMENT LINKED TO METALLIC ORES

One of the objectives of the present study was to collect data and estimate the amounts of tailings that are not deposited into EWFs, but are used as material for filling excavation voids. The results of this work are available in Annex L.2.
According to the estimates of the current study in EU-27, there are 70 active mines. However, there are certain cases that were excluded from these assessments:

- Mines that are not linked directly with processing plants for the production of concentrate, so they produce only ore, such as the bauxite mines in Greece and Hungary and the laterite mines in Greece;
- Alumina plants, werer the generated red mud/bauxite residues are not used for filling excavation voids, but are deposited in EWD or hazardous wastes facilities (Stade, Germany);

Mines that, even if they were active during the period 2015-2017, did not produce any marketable amounts of concentrate, so no tailings have been generated (even if for the purposes of the current study tailings amount had been calculated).

The methodology for the estimation of the amounts of tailings that are used for filling excavation voids is based on the estimates for the tailings generation and on the following procedure:

1. Selection of data for tailings management after exchange information with the extractive industry
2. Evaluate data from technical reports, feasibility or pre-feasibility studies, EWMPs that were available online
3. When no data were available the following estimation was conducted:
   a. If the tailings have been characterized as hazardous, it is not feasible to use them as material for filling excavation voids taking into consideration the EWD and the Article 5 “placing extractive waste back into the excavation void after extraction of the mineral, as far as is technically and economically feasible and environmentally sound [...]”
   b. if the waste stream is non-hazardous, then technically only the coarse stream can be used for filling excavation voids, which according to the previous steps of investigation corresponds to 50-60% of the total amount of tailings.

Applying this methodology, it seems that only the 16 mines listed in Table 40 are using tailings for filling excavation voids.

Table 40: Tailing Management, Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data was available some estimations have been done according to the principles of EWD

MS	Property Name	Commodity	Tailings (t) for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
AT	Mittersill	W	229,021	152,681	According to company data, 60% of the extractive waste is used for filling excavation voids and 40% of the tailings are deposited
EL	Olympias	Pb, Zn, As-Au	41,000	11,000	According to company data in the years 2015 and 2016 the mine was under construction and only from 2017 on ore was produced for some months

MS	Property Name	Commodity	Tailings (t) for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
EL	Mavres – Petres (Stratoni)	Pb, Zn	66,220	65,176	The company data show that close to 50% of the tailings are the coarse stream that can be used for filling excavation voids
ES	Los Santos	W	422,799	0	According to "Technical Report on the Los Santos Mine Project[19]": "*There is no tailings discharge from the process and no tailings dam: all plant waste is dewatered and transported back to the mine waste deposit for disposal*." So it is assumed that all the calculated tailings are being led back to the mine
ES	MATSA Aguas Tenidas, Magdalena, Sotiel	Cu, Zn, Pb	1,926,500	1,926,500	MATSA´s tailings are considered as a hazardous waste due to their pyritic characteristics, so the TMF is managed as Cat. "A" facility. Producing paste tailings allowed reducing the TMF footprint in the subsequet TMF expansions projects. The tailings are processed into a paste that has the required quality to infill the exploited stopes. Approximately 50% of the tailings are thus used within the mine (Eco-Efficiecincy et at, 2019).
ES	Penouta zone B (reprocessing old tailings)	Sn, Tn+Nb	39,949	0	According to the presentation "The Penouta Project: Strategic and Sustainable Mining[20]" the historical tailings will be reprocessed and the resulting extractive waste will undergo further processing in an industrial minerals plant. The stream that is not marketable will be used for rehabilitation purposes.
ES	Rio Tinto	Cu	2,555,112.90	2,555,113	According to the "Technical Report Update On the Mineral Resources and Reserves of the Riotinto Copper Project" published in 2018[21] "The coarse tailings (sands) are separated by cycloning and deposited as underflow to form the dam walls, while the overflow consisting of the fine tailings fraction (slimes) is deposited within the basin area. The ponded water is also located away from the dam walls." *It was estimated that 50% of total amounts of tailings are the coarse portion.*
FI	Kittila	Au, Ag	252,255	1,368,015	The data are based on the exchange of information with the company
FI	Pyhasalmi	Cu, Zn+Au	279,397	355,596	According to available information, 44% of generated tailings are used for filling excavation voids (the information are from the site of Kaivosvastuu[22])
IE	Navan Tara Mines	Zn, Pb	1,043,167	1,043,167	According to the report "Boliden Summary Report[23]": "The coarse fraction of the mill waste is used for infilingl while the rest is pumped over 2 km to a tailings management facility"
PL	Lubin-Malomice	Cu, Ag+Au	21,804,009.75	7,268,003	Taking into consideration that these mines have one EWF, they are evalutated together. According to the

[19] The technical report is available here: https://almonty.com/wp-content/uploads/2019/06/Los_Santos_43-101_Tech_Rep_Oct15_SEDAR.pdf (Access 14 September 2021)
[20] The presentation is available here: https://www.phytosudoe.eu/wp-content/uploads/2016/11/10_Strategic-Minerals_Penouta-Project_PhytoSUDOE-workshop-2017.pdf (Access 14 September 2021)
[21] The technical report is available here: https://atalayamining.com/wp-content/uploads/2018/07/RioTinto-July-2018-Complete-Report-Rev-6.pdf (Access 14 September 2021)
[22] Available here: https://www.kaivosvastuu.fi/en/yrityskortti/pyhasalmi-mine-oy/) (Access 14 September 2021)
[23] The report is available here: https://www.boliden.com/globalassets/operations/exploration/mineral-resources-and-mineral-reserves-pdf/2020/resources-and-reserves-tara-2020-12-31.pdf (Access 14 September 2021)

MS	Property Name	Commodity	Tailings (t) for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
PL	Polkowice-Sieroszowice	Cu, Ag+Au			official website[24] "Annually, from 20 to 26 million tonnes of flotation waste is deposited here, out of which 75% is processed further, and only one fourth is discharged"
PL	Rudna	Cu, Ag+Au			
PT	Neves-Corvo	Cu, Zn, Pb	1,506,464	1,506,464	The "Technical report for the Neves-Corvo mine" published in 2017 notes that "The backfill types used in the new production area, LP2, are: Paste fill (PF)made from cycloned process tailings; cemented rock fill (CRF); and rock fill (RF) produced from underground development waste." *It was estimated that 50% of total amounts of tailings are the coarse portion.*
SE	Garpenberg	Zn, Cu, Pb	752,620	1,528,047	According to their Extractive Waste Management Plan: The EWF Ryllshyttemagasinet accepts the tailings from the enrichment plant in Garpenberg which is asseigned under the waste code 01 03 05* (hazardous waste). According to EWMP it is estimated that about 25-35% of the tailings are used for the refilling of broken excavation rooms in the mine (chapter 8.1)
SE	Zinkgruvan	Cu, Pb	350,780	651,448	According to technical report [25]"The annual production of tailings is approximately 1.1 Mt with 35% used as mine inkfill and 65% disposed at the Enemossen Tailings Storage Facility (TSF)"

3.3.6. INVENTORIES OF CLOSED AND ABANDONED EXTRACTIVE WASTE FACILITIES ACCORDING TO ARTICLE 20 EWD

→ Introduction

Article 20 of the EWD (EC, 2006a) obliges MSs to identify closed waste facilities including abandoned facilities that cause serious environmental impacts or have the potential of becoming, in the medium or short term, a serious threat to human health or the environment. Namely:

"Member States shall ensure that an inventory of closed waste facilities, including abandoned waste facilities, located on their territory which cause serious negative environmental impacts or have the potential of becoming in the medium or short term a serious threat to human health or the environment is drawn up and periodically updated. Such an inventory, to be made available to the public, shall be carried out by 1 May 2012, taking into account the methodologies as referred to in Article 21, if available."

Article 21 EWD asks the Commission to ensure that there is an appropriate exchange of information with a view to develop methodologies related to the inventory and the rehabilitation of those closed waste facilities.

While the EWD does not define "serious negative environmental impacts or…the potential of becoming in the medium or short term a serious threat to human health or the environment",

[24] Tailings management | KGHM Corporate Website
[25] The technical report is available here: https://www.lundinmining.com/site/assets/files/3642/zm-techreport-113017-sedar.pdf (Access 14 September 2021)

Commission Decision 2009/337/EC (EC, 2009c) distinguishes between serious impact to humans and serious impact to the environment. A decription is given in Table 41.

Table 41: Distinction between serious impacts to humans and the environment (Commission Decision 2009/337/EC (EC, 2009c)

Receptor	Serious Impact
Humans	Loss of Life. Injuries leading to disability or prolonged states of ill health.
Environment	Intensity of the potential contaminant source strength is not decreasing significantly within a short time. Leads to any permanent or long-lasting environmental damage. Affected environment cannot be restored through minor clean-up and restoration efforts

The EWD requires that methodologies developed to draw up the inventories of closed waste facilities having either known environmental impacts or potential to impact the environment or human health, allow for the establishment of the most appropriate risk assessment procedures and remedial actions. The Directive does not however require application of a harmonised risk assessment methodology across all MSs. An Ad-hoc Group (AHG) of the Technical Adaptation Committee for the EWD developed criteria and 'Guidance' for a risk-based assessment of closed facilities in 2011 (Stanley et al., 2011).

The 2017 EWD implementation report (Cherrier et al., 2017) identified a number of data and information gaps concerning closed and in particular abandoned facilities. Some MSs had reported a much larger number of sites than expected. Hence Cherrier et al. (2017) noted incomplete and inconsistent national reporting and possible problems with the assessment criteria and/or procedures applied in the respective MSs. As the 'Guidance' was only published in 2011, various MSs had also completed their inventories before this time in order to meet the 2012 deadline set in the EWD.

This study attempted to shed light on the inconsistencies noted above.

→ **Evaluation of submissions by country**

The European Commission compiled a catalogue of national inventories, available at their website[26], based on the data collated by Cherrier et al. (2017). The compilation contains obvious gaps, as a number of MSs with a known significant mining tradition, e.g. Germany, appear to be missing. Other EU MSs clearly did not have any relevant extractive activities, e.g. the Netherlands, while some MSs, e.g. Italy, reported a very large number of sites.

The first step in the assessment was to compile a catalogue of all the data that were officially submitted to the Commission, who the responsible contact points were, and which guidance was used in the process of drawing up the inventories. This data collection aimed to obtain information

[26] Extractive Waste, Closed and abandoned waste facilities, National inventories, http://ec.europa.eu/environment/waste/mining/implementation.htm

on the relevant national criteria and procedures. An understanding of these national criteria and procedures allowed conclusions to be draws on the observed apparent inconsistencies and gaps.

The diverse political and administrative structures in the MSs made the situation with respect to identifying the responsible organisations difficult. The federal or provincial structure of some MSs, where mining legacies fall into the jurisdiction of regional or local levels of government while on-going mining activities fall into a higher level of jurisdiction, adds to the complexity. In addition, some of the inventories submitted have been compiled ten or more years ago and since then administrative structures have changed and responsible persons have moved on.

The information depth in the data sources listed by Cherrier et al. (2017) and identified through this study is quite variable. A number of MSs publish the relevant data on the internet, but the level of detail and information varies to a great extent. Some MSs merely list the names of the sites, without any geographical reference, and others detail the hazards that may be associated with each site.

There seems to be also a certain variation in the use and understanding of the terms ‘closed’ and ‘abandoned’. ‘Abandoned’ in the UK, for instance, does not seem to necessarily imply that the EWF has been left behind without proper closure. There it can mean that an EWF was closed and subsequently fell into disuse. It other MSs the term refers to sites that were literally abandoned without proper closure procedures (which appears to match the intended EWD definition). The report by DHI et al. (2012) proposes that “closed waste facilities are facilities with an identified former owner or licensee that have been closed in accordance with former licences or regulations. Abandoned waste facilities are facilities without an identified former owner/licensee and/or not having been closed in a regulated manner.”

This diversity seemed to indicate diverging interpretation of Article 20 EWD and different approaches and criteria to identify relevant sites. MSs, therefore, were asked to comment on how their approaches related to the ‘Guidance’ proposed by Stanley et al. (2011) through a questionnaire (Annex C).

While the ‘Guidance’ had been developed with those MSs in mind, that did not already have their own procedures and criteria, it was hoped that responses to the questionnaire in this study would help to understand the differing approaches and needs of the MSs that may hinder a harmonised picture of the situation across EU27.

For this study, some MSs were not contacted because of the absence of significant mining on their territory, namely Denmark, Latvia, Lithuania, Luxemburg, Malta, and the Netherlands. These MSs may host quarries and gravel pits, but these are unlikely to have resulted in EWFs of concern as described in Article 20 of the EWD. For a number of MSs it was not possible to identify the organisation that was originally responsible for drawing up the inventory. Several MSs received the questionnaire, but did not respond. Some MSs also requested a questionnaire in their country’s official language in order to avoid translation problems. Unfortunately, there where no project resources available to provide such official translations. This particularly also applied, when ‘technical’ level or lower administrative level (e.g. at ‘Länder’ level in Germany) organisations had to provide input to the responses.

Several respondants misunderstood the purpose of the Part 2 of the questionnaire concerning EWF design assumptions. This was understood as pertaining to operating facilities, rather than closed and abandoned ones, although the questionnaire explicitly addressed the latter. Indeed, the ‘Guidance’ did not assume that design documents were available for screening closed and abandoned sites.

Nevertheless, there seems to have been by and large an agreement among the respondents that the 'Guidance' had fulfilled its purpose in assisting MSs in the process and that the criteria set out therein were adequate for the identification of sites to be inventorised according to Article 20 of the EWD. A number of respondents on the other hand noted, that in their country the 'Guidance' was not used, because of *inter alia* pre-existing national procedures. It was also criticised that the 'Guidance' requires *a priori* documentary information, which often is not available, particularly for abandoned sites. These MSs needed to develop their own set of procedures and criteria.

A summary of e-mail responses of the various MSs contacted is presented in Annex N.

CHAPTER 4 ASSESSMENT OF THE PERFORMANCE OF MEMBER STATES IN RELATION TO THE IMPLEMENTATION OF THE EXTRACTIVE WASTE DIRECTIVE

Based on the conclusions of a stakeholder workshop organised on 11th April 2019, a plan for approaching MSs was developed with the objective to gain an understanding of how key concepts of the EWD are applied in the respective MSs and to clarify national figures on the generation of extractive waste and of national figures on waste facilities. To complement communication by e-mail or phone, physical meetings were organised with authorities in Bulgaria, Finland, Greece, Poland, Romania, Spain, and Sweden and with operators in MSs and their representatives. For another 13 MSs, the meetings were held in the form of telephone conferences. Due to the small size of the sector in Croatia, Cyprus, Latvia, Lithuania, Luxembourg, Malta, and Slovenia, their authorities were only contacted as a group through the project Workshops in 2019 and 2020. Contacts with MSs were coordinated in advance with the Commission (e.g. persons to be contacted, topics to be raised, meeting objectives and agenda). Draft minutes of the meetings were submitted to MSs and the Commission for comments.

Discussions with individual MSs clarified the following elements of a technical nature that relate to the understanding or interpretation of the EWD:

- issues of a technical nature related to up-dating of inventories of waste facilities including Category A waste facilities;
- an updated understanding of the existence of emergency plans where required;
- an updated understanding of why some waste facilities are still in the closure phase although disposal of waste was stopped decades ago;
- issues related to the interpretation or understanding of key concepts of the Directive and the reasoning of the competent authority for a certain view or decision.

It was not within the scope of the project to provide advice to MSs on how to interpret the EWD.

4.1. ISSUES OF A TECHNICAL NATURE RELATED TO UP-DATING OF INVENTORIES OF WASTE FACILITIES INCLUDING CATEGORY A WASTE FACILITIES

A European Parliamentary Research Service report from 2017 (EC, 2017b) described a rather difficult situation regarding the incomplete or inadequate information contained in the findings of a report prepared by BiPRO & Oakdene Hollins (2016). The picture arising from the studies conducted for the European institutions in previous years seems largely a reflection of lack of capacity on all sides, as well as possible interferences or lack of communication, coordination between competent authorities and the European Commission.

Every three years MSs shall deliver to the Commission a report on the implementation of the Directive, based on a questionnaire and additional guidance prepared by the Commission together with the MSs, according to the criteria for the categorisation of waste facilities. The report shall be transmitted to the Commission within nine months of the end of the three-year period covered by it. The Commission shall publish a report on the implementation of this Directive within nine months of receiving the reports from the MSs (EWD, Article 18).

When assessing the implementation of environmental legislation in the EU in 2017 the Commission stated in its Communication (EC, 2017) that amongst other things one of the causes for lack of implementation could have been:
“Lack of administrative capacity and insufficient financing: In some countries, a lack of financial and human resources poses an obstacle to implementation, as this prevents the authorities from preparing and implementing investment projects. Even when financing is available, local authorities sometimes lack the human resources and/or the know-how for organising public procurement and monitoring the quality of the service provided.“

Quite a number of EU operations, particularly in the area of energetic raw materials, are state-owned, and some of the information on the composition of the mineral ores and their processing agents can be commercially sensitive and hence confidential. In such cases, one must rely on the assessment carried out by the competent authorities. Statistics for sectors with less than three entities and operations with less than nine employees cannot be gathered or released by the Statistics offices.

Authorities competent for the implementation of different aspects of the EWD (e.g. data collection and compilation, data reporting and the acceptance of waste management plans) are often not at central, federal or national level in the MS, but can be at regional or local level. Due to the nature of permitting under the EWD, some of the desired information is held at a very local level or within permits themselves. Furthermore, there is no legal basis for data reporting to regional or national level. This is reflected by the fact that some MSs use multiple websites (per Region or Competent Authority) to publish related information. In several MSs, even relevant legislation is held at regional or local level making it difficult to identify and access, for example;

- Croatia and Hungary have in the past reported overlap of competencies between different ministries.
- In various MSs (e.g., Bulgaria, Czechia, Romania) the competent authority for uranium mining and its legacies is different to that dealing with other mining activities.
- France has in the past not reported numbers of EWFs for inert waste, whilst the French regions only report to national bodies on Category A facilities.
- In many MS (e.g., Bulgaria, Germany, Italy, Poland and Romania), the authorities dealing with active mines are different to those dealing with closed mines and legacy wastes.
- In Bulgaria, Italy, Poland, Romania, Slovakia, Spain and Sweden, the competent authority for establishing the external emergency plans for Category “A” installations is different to the administrative body in charge of coordinating the yearly and triennial reports to the European Commission.
- In Italy, Poland, Slovakia, Spain and Sweden, competence for undertaking inspections of the waste facilities is different to the administrative body in charge of coordinating the yearly and triennial reports to the European Commission.
- In Poland, coal mining data for this study had to be obtained from five different sources (4 official, 1 based on own research – company by company).
- In Romania, information referring to polymetallic and radioactive ores is classified as confidential by provisions of the national mining law.

Previous studies compared the number of extractive waste facilities reported by MSs in the first two consecutive reports on the implementation of the EWD with the amount of extractive waste reported to Eurostat. The figures provided vary significantly between MSs and the number of extractive waste facilities are relatively low when compared to the amounts of extractive waste produced.

In past studies, significant variations in the share of sites within a single Member State that manage inert wastes were found across MS. Some MS have previously reported exclusively inert waste facilities (e.g. Malta and Austria) and others have previously reported no inert waste facilities at all (e.g. Hungary, France and Bulgaria). CZ, ES, FI, FR, LT, PT, and SK define 'inert waste' by means of lists of materials.

Until now Greece has no inert waste list, but no established national threshold values for sites identified as not contaminated, neither relevant national natural background levels. Greece therefore has no way to classify extractive wastes as 'inert'.

Bulgaria initially reported significant amounts of hazardous waste from the mining and quarrying sector (amounting to nearly 93% of the total hazardous waste produced in the EU from that sector). This study revealed likely persisting application of reporting rules that pre-dated accession to the EU. Reported hazardous waste quantities are therefore expected to decline over time as EU hazard classification rules are fully applied in Bulgaria. Austria has previously reported significant amounts of hazardous waste being generated by the mining and quarrying sector, but no Category A EWF. The statistics for Austria make sense if, for example, none of the reported hazardous waste is actually 'extractive waste'. Estonia previously reported cases of re-categorisation of EWFs as non-Category A after closure and Ireland considers that >1000 quarry sites do not have extractive waste facilities present.

Due to multiple sources of variation (discussed below), a general comparison of the amount and the category of the extractive wastes (EW) per mine, and the yearly extraction, type and grade of the ore may explain legitimate variation in reporting across MS. Whilst ore grade affects the quantities of tailings and waste rock generated, its link with topsoil and overburden is much less direct. Stripping ratios, which give a better estimate of overburden quantities, vary from 8:1 to 2:1 for open pit mines and from 2:1 to 0.5:1 for underground mines (see also the discussion above of stripping ratios). Therefore, both ore grade and stripping ratio are probably required to understand the variation in MSs' reporting of Category A facilities.

Stakeholders have argued that the discrepancies identified in waste facility enumeration so far, have been mainly due to reporting inconsistencies. The EU Waste Codes cover waste from the extraction of all the different types of minerals together (construction, energy, industrial, metallic) and waste from the production of primary and secondary raw materials is not reported separately. For example, data on the volume of extraction from deposits and the volume of total extraction in Poland differs by approximately 15%, probably because of the amount of coal that has been produced from mine waste deposits (see 'Coding' section below).

Another cause of variation among MS is, that waste may be reported per production site at the provincial level (e.g., a Polish Voivodship), but per entity (e.g. holding company) at national level (i.e., not per individual mine). Many mine sites may deposit their waste into one EWF or, *vice versa*, a single mine may exploit more than one deposit and/or make use of more than one EWF.

Clarification was sought from MSs on the main material streams resulting from the extraction process and which of these streams are considered as extractive waste. The discussions aimed at clarifying any mismatches between the volumes of waste expected according to this study's estimates and data reported to Eurostat. This necessitated discussing material streams that were considered by the sector as being neither a product placed on the market nor an extractive waste (e.g. process intermediates, by-products used on site). In case additional extractive waste facilities were identified, the list presented in Annex L was updated.

Data on the identified material streams were critically examined to determine, whether all waste was covered by the waste facilities identified and whether the waste facilities were attributed to the appropriate category. In cases where the results of this examination diverged from the assessment of the competent authority, the authorities were contacted to explore the reasoning for the decisions taken.

This study has not detected any lack of implementation or enforcement of reporting requirements laid out in the EWD. Much of the information requested of Member State authorities within Task 6 represented 'extra' work for which competent authorities lacked legal basis and/or budgetary mandate. This suggests there is a general lack of capacity within the MSs' competent authorities to undertake any accompanying or enhancement measures that might:

a) Provide the European Commission with more background/comfort to support the legal reporting;
b) Promote awareness raising of the compliance of the sector beyond the competent authority itself

No statistics are available at this stage of percent reductions in national mining authorities' capacity with the decline in mining in general and lately during the successive crises of the 21st Century, but it is obvious that restructuring and cost saving exercises in the MSs have taken some toll. In addition, it must be feared that due to the closure of coal and lignite mines across Europe the reduction of personnel in mining authorities will continue. In some MSs, mining is seen largely from the perspective of its potential environmental impact and in consequence the remaining mining authority competences have been subsumed into environmental authorities. This in turn may have resulted in regulatory oversight being entrusted to staff with limited experience in mining-related matters.

On the other hand, timing has also been an issue. The rate of delays in the implementation of the EWD as indicated by previous studies is a result of staggered transposition of its different provisions, which collided with national legislation and provisions, and permits granted under specific national legislation that took time to revoke, replace or modify. A number of infringement procedures have also been undertaken and only resolved since publication of the previous Commission studies. This may have affected particularly those MSs that had more advanced legislation and procedures, predating the EWD (EC, 2016).

The EWD sets a number of different reporting deadlines for MS to observe. Annual reports of the occurrence of certain events must be submitted by 1 July. Triennial reports to the Commission were due on 1 February of 2012, 2015, 2018, 2021, and will be due again on 1 February 2024. At the same time, EWMPs should be reviewed every 5 years. The data are not reported on a regular basis, but must be compiled as far as possible when requested by the national authorities for the purpose of reporting to the EC.

Meanwhile, the EWD also sets a number of different transposition deadlines for MSs to observe (Table 42; e.g. 1 May 2008; 1 May 2012; 1 May 2014). The Commission Decision that formalises the information to be included in the triennial reports was finalised in sufficient time (in 2009) and included requests for information about Member State inspections of EWFs, which are crucial for enforcement. However, the European Commission had not yet provided the technical guidelines on inspections that were required by Article 22 of the EWD. Whilst the first BAT document was available already in 2004 (and adopted by the Commission in 2009), it did not sufficiently address physical stability of EWFs, and this has only been remedied in late 2018 (after the 3rd triennial reporting deadline).

Many permits issued before the EWD took force were of unlimited duration. By 1 May 2012, competent authorities should at least have confirmed that any such permits fulfil the requirements of the EWD. However, under certain conditions, some of these requirements may be waived by the Member State concerned in accordance with Article 2 of the EWD, meaning that it is at least possible that some permits have never been reviewed against the full set of EWD requirements – because not considered necessary - since its entry into force.

Mergers and acquisitions being relatively frequent in the mining sector, a lack of coherence between names of companies and operators could also appear in Member State reporting over time.

Table 42: Overview of EWD transposition over the first three reporting periods

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operating Sites	Last exemptions				**1st permits**		**1st FGs**					
Abandoned Sites					**1st Inventory**							
Annual Reporting		COM DEC **1st Annual Report**	2nd Annual Report	3rd Annual Report	4th Annual Report	5th Annual Report	6th Annual Report	7th Annual Report	8th Annual Report	9th Annual Report	10th Annual Report	11th Annual Report
Tri-annual Reporting		COM DEC			**1st 3yr Report**			**2nd 3yr Report**			**3rd 3yr Report**	
Waste Characterisation		COM DECs			**CEN Standards**							
Exchange on BAT		**1st BAT Document**										2nd BAT Document
EWMPs					**1st EWMPs**					2nd EWMPs		EWMP Guidance
WAD Cyanide Limits	50ppm CN				**CEN Standard**	25ppm CN					10ppm CN	
Inspections												**Technical Guidelines**

__Notes__:

The 1st full implementation reports from the MS were due before all operations were required to have an Article 7 permit.

The 2nd implementation reports from the MS were due after all transposition deadlines had passed but were not required to cover Part A of Annex III of Commission Decision 2009/358/EC, which lists the information required to check initial implementation.

The 2nd implementation reports from the MS were due before the latest possible deadline for review of the 1st EWMPs.

The 3rd implementation reports from the MS were the first to occur after the deadline for all activities to be reported.

The 5th implementation reports from the MS (due 1 Feb 2024), will be the first to cover a period during which technical guidelines for Article 17 inspections were available to MS.

An added source of variance is that many mines and quarries are, in fact, multi-product mines, which means that at – at any one point in time – the grades of the different materials produced may be driving production to a lesser or greater degree. For example, it may be necessary to look at different classes of industrial mineral product to understand why reported quantities of extractive wastes vary over time.

For this study, existing information was extracted from information on publicly available websites (e.g. permits for mining waste facilities are available online in several MSs), Horizon 2020 projects, and an inventory of extractive waste facilities provided by the Commission. This inventory contained information notably on the location of the extractive waste facility, the name of the operator, the type of waste and of waste facility and the date of permit approval.

In the ensuing discussions, stakeholders have repeatedly responded, with reference to their respective interpretation of European Court of Justice (ECJ) rulings, that the key definitions of the EWD are clear for them (ref. Stakeholder Workshops March 2017, April 2019 & February 2020).

Further explanation of the uncertainty of Eurostat data was provided by the EU ORAMA Project (https://orama-h2020.eu/about-the-project/; Bide et al., 2018). Within the EU there is a legal requirement to provide data on primary mineral production (for the PRODCOM database; Annex B) and trade (for the ComExt database; Annex B), but many countries do not routinely collect production data for primary minerals. Often individual commodities cannot be split from larger aggregated groups and large amounts of data are confidential and cannot be publicly released. Geological surveys and mining authorities tend not to use PRODCOM – perhaps because of a lack of detail or because they do not undertake tasks for which PRODCOM data are legally required.

Exactly who publishes what within a county will often depend on the regulatory and legal framework that determines who has responsibility for certain aspects of primary minerals extraction, for example licencing, taxation, environmental monitoring, etc. Kulczycka et al. (2020) report differences in data reported by Eurostat, the Polish Statistical Office and the Polish Geological Institute. Ultimately the source of all data will be the minerals industry, i.e. the mining companies, who will supply them on a legal or voluntary basis, depending on the data type, for aggregation at a regional or national level. In most cases there needs to be a legal requirement for the industry to report to ensure provision of data.

National statistical agencies are not specialist scientific organisations and data regarding primary minerals will only be a minor part of the data they collect. As a result, these organisations often report data as received without the technical ability for detailed quality assurance or harmonisation between methods of reporting used by different companies or regions. In many cases the data that Mining Authorities collect and hold maybe confidential. Voluntary provision of data is rare.

The EU ORAMA project (Bide et al., 2018) found that the majority of data-holders they surveyed do not make estimates for any production of minerals that are missing from the data when collected. This is very important because it will lead to potentially significant under-reporting of Europe’s mineral production. With regards to metals, 58% (21/36) participants stated that their organisations collect data for a gross weight of ore extracted, whilst only 33% (12/36) collect metal content of the ore extracted. Fewer respondents appeared to collect the grade of metal in an ore or concentrate produced (19% and 17% respectively). It is necessary for some assumptions to be made when publishing data for contained metal, which is usually the way figures for most metals are presented. 86% of responders indicated they aggregate figures in some way before publication. This adds a degree of uncertainty to the final numbers. Other factors contributing to uncertainty include: preliminary versus final figures; figures with differing amounts of estimation; different degrees of rounding; later revisions or corrections; the inclusion or not of small producers or confusion over commodity definitions.

Production data for by-product materials can be very difficult to obtain because often they are not recorded by the producing companies as they are focused on the primary products, which is of most importance to their business. Hence the data often simply do not exist. It can be difficult to track where a material has been shipped from/to for processing because it is often obscured in trade data by a description that does not mention the potential by-product. For commercial reasons, purchasers of mining by-products may prefer to declare them as ‘waste’ and have little interest in disclosing what exactly results from their further processing (pers. Comm. 1st SCRREEN Expert Group meeting, 29.06.2017).

In some instances, data may not be collected at all by any government organisation. This may be due to a shortage of funding to conduct a survey, due to the structure of mineral licencing or because these data are not seen as important. Data from state-owned or private companies are more difficult to obtain than data from publically-owned companies because these companies do not have to report to shareholders or stock exchanges. Data for construction or industrial minerals can be more difficult to collect than for metals because mineral licencing tends to be less restrictive or because small companies, for example with fewer than a certain number of employees, may have reduced reporting requirements (MinPol, 2017).

Regarding potential future waste amounts, the information available to authorities and operators is limited to the extent to which the exploration, mine planning, the Environmental Impact Assessment (EIA), and the EWMPs (as per EWD; EC, 2016) have identified such potential waste amounts. Since the geology is not always predictable throughout the lifetime of a mine or quarry, forecasts can only be estimates. Their plausibility depends on the quality of the exploration and the EIA carried out. Such information is usually only available to the operator and the competent authorities.

Extractive Waste Management Plans contain predicted volumes, not real volumes. Availability of use options for some materials occurring during operation might change the volumes and predictions. The reporting of arisen “wastes” depends on the national practice of using/reusing the material for different purposes and on legal interpretation of the EWD (EC, 2016) and supporting Commission Decisions. In some countries aggregate quarries are considered not to have any wastes, in others they do.

Main sources of uncertainty for the European Commission may be summarized as follows:

- <u>Decentralization, competences and reporting lines:</u>
  Data generated in accordance with the EWD (EC, 2016) are not necessarily all required in reports to a national body, or to the European Commission (the questionnaire referred to in Articles 22(1)(a) and 18 of EWD (EC, 2016) does not require reporting of waste volumes [COM DEC 2009/358/EC]).
- <u>Categorisation of wastes arising from the sector:</u>
  Extractive Waste Management Plans are required to use European LoW categories, which are not specific to individual extractive industries (Annex II of the Directive)
- <u>Hazard Classification of extractive wastes:</u>
  Once extractive waste is reported under different European LoW categories, it is irretrievably aggregated with similar waste from other sectors (COM DEC 2000/532/EC as amended).
- <u>No valid basis for disaggregation of reported data:</u>
  The combined legal requirements of the Directive and Eurostat do not generate centralized data on different categories of extractive waste arising from different extractive industries.

4.2. AN UPDATED UNDERSTANDING OF THE EXISTENCE OF INTERNAL AND EXTERNAL EMERGENCY PLANS

Usually, emergency planning includes the development of a documented emergency plan for critical situations and failure scenarios (internal emergency plans). In some cases, measures to handle emergencies are planned together with the competent authorities (external emergency plans) (Garbarino et al., 2018).

Article 5§3 of the EWD states that “t*he extractive waste management plan shall contain, where **<u>a Category A waste facility</u>** is required, a document demonstrating that a major-accident prevention policy, a safety management system for implementing it and an internal emergency plan will be put into effect.”*

Article 6§2-3 of the EWD states that “*each operator of **<u>a Category A waste facility</u>** shall, before the start of operations, draw up a major-accident prevention policy for the management of extractive waste and put into effect a safety management system implementing it, and shall also put into effect an internal emergency plan specifying the measures to be taken on site in the event of an accident.*

As part of the application for an Article 7 permit for a Category A EWF, the operator shall provide the competent authority with the information necessary to enable the latter to draw up the external emergency plan."

All should be proportionate to the major-accident hazards presented by the waste facility. For example, competent authorities may reduce or waive these requirements for the deposit of:

- non-hazardous extractive waste except oil and evaporites other than gypsum and anhydrite
- unpolluted soil and of waste resulting from the extraction, treatment and storage of peat.

EWFs that were not covered by Directive 96/82/EC (Seveso II), were incorporated in the EWD. Between 1996 – 2006 there was no obligation for the operator of the EWF to work out an emergency plan. Specifically, for those EWFs that stopped accepting waste before 1 May 2006 and/or were effectively closed by 31 December 2010 Article 6 of the EWD does not apply. Since 2012 EWFs fall within the scope of Directive 2012/18/EU (Seveso III). As a consequence, there are EWFs without emergency plans for example, this is the case for several Category A EWFs in Bulgaria, Finland and Hungary, at Żelazny Most in Poland, Manaila in Romania and Skouriotissa in Cyprus).

The *safety management systems* are described in the EWMPs of Category A EWFs. For example, dam safety risks are mainly covered by dam break hazard analysis documents, site operation manuals and rescue plans. In Finnish EWMPs, these documents are referred to or even appended to the EWMPs. In other cases, their role in safety management is summarised in the EWMPs (Eco Efficiency Consulting and Engineering Ltd., 2019).

The newly adopted Commission Decision laying down technical guidelines for inspections in accordance with Article 17 of the EWD in turn requires MSs to consider compliance with the *major-accident prevention policy*, *safety management system* and *emergency plans* when inspecting Category A EWFs that are newly built, operating or prepared for closure.

The *safety management system* should include the part of the general management system which includes the organisational structure, responsibilities, practices, procedures, processes and resources for determining and implementing the *major-accident prevention policy*.

The issues to be addressed by the *safety management system* are virtually identical to those required to be addressed collectively by Directives 92/104/EEC (EC, 1992) and 2012/18/EU (EC, 2012), with the exception of change management, performance monitoring, audit, review and disclosure of information to the public concerned, all of which are generally only usually required for Seveso installations. The *external emergency plan* required for Category A EWFs is also very similar to that otherwise required for Seveso installations. The Irish EPA has published guidance on management of waste from the extractive industries (IE-EPA, 2012).

4.2.1. DIRECTIVE 92/104/EEC ON THE MINIMUM REQUIREMENTS FOR IMPROVING THE SAFETY AND HEALTH PROTECTION OF WORKERS IN SURFACE AND UNDERGROUND MINERAL-EXTRACTING INDUSTRIES:

Directive 92/104/EEC (EC, 2012) provides minimum requirements for the safety and health protection of workers in the surface and underground mineral-extracting industries. It requires employers to ensure that workplaces are built in such a way that workers can perform their work without risks to their safety and health. It states that safety instructions must be comprehensible to the workers, appropriate first aid facilities must be provided, and any relevant safety drills must be performed at regular intervals. Employers shall implement measures necessary for the safety and health protection of workers, including prevention of occupational risks on the basis of a '***safety and***

health document': a coherent overall prevention policy which covers technology, organization of work, working conditions, social relationships and the influence of factors related to the working environment, and an assessment of the risks to safety and health at work, including those facing groups of workers exposed to particular risks. The safety and health document must be drawn up before work starts and be revised if the workplace has undergone major changes, extensions or conversions. A supervisor, in charge of the safety of the workplace, must be appointed.

4.2.2. DIRECTIVE 2012/18/EU ON THE CONTROL OF MAJOR-ACCIDENT HAZARDS INVOLVING DANGEROUS SUBSTANCES (SEVESO III):

MSs shall require the operator to draw up a document in writing, setting out the *major-accident prevention policy* and to ensure that it is properly implemented. The *major-accident prevention policy* shall be designed to ensure a high level of protection of human health and the environment. It shall be proportionate to the major-accident hazards. It shall include the operator's overall aims and principles of action, the role and responsibility of management, as well as the commitment towards continuously improving the control of major accident hazards and ensuring a high level of protection. The *major-accident prevention policy* shall be implemented by appropriate means, structures and by a *safety management system*, proportionate to the major-accident hazards, and the complexity of the organisation or the activities of the establishment. For lower-tier establishments, the obligation to implement the *major-accident prevention policy* may be fulfilled by other appropriate means, structures and management systems, proportionate to major-accident hazards. MSs shall ensure that, for all upper-tier establishments: a) the operator draws up an internal emergency plan for the measures to be taken inside the establishment; (b) the operator supplies the necessary information to the competent authority, to enable the latter to draw up external emergency plans. MSs shall ensure that the public concerned is given early opportunity to give its opinion on external emergency plans when they are being established or substantially modified. These requirements are almost identical to those of Article 6 of the EWD applying to Category A EWFs.

4.2.3. MEMBER STATE, STATUS OF INTERNAL AND EXTERNAL EMERGENCY PLANS

Although the directives "92/104/EEC", "2012/18/EU" and EWD contain some similar requirements for the internal emergency plans, the competent authority for all three Directives are different in some Member States, resulting in extreme long approval time, taking several years. As a consequence there is also a delay in the external plans as long as the internal plans have not been approved. According to the information received from the MS, the status of external emergency plans is listed in Table 43.

Table 43: Updated status of External Emergency Planning for Category A facilities (Member States not listed report zero Category A facilities on their territories) (Green – apparently compliant; Orange – some uncertainty about compliance; Red – apparently not compliant)

M State	# Cat A facilities	Emergency Plans response	Observation
Bulgaria			
	3	Local Civil Protection Agencies (of which there could be about 29 across the country) are responsible. There are only three existing (three Category A EWFs at two mines: 1 at Chelopech & 2 at Ellatzite).	No confirmation at national level
Cyprus			
	1	An emergency plan has been prepared for the only one Category A facility	
Finland			
	10	According to the Section 48 of the Rescue Act (379/2011) the local rescue departments (113ft he113a113 by municipalities) are responsible for establishing external emergency plans for Category A installations, in cooperation with the plant operator. The external emergency plans are seen for instance in the webpages of Regional Rescue Departments (2 Category A facilities are in the Closure phase). https://www.environment.fi/en-US/Waters/Use_of_water_resources/Dams_and_dam_safety/Dam_Safety_Guide	
France			
	1	The three category A facilities (two of which are in the closure phase) are covered by an external emergency plan	
Greece			
	1	The Mineral raw materials policy Directorate is responsible. Only one emergency plan has been submitted that corresponds to the Category A EWF Kokkinolakkas (Hellas Gold S.A.). The emergency plan has been submitted to the Mineral raw materials policy Directorate. There is not a technical approval of the Emergency Plan. The Directorate of Mineral raw materials policy in cooperation with the Inspectors-Controllers Body evaluate the plan.	Not yet formally approved
Hungary			
	6	6 operating, 18 in closure phase and 1 closed or abandoned. The National Directorate General for Disaster Management, Ministry of the Interior (OKF) regional body, in cooperation with the mayor, prepares an external emergency plan. During the preparation of the external emergency plan, the Regional Government Office, the Environmental Authority, the County, Capital Disaster Management Directorate, the Fire	Three plans are possibly still in progress

		Protection Authority, the Ambulance Service, the Police and the operator will give their opinion. The external emergency plans in force for Category A installations are AL Kolontár – Ajka red sludge pond, Répcelak II. – carbon dioxide extraction plant and Mihályi II. Carbon dioxide extraction plant (main provision 4).	
Ireland			
	2	Prepared by Operators in conjunction with local authorities. No list available.	
Italy			
	2	2 operating and 219 closed or abandoned. All Category "A" installations are covered by an emergency plan	
Poland			
	1	Regional Headquarters of the State Fire Service prepares the plans and the Voivodship Marshal approves it and issues permit. Regional Headquarters of the State Fire Service. The list is available publicly available online. http://stara.kwpsp.wroc.pl/zagr/inf_zelmost/info.htm#powr%C3%B3t_1	
Portugal			
	3	3 in operation, 1 closed or abandoned. The 3 emergency plans were in progress in 2018.	Three plans are possibly still in progress
Romania			
	2	Local Civil Protection Agencies (of which there could be about 41 across the country). In practice, there are only two existing (two Category A EWFs at two mines).	No confirmation at national level
Slovakia			
	3	Under Act No 514/2008 on the management of waste from extractive industries and amending certain acts, as amended, extractive waste management authorities do not have the option of checking up on the production of external emergency plans. They can only check that operators have provided underlying documentation for the production of these plans. Checks revealed that two operators of Category A facilities provided all the underlying documentation required to produce external emergency plans. In 2015, unscheduled checks covered the implementation of external emergency plans in relevant municipalities (14-15 December 2015, Jelšava, Markušovce). One operator of a Category A facility (Nižná Slaná) is in insolvency proceedings and has not complied with any of the obligations under Sections 5, 6, 7 and 11 of Act No 514/2008	No confirmation at national level
Spain			

	4	All facilities are required to have an Emergency Plan in compliance with Royal Decree 975/2009. But the number of existing or missing plans and the concrete procedure for establishing these plans is not included as the mining competencies are transferred to the autonomous communities, which can ensure is that all facilities have approved emergency plans, according to the Royal Decree 975/2009. Corta del Valle reservoir – El Valle-Boinás mine. Cobre Las Cruces external emergency plan (http://www.juntadeandalucia.es/boja/2016/110/BOJA16-110-00051-10228-01_00092740.pdf) Aguas Teñidas external emergency plan (www.juntadeandalucia.es/export/drupaljda/02%20PLAN%20MATSAfeb15.pdf) AguaBlanca being processed.	Total number of Cat A facilities still unclear
Sweden			
	14	Municipality fire and rescue services are responsible. External emergency plan exists for all but one (maybe) category A facilities. The counties are competent authorities for evaluating the plans.	One plan possibly still in progress
Total			
14 States	53	A further 243 no longer in operation (219 in Italy alone)	

4.3. An updated understanding of why some waste facilities are still in the closure phase although disposal of waste was stopped decades ago

MS often have insufficient information about closed and abandoned facilities to be able to categorise the waste within many of them. Whilst many of the Articles of the EWD do not apply to any facilities closed or abandoned before 1 May 2006, Article 20 does require MS to prepare an inventory of all closed and abandoned facilities that cause serious negative environmental impacts or have the potential of becoming in the medium or short term a serious threat to human health or the environment. It may have been unclear for MS whether these were to be included in the triennial reporting. MSs' assessment of whether a closed or abandoned EWF causes serious negative environmental impacts or has the potential of becoming in the medium or short term a serious threat to human health or the environment may also differ.

This study has confirmed that the terms (e.g. in operation, in operation with permit, in transition, in closure phase, closed versus abandoned) appearing in the questionnaire for the report by Member States on the implementation of EWD[27] have been a source of variation in interpretation and reporting.

27 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009D0358&from=EL

4.4. 'Review of the information and gaps identified (examples of common and differing interpretation of authorities on key concepts of the Directive and gaps)

4.4.1. Definitions

During previous studies, MSs had reported that the definitions of 'waste' and 'waste facility' were clear, but that the definition of what is 'extractive waste' was not clear. As each Member State has its own mining and related legislation (which usually includes legislation on mineral waste) definitions and categorizations of mining waste, by-product and overburden have varied. Kulczycka et al. (2020) and Twardowska et al (2004) suggest that this is not unique to the EU, but common amongst OECD countries as well. OECD and Eurostat data cover not only waste from mining and processing operations, but also some smelting operations.

However, interviews with the MSs as part of this study did not reveal major differences in the interpretation of definitions of 'extractive waste' and 'treatment' between them. Though all MS appear therefore to have adopted legal definitions of extractive waste consistent with the EWD, the project has noted some potential for differences between usages of the general term "waste" by different stakeholders; namely operators and regulators at all levels, ranging from the local to the international level. Different stakeholders tend to call any material that is not declared a product or by-product, "waste". Stakeholders' references to some (by-)products as "waste" and *vice versa* may be a result of operators seeking a management route that best complies with all environmental, social and economic standards, just as some MS have exercised their legal right to extend or reduce the scope of relevant EWD provisions within their territories for reasons of practicality and workability. For example, in Cyprus the copper mine of Skouriotissa produces copper metal cathodes (99.99%) applying the Leaching – Solvent Extraction – Electrowinning method. The raw material for the process are old stockpiled tailings. After re-processing, the resulting tailings are deposited back into the excavation voids of the old mine. Even though the voids do not constitute an extractive waste facility under the provisions of the EWD, for practical reasons of ease of monitoring, Cyprus has classified them as a Category A facility in its national law.

The EWD states that 'extractive waste' means waste resulting from the prospecting, extraction, ***treatment*** and storage of mineral resources and the working of quarries [EWD Article 2§1].

To fully understand the definition of extractive waste, the term "treatment" needs also to be clearly understood. The EWD states that 'treatment' means the mechanical, physical, biological, ***thermal or chemical process*** or combination of processes carried out on mineral resources, including from the working of quarries, with a view to extracting the mineral, including size change, classification, separation and leaching, and the re-processing of previously discarded waste, but ***excluding smelting, thermal manufacturing processes (other than the burning of limestone) and metallurgical processes*** (EWD Article 3§8).

This corresponds well to the industry conventions related to categorisation of processes. Beneficiation of ores to produce a concentrate exploits differences in the physical properties of different mineral grains and typically encompasses optical/mechanised sorting, magnetic/electrostatic separation, gravity or dense medium separation, preferential crushing, grinding or milling, screening, hydrocycloning or classification, agglomeration or froth flotation, leaching/washing processes, thickening and filtration, drying (or calcination that results in removal of water and impurities only), and pelletising by granulation only.

"Smelting, thermal manufacturing processes (other than the burning of limestone) and metallurgical processes" is typically understood by industry to encompass pelletising with sintering, ion-exchange, solvent extraction, electro-winning, pressure digestion in aqueous NaOH, sintering, roasting and smelting, calcination involving changes in the chemical structure (e.g., CO_2 release), precipitation and gas precipitation (in lead/zinc smelters for example).

De facto, a couple of exceptions are commonly imposed throughout the MSs: gold mine tailings, following cyanidation processes are clearly referred to by the EWD itself as extractive waste; and the European Commission has formally adopted the view that red-mud resulting from pressure digestion of bauxite in aqueous NaOH (the Bayer process) should also be considered extractive waste (EC, 2017b).

Alumina refineries are typically separated from bauxite mines by large distances, which makes their distinction relatively easy. However, in gold mining, analogous processes may take place at the mine site. At such facilities, strict application of a boundary between extractive waste and metallurgical waste may cease to be meaningful in terms of materials management for protection of human health and the environment. For example, the recovery of gold through metallurgical processes very often takes place at the gold mine and as a result the final waste may be a mix of extractive waste (from treatment of the mineral resource to produce a concentrate or leachate) and metallurgical waste (resulting from the final step to produce a gold doré bar). From the definition in the EWD, it is clear that waste from a cyanide-leach process is included in the definition of "extractive waste", but bottom ash from a furnace is not. Industry stakeholders indicate that it is common across EU Member States for sludges from treatment of mine water and/or extractive waste influenced water (EWIW), for example, to be managed together with extractive waste. The legal justification for such implementation practices appears to rest on the phrase '*or combination of processes*' within the EWD's definition of 'treatment' (see above).As a consequence there are some MSs (e.g. Poland) realising the above problems and solve them by creating additional waste code under Chapter 1 of the LoW (as extractive waste). Other countries however have not defined a specific approach for the characterisation of the aforementioned waste as extractive or not.

The results of previous studies suggest that there may have been some uncertainty as to how these definitions applied to energy minerals. For example, in some MSs, significant quantities of waste can be expected to be generated by the combustion of coal or oil shale. On the face of it, such wastes should not be reported as extractive waste because combustion processes do not appear to fit within the above definition of 'treatment'. During this study, MSs indicated that they do not consider combustion processes to constitute 'treatment' of mineral resources.

Materials that are designed for use in mined-out voids through analysis of their composition and their behaviour in situ (e.g., in combination with cement) are not considered as waste).If this material is inert, the first crucial criterion for such material is its physical stability. It must be physically stable to enable continued mining. So, physical stability (e.g., by compressive strength testing) of such material is assessed. For non-inert materials the potential for acid generation to cause impacts has to be assessed. In general, for non-inert materials used for filling excavation voids, MS requires the operators to define a long term monitoring scheme.

According to Judgement of the Court (Sixth Chamber) in Case C-114/01 of the 11th September 2003 (EC, 2003) *"the holder of leftover rock and residual sand from the ore-dressing operations from the operation of a mine discards or intends to discard those substances, which must consequently be classified as 'waste', unless he uses them lawfully for the necessary filling in the galleries of that mine and provides sufficient guarantees as to the identification and actual use of the substances to be used for that purposes. […] Only if such use of those residues were prohibited, in particular for reasons of safety or protection of the environment, and the galleries had to be sealed and supported by some other process, would it have to be considered that the holder is obliged to discard those residues and* *that they constitute waste*." The Technical report CEN/TR 15310-1 explains that "*testing of wastes allows informed decisions to be made on how they should be treated (or not), recovered or disposed of*".

There is no need to permit an extraction void as an EWF, if extractive waste is placed back in extraction voids for certain purposes, such as rehabilitation or to increase ore recovery by allowing to mine e.g. pillars. Article 3 of the EWD explicitly excludes such voids from the scope of the definition of EWF. There has been some disagreement between the European Commission and MSs about the status of material placed into such voids and the extent to which the provisions of different EU legislation apply to it. Of course the operation facility needs to have received the permit to operate as a mining activity.

This can give rise to reporting results that may at first be surprising: e.g., lignite mines typically do not report extractive waste, but may report waste from the production of aggregates from excavated materials. Primary aggregates quarries, however, typically sell all materials and report zero waste.

In the extractive sector and in each MS, multiple terms are used such as residues, residual waste, tailings, to describe materials that are not considered to fall under the legal definition of extractive waste. Mining and mineral processing generates significant material streams that are not considered as 'extractive waste' according to the definition which is given by the Court decision C-114/01 and, therefore, are not reported under the EWD . Some operators may therefore not feel obliged to cover them in their Extractive Waste Management Plans (cf. in case of aggregates, many MS, including Belgium, Luxembourg, Malta do not report material streams that can not be sold as waste since it is kept at the extraction site). In addition, many 'wastes' generated in mines and quarries can readily become valuable again when commercial conditions change. For example, the prices of many internationally traded metals and other commodities depend on market conditions, which regularly give rise to a quadrupling or a quartering of associated metal prices over a certain period. In some MS companies ask for new permits to treat and/or reprocess historical excavated materials and/or tailings.

Legal terms such as "waste" and "waste facility" directly determine the applicability of the EWD to operators and national authorities. Uncertainties and different understandings regarding their meaning are likely to generate variation in MSs' statistics, making it difficult to correctly interpret the reported data.

For example, events that may, in general, increase the risk of damage and accidents may not be reported to the European Commission because the facilities in question may not be classified as an EWF falling within the scope of the EWD:

- As a facility has erroneously been classified as non-category A instead of a Category A;
- As a facility has been classified as non-category A and the wastes deposited therein have been correctly classified as inert, then the Member State may legitimately exercise its right to waive certain requirements of the EWD (article 2 §3).

In both cases, the information submitted in triennial implementation reports may look very much the same, without the European Commission being able to easily discern the difference. In transposing the EWD, MS guarantee the effectiveness of EU law, in accordance with the principle of sincere cooperation established in Article 4(3) TEU. MSs must ensure, therefore, that interpretation errors such as those described above do not occur, as EU law is enforced by the MSs.

4.4.2. Classification of extractive waste

A waste evaluator in order to satisfy the provisions of the EWD seeks the suitable waste code as stated by the relevant entry in Decision 2014/955/EU (EC, 2014a), which in turn depends on its hazard classification. According to Article 5 of the EWD, operators are legally required to allocate appropriate codes to extractive wastes according to the relevant European LoW entry when submitting their Extractive Waste Management Plans. According to the Decision 2014/955/EU on the LoW (EC, 2014a), waste resulting from exploration, mining, quarrying, and physical ***and chemical*** treatment of minerals are reported in the LoW with 01 as two first digits and are subdivided as follows (Table 44):

- Wastes from mineral excavation (waste codes 01 01);
- Wastes from physical and chemical processing of metalliferous minerals (code 01 03);
- Wastes from physical and chemical processing of non-metalliferous minerals (code 01 04);
- Drilling muds and other drilling wastes (waste code 01 05).

Table 44: Waste Codes from Decision 2014/955/EU for extractive waste (EC, 2014a)

Code	Waste	Observations
01 01 01	Wastes from mineral metalliferous excavation	Can be reactive or not
01 01 02	Wastes from mineral non-metalliferous excavation	Can be reactive or not
01 03	Wastes from physical and chemical processing of metalliferous minerals	Can be reactive or not
010304*	Acid-generating tailings from processing of sulfide ore	Is, by definition, reactive waste
010305*	Other tailings containing hazardous substances	Can be reactive or not
010306	Tailings other than those mentioned in 01 03 04 and 01 03 05	Can be reactive or not, but not hazardous
010307*	Other wastes containing hazardous substances from physical and chemical processing of metalliferous minerals	Can be reactive or not
010308	Dusty and powdery wastes other than those mentioned in 01 03 07	Can be reactive or not
010309	Red mud from alumina production other than the wastes mentioned in 01 03 10	Can be reactive or not but not hazardous
010310*	Red mud from alumina production containing hazardous substances other than the wastes mentioned in 01 03 07	Can be reactive or not
010399	Wastes not otherwise specified	Can be reactive or not
01 04	wastes from physical and chemical processing of non-metalliferous minerals	Can be reactive or not
010407*	wastes containing hazardous substances from physical and chemical processing of non-metalliferous minerals	Can be reactive or not
010408	waste gravel and crushed rocks other than those mentioned in 01 04 07	Can be reactive or not but not hazardous
010409	waste sand and clays	Can be reactive or not but not hazardous
010410	dusty and powdery wastes other than those mentioned in 01 04 07	Can be reactive or not but not hazardous
010411	wastes from potash and rock salt processing other than those mentioned in 01 04 07	Can be reactive or not but not hazardous
010412	tailings and other wastes from washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11	Can be reactive or not but not hazardous

Code	Waste	Observations
010413	wastes from stone cutting and sawing other than those mentioned in 01 04 07	Can be reactive or not but not hazardous
010499	wastes not otherwise specified	Can be reactive or not

A first observation that can be made, is that waste from metallurgical processes should not be considered extractive waste, because according to the European LoW, the first step for the coding of waste is the identification of the source that generates the waste. In legal terms, any waste from the treatment of concentrate to metal is a metallurgical waste covered by section 10 “Wastes from thermal processes” of the LoW and not an extractive waste covered by section 01 “Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals”. Waste resulting from smelting, thermal manufacturing and metallurgical processes, which are all excluded from the definition of extractive waste, are provided as separate entries in the European LoW, for example:

- 10 02 wastes from the iron and steel industry;
- 10 03 wastes from aluminium thermal metallurgy;
- 10 04 wastes from lead thermal metallurgy;
- 10 05 wastes from zinc thermal metallurgy;
- 10 06 wastes from copper thermal metallurgy;
- 10 07 wastes from silver, gold and platinum thermal metallurgy;
- 10 08 wastes from other non-ferrous thermal metallurgy.

This can obviously result in confusion for the exceptional cases referred to above: tailings from cyanidation of gold concentrates and red-mud from pressure digestion of bauxite in aqueous NaOH.

Secondly, the European LoW does not distinguish inert waste from non-inert waste or reactive waste from non-reactive waste, both of which are important concepts for determining the proportionate scope of application of several EWD provisions.

Article 2 of the EWD defines two categories in-particular:

- ‘hazardous waste’ is as defined in Article 1(4) of Council Directive 91/689/EEC (EC, 1991),
- ‘inert waste’, defined as waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and not endanger the quality of surface water and/or groundwater
- (‘reactive waste’ is not defined in the EWD – see discussion above).

Differentiation of inert or reactive waste does not exist in the European LoW coding, and yet operators are legally required to categorise the waste according to the relevant European LoW entry when submitting their Extractive Waste Management Plans to the competent authority (see Text Box below).

Article 5.3(b) and Annex II Waste Characterisation

The waste management plan shall contain at least the following elements:

,…,

(b) waste cgaracterisation in accordance with Annex II and a statement of the ***estimated total quantities of extractive waste to be produced during the operational phase***;

The waste to be deposited in a facility shall be chracterised in such a way as to guarantee the long-term physical and chemical stability of the structure of the facility and to prevent major accidents. The waste characterisation shall include, where appropriate and in accordance with the category of the waste facility, the following aspects:

,…,

(2) ***classification of the waste according to the relevant entry in Commission Decision 2000/532/EC*** *of 3 May 2000 replacing Decision 94/3/EC* ***establishing a list of wastes*** *pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste (OJ L 226, 6.9.2000, p. 3). Decision as last amended by Council Decision 2001/573/EC (OJ L 203, 28.7.2001, p. 18).*, with regard to its hazardous characteristics.

The main difficulty whith applying the Eurostat statistics on extractive waste is related to the waste codes that cover extraction of different types of minerals (construction, energy, industrial, metallic). It is not possible to separate data for individual minerals. Additionally, waste from production of primary and secondary raw materials is not reported separately.

EWC-Stat / Version 4 (EC, 2010) already splits mineral waste from construction and demolition waste (Code 12.1) from other mineral wastes (Codes 12.2, 12.3 & 12.5). The remaining aggregated statistic "Other mineral wastes" still includes:

- Asbestos materials from all branches (asbestos processing and -cement, brake pads etc.);
- Mineral wastes from mining and quarrying;
- Blasting material and grinding bodies;
- Casting cores and moulds;
- Linings and refractories from all thermal processes.

Eurostat guidance (Eurostat, 2010; Eurostat 2013) states that the "Other mineral wastes" statistic mixes some wastes from the following families of EU Waste Codes:

- **01 exploration, mining, quarrying, physical and chemical treatment of minerals;**
- 02 agriculture, horticulture, aquaculture, forestry, hunting and fishing, food;
- 06 inorganic chemical processes;
- 08 coatings (paints, varnishes and vitreous enamels), adhesives, sealants and inks;
- 10 from thermal processes;
- 15 packaging; absorbents, wiping cloths, filter materials and protective clothing;
- 16 not otherwise specified in the list;
- 17 Construction and demolition wastes (including soil from contaminated sites);
- 19 waste management, waste water treatment, water for human consumption and industrial water;
- 20 household and commercial, industrial and institutional wastes including separately collected fractions.

According to the guidance on the coding of waste according to the EWC-Stat categories published in 2010 (EC, 2010), the Waste Statistics Regulation stipulates that the EWC-Stat has to be used for the reporting of data to Eurostat but it does not prescribe a specific coding to be used for data collection.

Eurostat entries for waste do not line up exactly with the definitions of the EWD. According to the Regulation (EC) No 2150/2002 on waste statistics (EC, 2002) and the Regulation (EC) No 849/2010 that amends the Annexes I, II and III to this Regulation, MSs shall produce statistical data, following the breakdown set out in Annexes I and II. Furthermore, according to Article 5(1) of this Regulation the Commission shall establish a table of equivalence between the statistical nomenclature of Annex III and the LoW established by Commission Decision 2014/955/EU (EC, 2014a). This table is presented in Regulation (EC) No 849/2010 (EC, 2010) in Annex III and extractive waste may register in the group 12.31 *Waste of naturally occurring minerals*. This group is divided to Non-hazardous and hazardous waste codes. However, the "*Waste of naturally occurring minerals"* not only includes waste codes from the first chapter of the LoW (wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals), but also waste from other chapters, for example:

- 08 02 02 aqueous sludges containing ceramic materials;
- 10 11 10 waste preparation mixture before thermal processing other than those mentioned in 10 11 09;
- 19 08 02 waste from de-sanding;
- 19 13 01* solid wastes from soil remediation containing dangerous substances.

So, this approach aggregates extractive waste from chapter 01 with other waste, making difficult to later disaggregate the data from published waste statistics. Table 45 presents different waste categories applied by all databases.

Table 45: Exemplary table of different categories of extractive waste databases (NH: non hazardous; H: hazardous)

OECD	Mining wastes				
	mining-and-quarrying extraction wastes which are barren soils removed from mining and quarrying sites during the preparation for mining and quarrying and which do not enter into the dressing and beneficiating processes			mining and-quarrying dressing and beneficiating wastes which are obtained during the process of separating minerals from ores and other materials extracted during mining-and-quarrying activities	
Eurostat	Waste from mining & quarrying				
	Hazardous		Non-hazardous		
EU NACE	Section B: Mining and quarrying				
	Aggregates	*Other construction*	*Industrial*	*Metallic*	*Energy*
EWC-Stat	*12.31: Waste of naturally occurring minerals*				
	12.31.1: Hazardous		*12.31.0 Non-Hazardous*		
EU LoW	01 Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals				
	01 01 Wastes from mineral excavation	01 03 Wastes from further physical and chemical processing of metalliferous minerals		01 04 Wastes from further physical and chemical processing on non-	01 05 Drilling muds and other drilling wastes

<table>
<tr><td rowspan="2"></td><td colspan="2"></td><td colspan="4"></td><td colspan="2">metalliferous minerals</td><td colspan="2"></td></tr>
<tr><td>NH</td><td>H</td><td>NH</td><td>H</td><td>NH</td><td>H</td><td>NH</td><td>H</td><td>NH</td><td>H</td></tr>
<tr><td colspan="11"></td></tr>
<tr><td>EWD (type)</td><td colspan="2">Unpolluted soil</td><td>Inert</td><td colspan="2">Non-inert non-hazardous</td><td colspan="5">hazardous</td></tr>
<tr><td colspan="11"></td></tr>
<tr><td rowspan="3">EWD (fate)</td><td colspan="4">Deposited in an EWF</td><td colspan="6">Not deposited in an EWF</td></tr>
<tr><td colspan="2" rowspan="2">Category A</td><td colspan="2">Non-Cat. A</td><td colspan="2" rowspan="2">Other (out of scope)</td><td colspan="4" rowspan="2">Excavation void (within scope)</td></tr>
<tr><td>With waiver(s)</td><td>Without waiver(s)</td></tr>
</table>

Notes:
Competent authorities may also reduce or waive the requirements for the deposit of non-hazardous waste generated from the prospecting of mineral resources, except oil and evaporites other than gypsum and anhydrite, as well as for the deposit of unpolluted soil and of waste resulting from the extraction, treatment and storage of peat as long as it is satisfied that the requirements of EWD article 4 are met.

The Statistical coding of economic activities in the European Community registers the Mining and Quarrying activities as “Section B”, where the extraction of minerals occurring naturally as solids (coal and ores), liquids (petroleum) are included. The section B includes supplementary activities aimed at preparing the crude materials for marketing, for example, crushing, grinding, cleaning, drying, sorting, concentrating ores, liquefaction of natural gas and agglomeration of solid fuels. These operations are often accomplished by the units that extracted the resource and/or others located nearby. Mining activities are classified into divisions, groups and classes based on the principal mineral produced. Divisions 05, 06 concern mining and quarrying of fossil fuels (coal, lignite, petroleum, gas); divisions 07, 08 concern metal ores, various minerals and quarry products.

However, the data for extractive waste generation in Eurostat are presented under the title “Mineral and solidified Wastes” and none of the aformentioned titles is retained (neither “Waste of naturally occurring minerals” nor “Mining and Quarrying”). For this waste category “Mineral and solidified Wastes”, there are three classifications “hazardous and nonhazardous total”, “hazardous” and “nonhazardous”. At the same time, there are waste groups such as “mineral waste from construction and demolition” and “mineral waste from waste treatment and stabilised wastes” that make it difficult or impossible to split out the extractive waste component for evaluation.

The problems described here tend to come from Eurostat rather than the EU Waste Codes, though neither of them entirely matches the different sources and categories of waste mentioned in the EWD.

This study reviewed and discussed with MSs the purpose of the information collected via the waste codes, the original intention and current considerations:

- At company level: such statistics are integrated into planning and management processes and are first and foremost a cost component.
- At local/regional level: statistics at local and regional level are being used to identify potential planning requirements, environmental management issues, permitting issues (since most enterprises are provided permits at this administration level).
- At national level and at EU level: statistics at national and EU level are being used to assess the performance of waste reduction and waste management as well as assessing potential hazards, which might require additional legislation.

Unfortunately, data about generated wastes in individual MSs according to the LoW are not readily available. Whereas in national and EU statistics Eurostat and MS data are based on the Regulation (EC) 2150/2002 (EC, 2002) on waste statistics and its amending Regulation (EU) No 849/2010 (EC, 2010), MS are obliged to report statistical data on waste generation and waste treatment according to the statistical waste nomenclature EWC-Stat.

Some MSs have overcome these obstacle by inserting extra waste codes in their national legislation. Countries are free to use any waste coding if they can produce the defined formats in the required quality when reporting to Eurostat. Countries can even collect their data according to the LoWs and subsequently convert them to the required EWC-Stat-categories. For example, in Poland a proper description for their extractive waste in the LoW is missing, therefore they create additional waste codes and descriptions:

- 01 01 80 Rock waste from copper, zinc and lead mining;
- 01 03 81 Wastes from flotation enrichment of non-ferrous ores;
- 01 04 81 Waste from coal flotation enrichment.

4.5. Preparation of country fact-sheets (structure, Definition of areas of intervention: Major accident prevention, Waste facility categorisation etc)

Following consultation with MSs in personal and telephone interviews and two rounds of reviews of the summary texts, the study's findings have been summarised in Country Fact Sheets that provide an overview of the national mining sectors, related waste management information and the implementation of the EU Directive. They provide information on the current reporting, categorisation, number of EWFs and number of Category A facilities for metallic (Table 38) an non-metallic minerals (Table 39). The set of Country Fact Sheets – one for every Member State – lists the reported number of extractive sites (mines and/or quarries) for aggregates, ceramic clays, dimension stones, industrial minerals, metallic minerals and energy minerals. A comprehensive set of Category A waste facilities has thereby been identified. The permitting status of associated extractive waste sites was clarified. Whilst national mining sector descriptions are regularly published by most MSs themselves, the Country Fact Sheets give an overview of the national mining sector's related *waste management* and the implementation of the EU Directive (Annex Q).

4.6. Options to improve reporting of extractive waste

This study has implemented an alternative means of counter checking the number of Category A EWFs identified by MSs in order to trigger clarifications from individual MSs. For each of the categories "aggregates", "other construction minerals", "industrial minerals" and "energy minerals", it is proposed that the check-items listed feed into future EWD Annex III risk evaluation to be applied by the competent authority (Table 46; those in boldface were already applied as part of this study):

Table 46: Proposal of items to be checked in future EWD Annex III risk evaluation

Possible EWD Annex III Risk Evaluation Check Item	*Corresponding EWD Article 17 Inspection Item*
The mineral sector ("aggregates", "other construction minerals", "industrial minerals" or "energy minerals")	
Mine type (surface or underground)	
Type of ore body	
Prediction of whether extractive waste is likely to arise or not	
Longitude & Latitude	
Geological setting	Site conditions
Related seismic zoning	

	Related topographic slope	
	Average rainfall	compliance of the water balance of the waste facility in comparison to projections in the waste management plan
	Proximate watercourses	measures planned to prevent pollution or contamination of surface water
	Proximate settlements	assessment of the potential impacts of the facilities concerned on human health
	Proximate Natura 2000 sites	relevant environmental issues and risks presented by the facilities
N° of EWFs		arrangements in place for co-operation and co-ordination in relation to facilities covered by Article 7 of the EWD
N° of EWFs already reported as Category A		
Waste (t) reported & year		quantities of the waste deposited in comparison to projections in the waste management plan
	Hazardous Waste (t) reported & year	characteristics of the waste deposited in comparison to projections in the waste management plan
Ore (t) extracted & year		
	Typical angle of repose of the ore	
Product Concentrate (t) & year		
Byproduct Concentrate (t) & year		
Applicable markers of BAT		
	Process for treatment of mineral resource	
	Associated reagents	
	Associated REACH Authorisations	operators' knowledge of the relevant legal requirements
	Basal structure	
	Typical angle of repose of the resulting waste	characteristics of the waste deposited in comparison to projections in the waste management plan

To address misleading statistics coming out of Eurostat, EWC-Stat / Version 4 (EC, 2010) already splits mineral waste from construction & demolition waste (Code 12.1) from other mineral wastes (Codes 12.2, 12.3 & 12.5). At the February 2020 Workshop MSs explained that "major mineral waste" is excluded from the statistical reporting obligations of MSs as apparently there is no statutory requirement to provide these data centrally. An obvious recommendation would then be to request that Eurostat requires separate reporting of ***mineral wastes from mining and quarrying***, ensuring that its definition remains one-to-one equivalent to the totals reported under the 01 EU Waste Codes (***wastes from exploration, mining, quarrying, physical and chemical treatment of minerals)***.

The project's approach to estimating the appropriate category of EWF to accommodate extractive waste from metal mines is probably already more useful than comparing Waste Code and Eurostat data, but needs refinement to be sufficiently useful for the European Commission, MSs and the extractive industry. Perhaps the most pressing need is to ensure that the assumption that sulfidic wastes are hazardous (waste code 01 03 04*) is only applied when generation of acid rock drainage is likely, by:

- A first reality check from MSs using their respective Country Fact Sheets;, with regards to hazard classification of their their sulfidic metal mining waste.

- A more granular split of “sulfidic” Ore Types: Categorising tailings per deposit type rather than commodity; linking generic ore-type models with most representative mineral processing steps treatment/management practices and a geo-referenced climate seasonality dataset (e.g., Köppen-Geiger climate classification);
- Better binning/filtering of the available data as per the above to identify groups of EWFs for which, in the first instance, the waste code 01 03 04* might be more reasonably assumed to apply;
- Ensuring more stringent and detailed reporting channels between producers, local and regional, and national authorities via the national legislation to improve the data and the outcomes.

Implications for the Country Fact Sheets and/or triennial questionnaire:

- Add “ore-type” and “processes” for each metal mine to the questionnaire;
- (alternatively, add an integrating question: “please list EWFs where waste characterization has indicated that generation of acid rock drainage is likely”);
- Access geo-referenced seasonal climate parameters from Joint Research Centre;
- Alternatively, the information could be retrieved as part of a European wide digitalisation project (see below), including additional information from EIAs/EWMPs.

As requested by the European Commission, this study has proposed a new reporting questionnaire to solve such issues, but also to include new information related to the various supporting legislation and guidance that has been adopted since the EWD entered into force.

The result is a shortened, more specific questionnaire that would hopefully eliminate redundancies, be clearer for MSs and therefore lead to more consistent and comparable responses.

The review of the current practices in the various MS has clearly shown a large diversity and degree of centralisation and decentralisation across the MSs. Difficulties can arise from the size of the companies and their obligation to report to various institutions at various levels in different MSs.

There are differences in responsibilities of the various institutions/authorities in MSs and there are problems in accessibility of reported data for various institutions which might require these data for policy decisions.

A few illustrative case studies were identified during this study to highlight the latest developments and efforts to digitalise this area of data management.

It might be envisaged to undertake a one-off EU-funded project to digitalise the reporting in each Member State and to convert older paper or pdf information into a structured digital form. It may be necessary to specify a pragmatic temporal scope to avoid having to enter a lot of old, invalid information. For example, a national database could be constructed to store at least the parameters listed in Table 46.

The European Commission has recently announced a wider review process concerning the reporting on implementation of EU directives. The aim of the new proposals would be, e.g., to modify the reporting and to remove issues that concern the implementation of directives in the national laws of the MSs. The implementation of directives into national law is currently reported separately to the EU at the stage when the law is enforced (at the beginning). The aim would be to avoid questions that require a verbal answering and to seek questions that can be answered directly through data mining, using public information sources in the MSs where possible.

It is therefore recommended that the reporting of the Mining Waste Directive should follow these same principles as mentioned above. Therefore, questions about changes in national legislation should be excluded from the questionnaire. In particular, questions such as in section A "Has there been any change in national legislation? Please specify" should be deleted; as they are too broad - including administrative procedure, environmental protection legislation, waste legislation, chemicals law, etc. It is not possible to answer such a general question in a standard way that facilitates the data mining approach envisaged by the Commission.

The obligation to report on facilities should only apply to facilities that are required under Article 7 of the EWD. Since according to the Article 2 (3) of the EWD, *inter alia*, the Articles 7 and 8, the Article 12, and the Article 14 do not apply to inert waste (unless deposited in a Category A waste facility), reporting (Table B (a)) should not ask for information about inert wastes not managed in a Category A EWF.

4.7. INVENTORY OF CLOSED AND ABANDONED EXTRACTIVE WASTE FACILITIES IN THE EU

4.7.1. SITES LISTED IN THE INVENTORIES THAT HAVE BEEN REHABILITATED

Article 4 of the EWD requires MSs to ensure that the environment and human health are protected from adverse effects arising from extractive wastes. Article 20 serves to develop an understanding of the actual and potential adverse effects of legacy wastes, but in the absence of imminent danger, does not require MSs to take rehabilitation actions. Article 20 of the EWD states '... *or have the potential of becoming in the medium or short term a serious threat to human health or the environment* ...'. It thus must be concluded that the sites eventually included in the inventories do not pose an imminent danger and, therefore, monitoring was considered sufficient for the time being. MSs thus did not link the inclusion of a particular site into their inventory with immediate action towards rehabilitation.

Most inventories have been compiled after the EWD came into force in 2006, but some inventories pre-date the EWD. In some instances, the assessments have identified situations that posed serious and imminent risks, e.g. from collapsing slopes, and these have subsequently been addressed. In consequence, it appears that most MSs considered the investigation of sites on their territory according to Article 20 of the EWD as a one-off undertaking without a schedule for revision. Some MSs have flagged their list as preliminary, indicating that more detailed investigations are under way or will be undertaken with a view to ascertain, whether the respective site should be on the inventory and whether rehabilitation action needs to be undertaken. Article 21 aims at facilitating these actions by fostering exchange on suitable measures and techniques. Many MSs monitor periodically the sites included in their inventories with a view to trigger action, should this be required.

For the said reason it has not been possible to identify any cases of rehabilitation of sites that were originally listed in the inventories. In the questionnaire sent out to Member States no anwers were given to the respective question. There are numerous descriptions of rehabilitated EWFs around Europe, but they not normally contain technical details on the rehabilitation techniques and the underlying design criteria.

It should be noted that several MSs, notably Germany, the Czech Republic, Romania, Bulgaria, and Portugal have on-going programmes to rehabilitate their uranium mining and milling sites. The progress on these sites is regularly reported in the bi-annual reports under the 'Joint Convention' (IAEA, 1997), in the joint OECD-NEA and IAEA 'Red Book' on uranium supply and demand, and also at numerous scientific conferences. It appears, that these mines are the few ones on which more or less detailed descriptions of the rehabilitation activities and regular updates on progress are available.

However, there are possibly also other reasons for not proceeding with rehabilitation of the sites listed in the MSs inventories and these are discussed in Section 4.7.2 in more detail.

4.7.2. OBSTACLES TO REHABILITATION

In principle, the obstacles to the rehabilitation of abandoned (or orphaned, as sometime referred to) mines and EWFs have been recognised for many decades, for both, mines in general (UNEP, 2001), but also particularly for uranium mines (IAEA, 1994, 2013). UNEP (2001) observed that progress towards rehabilitation may be hampered by:

- the fact that mine closure practices and expectations related to proper mine closure have changed;
- the lack of clearly defined or assumed responsibility;
- the lack of definitions of what an abandoned mine site/EWF is;
- the absence of criteria and standards of rehabilitation, and
- the real and perceived cost of rehabilitation.

Certainly the most important obstacle to rehabilitation is the lack of financial resources. Also, when there is no immediate threat to human lives and health, there is little incentive for rehabilitation, in particular, when the site has been abandoned and the public would have to pay for the rehabilitation.

Decisions on the rehabilitation of abandoned mining sites often fall into the responsibility of political and administrative decision makers at local or regional level. Therefore, it is very difficult to elucidate the rationale behind decisions not to undertake rehabilitation or to postpone it. The reasons only become apparent, when there is a public debate in the light of perceived or actual threats to human lives or health.

Technical aspects rarely constitute obstacles as such. It is typically the cost and the available financial resources that prevent the implementation of technical solutions. This wants to say that there is nearly always an adequate technical solution for a rehabilitation problem, but the cost cannot be borne by those responsible.

Unrealistically high demands on rehabilitation projects (e.g. rehabilitation to ‘green field’ standards) can be counterproductive. Finding implementable technical solutions and negotiating their public or regulatory acceptability can significantly delay projects and thus degrade effectively their overall safety. It needs to be communicated to all stakeholders concerned that a rehabilitation solutions always constitutes a compromise between technical feasibility, cost vs. available resources, regulatory acceptability, and public expectations.

Legal action taken by (public) stakeholders against operators/site owners can also delay rehabilitation actions, as usually the resulting court case has to be heard first, before any changes to the status quo on a site can be made. Court cases often take years and entail high legal costs that reduce the resources available for the actual rehabilitation. It is almost always preferable to negotiate a solution out of court.

Certain regulatory regimes and policies also can unintentionally hinder or delay rehabilitation programmes. Examples include competing regulations and competing environmental and other objectives. Depending on the governmental and administrative structures in a given Member State, regulatory bodies for different environmental aspects may be located at different levels of government, e.g. local, provincial, national level. A particularly complex example was the rehabilitation of the uranium mines in the former GDR, where *inter alia* the water resources agencies at regional and Länder level, the mining and environmental regulators at Länder level, as well as the radiation protection agency (operating two standards, the old GDR and the one of the newly unified Germany) had to be satisfied. A potential deadlock was resolved by appointing a lead agency.

There is a case in Romania, where emergency stabilisation measures and rehabilitation could not proceed, because a forestry administration did not permit access to land owned by them, claiming that such works are not permitted by the forestry code.

Uncertain legal status and ownership can also hinder or delay rehabilitation. While in many jurisdictions government bodies would step in to avert immediate dangers to the public, normal rehabilitation requires certainty of the legal status of a site. Typically, the 'polluter pays'-principle is operated, but this may not work in the case of abandoned EWFs, where the operator has ceased to exist. The second tier of responsibility is the site owner, but ownership may be unclear, if a mine operator has ceased to exist many years ago. Some MSs have set up legislation that would transfer 'orphan' sites into state ownership and, hence, the liabilities of such sites. Other MSs have been hesitant to do so due to the obvious financial liabilities associated with such a step.

Rehabilitation projects have been delayed by disagreement between stakeholders (regulators, operators, local communities, general public) over the desirable end-point and after-use of rehabilitated EWFs. Each after-use may require specific rehabilitation solutions in order to facilitate it, e.g. a design of capping s that allow building construction on the site etc. For this reason it is advisable to develop post-closure (which may involve rehabilitation) early on in a project in order to give sufficient time to develop future use scenarios together will all stakeholders concerned. This applies to the rehabilitation of abandoned sites, as well as to new or on-going extractive operations, when they are closed.

There are also cases, where rehabilitation of EWFs has been undertaken by the mining companies, but they could not proceed with handing over the sites e.g. to the local communities for further beneficial use (IAEA, 2013). One reason is the unclear (financial) liability in case of possible future failures of the rehabilitation solution. Local communities may not be prepared to assume this responsibility or the mining companies may not accept to retain the responsibility after relinquishing the land. This can also be related to not very clear criteria and best practices for rehabilitation solutions. Governments and regulators may not very well understand and are not able to judge residual risks and long-term liabilities and, therefore, may hesitate to give rehabilitation projects the final approval.

4.7.3. INFORMATION ON THE STABILITY OF CLOSED AND ABANDONED EWFS

The rehabilitation of previously closed and abandoned EWFs entails implicit or explicit assumptions about the stability and resilience of the facility for a given set of environmental conditions today and in the future. Such assumptions particularly concern climatic conditions (e.g. rainfall intensities or the frequencies of floods), or geodynamic conditions (e.g. the expected frequency and magnitude of earthquakes). These conditions will influence the long-term stability of man-made structures, such as covers or dams. The design parameters taking into consideration climatic conditions are chosen to give critical structures a safety margin against rare events, such as a 1000-year flood event The consideration in Garbarino et al. (2018, p. 256) can also be used in the case of the rehabilitation of abandoned sites. UNEP-ICMM-PRI (2019, Annex 2) base the design safety margins on a link between the recurrence of flooding or earthquakes and the failure consequence classification level of an extractive management facility for tailings. Facilities that are classified to have extreme consequences in the case of failure have to withstand the Probable Maximum Flood (PMF) and the

Maximum Credible Earthquake (MCE). The minimum criterion for low-risk TMFs is a 2500-year flood or earthquake event. Schafer et al. (2018) note that these very long design periods make it difficult to assess likely changes in receptors.

The likelihood and magnitude of such events is extrapolated from historical records, which assumes that the principal system conditions remain the same over time. However, as a result of the expected climate change, the frequency and magnitude of certain meteorological events will change, as may the vegetation cover in the catchment area and, hence, its water retention capacity. Therefore, rainwater diversion channels will have to cope with more frequent and more intense rainfall events and covers must resist the erosional forces from these more intense events. This could mean that what was considered a 1000-year flood event could become say a 500-year or even a 200-year event, or conversely that the 1000-year event increases in severity (IPCC, 2013).

Endogenous events, such as earthquakes, of course are not affected by climate change, but our historical records become longer and, therefore, our statistics more reliable, which may change our picture of the frequency and magnitude of these events.

Very few MSs have developed a dynamic database and a database that contains detailed assumptions on the design of the EWFs listed in the Article 20 inventories. Such information would only be available from the (previous) operators or the local competent authorities. In most of the cases the facilities have been abandoned many years ago, so that this kind of information appears to be virtually impossible to retrieve by now.

The question of design criteria was raised in the questionnaire distributed to the authorities in the MSs that were responsible for submitting the inventories to the Commission. The majority of those MSs who responded to the questionnaire, did not respond to these questions. The small number who responded, stated that they do not have any information on the design criteria and long-term stability and that such information was not collected during the assessments for the inventories or that these details were not available. It applies to both groups of MSs, those who had their own guidelines for assessment and those, who used the 'Guidance' (Stanley et al., 2009).

Spain explicitly uses rainfall intensity and the frequency of re-occurrence of extreme events when assessing the stability of EWFs (Alberruche del Campo et al., 2016). Garbarino et al. (2018, p. 256) summarise the assumptions for flooding events in different countries and by different organisations, such as ICOLD (2011a,b). Austria uses a 300-year flood criterion, as noted above.

The level on information on former uranium mining operations and their rehabilitation is more detailed. The majority of them are in the former Warsaw Pact states and have only ceased operation after the end of the Cold War. These rehabilitation programmes were accompanied by extensive (international) research programmes, so that much of the work is quite well documented in the public domain. However, as noted under the various country entries above, not all MSs report (former) uranium mining sites under the EWD, although the latter was explicitly amended to cover such sites. The uranium mining sites in East-Germany, the Czech Republic, Bulgaria, and Romania are in a process to be rehabilitated to such a high standard that they will not pose a threat anymore. France had numerous small uranium mines, but they had been rehabilitated by the early 2000s to a standard by which they do not fall under the criteria of Article 20 anymore. The various uranium mines in Portugal are currently being rehabilitated, but none of these mines in consequence will fall under the criteria of Article 20 anymore either.

In summary, such EWFs across the EU for which information on design criteria and stability would be available do not fall under Article 20 EWD because they have been rehabilitated to an appropriate standard. For those that have been rehabilitated years ago, such information is usually not available anymore or retrieving such information would require archival searches in the records of the mining companies (if they still exist) or of licensing authorities (if such information was received and retained).

A review of the concepts of good practice for rehabilitation and examples are given in Annex O.

4.7.4. CONCLUSIONS AND RECOMMENDATIONS

Although differences in level of detail remain between MSs, a general overview over the mining and milling legacies in the European Union is now available.

The level of detail in the submitted inventories varies considerably, ranging from lists with site names to comprehensive risk assessment dossiers. Article 20 of the EWD does not stipulate the actual contents of the inventories and what details should be provided. The lack of details in some inventories makes it difficult to understand why any particular site has been included and how serious a risk it poses.

Most of the currently available inventories have been compiled somewhere between 2006 (after the EWD came into force) and the present. Some MSs have begun to compile such inventories already in the 1980s. For this reason, approaches and criteria used have been different. This project has tried to elucidate these differences by comparing the approaches used to a guidance document published in 2011 (Stanley et al., 2011).

Retracing of the approaches and criteria used in drawing up the different MS inventories has proven difficult since in several cases the organisational structures in the MSs have changed or the then responsible government body has ceased to exist. Many individuals charged with the work have since moved to different positions or have retired, resulting in a loss of institutional knowledge. While some MSs have published detailed accounts of the methodologies they used, sometimes even in English, such information was not readily available in others.

In most MSs, the government department that reports to the Commission is not the one that oversees compiling and maintaining of the inventory. Reporting to the Commission is usually the prerogative of either a ministry (e.g. the economics ministry) or one specific government organisation. The assessment of previousy closed and abandoned EWFs, on the other hand, is undertaken by specialised technical agencies at national level (e.g. national geological surveys), or in some cases by several agencies at provincial or state level (in the case of a federal state such as for Germany). Processes and procedures may vary at this level. The government agencies that have technical knowledge often are not prepared to - or may not be allowed to- communicate with the Commission or its agents. For this reason, it has not been possible in various cases to arrive at an understanding of the precise strategies and methods with which the MSs' inventories have been developed.

While it is understandable that national governments want to ensure that the country speaks with one voice and that communications are routed through government agencies that are aware of the political and economic implications of what they are saying, it would be helpful for an improved implementation of the EWD, if routes of exchange with the responsible technical agencies could be made more transparent and direct. This study observed that the efficiency of such exchanges depends also to a significant degree on the individuals that are charged with these exchanges and their technical knowledge.

While the EWD with its Articles 20 and 21 was conceived as instrument of continuous improvement, rehabilitation of virtually none of those sites listed in the inventories so far seems to have been completed subsequently. Although Article 4 of the EWD would seem to stipulate the need for rehabilitation, once a site has been included in the inventory, this has either not led explicitly to such action or the actions taken are extremely complex and long-term in duration. The foremost cited reason for lack of action is the lack of funding and/or time. Another reason seems to be also in many cases, that the sites listed do not pose an imminent threat, so that monitoring them is an adequate course of action until funds for rehabilitation become available. ***To obtain a more realistic picture of the real risk situation, it would be desirable for MSs to exchange further information on the level of risk and their method of prioritisation***.

Lack of funding and time is not the only reason for not undertaking rehabilitation. Many abandoned EWFs, due to the very fact that they are abandoned, do not have a responsible owner/operator anymore and/or landownership may be unclear. ***To understand whether this is a quantitatively relevant obstacle, MS could exchange further information on the status of ownership of the sites listed in the inventories.***

Unclear, missing, or competing regulations in some MSs also appear to impede rehabilitation. It is understood that the body of regulations at European as well as national level is the result of a history of addressing issues as they arose over time. Many developments, cross-linkages and evolving objectives could not be foreseen at the time when the respective pieces of regulations were drafted. However, *it should become a longer-term task to review, whether the regulations collectively meet the overall policy objectives of today*.

At first view, the rehabilitation task may appear to be so huge and costly that it risks causing paralysis. However, a well-structured assessment of the needs, prioritisation of the risks, and a stepwise approach has in several MSs made the implementation of such complex task more manageable. It is important to enter dialogue with the public and regulatory stakeholders, who may demand quicker solutions, in order overcome these constraints in a practical way.

Rehabilitation of previously closed and abandoned EWFs is a mature area of environmental protection. While such activities date back into the 1980s or even earlier, the daunting task of rehabilitating the uranium, coal, and lignite mines and their associated EWFs across Europe from the early 1990s onwards has helped to establish a comprehensive portfolio of technical solutions. This was aided by considerable sums of public money to support research and technical development.

As none of the sites listed in the national inventories have been completely rehabilitated since the inventories has been established, it has not been possible to identify relevant good practice examples on the basis of these inventories. However, approaches to rehabilitation have been documented in various case studies and textbooks on the subject, and numerous technical and scientific reports and journal papers. The essential concepts that emerged have been summarised above.

While many EWFs have been rehabilitated over the past 40 years, it is in general difficult to obtain detailed information on the actual works undertaken and the underlying design criteria. Once the projects have been completed, such information is filed in the archives of the responsible organisations, but not available for easy scrutiny, with the exception of some high-profile cases that have been reported in scientific literature.

CHAPTER 5 ASSESSMENT OF THE POTENTIAL ENVIRONMENTAL IMPACT OF SUBSTANCES USED FOR FLOTATION & THE NEED FOR RISK MANAGEMENT OF THESE SUBSTANCES

5.1. INTRODUCTION

The treatment process of mined ores involves a significant number of chemicals at every stage of treatment after grinding. Chemicals are employed in a variety of delicate processes to separate the metal value from the ores, including leaching with alkaline or acidic media, flotation, and concentration. The current permitting practices primarily focus on the releases of pollutants, such as heavy metals, nitrates, cyanides etc. into tailing ponds and not so much on the chemicals used for the treatment of the ores that also may be released into tailing ponds, effluents, or surface water courses. For the purposes of this chapter, only the chemicals used to concentrate metals will be discussed. The aim is to provide an overview of chemicals that are used at the stage of flotation by substance group and collect information on their hazard properties and conclude on whether their environmental impacts may have been assessed at the current permitting practices.

Flotation is one of the most important processes for the selective separation of minerals. This process separates materials based on their hydrophobicity with the aid of specific chemical substances. These chemical substances modify the surface properties of the minerals, enabling them to attach to air bubbles in the flotation cell. Chemicals used in this process have various uses as collectors, frothers, flocculants, and pH regulators (Bach et. al.,2016).

Liquid effluents and tailings produced by the mineral treatment process may contain these chemicals. Therefore, their environmental impact should be investigated at the stage of permitting and monitored at the stage of processing. The releases of these chemicals may be considered of secondary importance when assessing the environmental impact for the purpose of permitting compared to other releases that are associated with mine operation, such as heavy metals, cyanides etc. However, some of these chemical substances require attention due to their properties and their inherent hazard profile.

The amount of chemicals used, although it is proportional to the enriched ore, it is still very small in relation to the amount of enriched ore and the amount of waste produced. For this reason, the amount of chemicals used even with the most conservative approach does not exceed the limit values for hazardous waste and, therefore, should not affect the classification of the waste. (Eriksson & Bohlin, 2017). Of course, taking into consideration that some of these chemicals may be associated with properties of very high concern, e.g. mutagenicity, or may dissociate and produce products with more severe classification, they need to be examined per case at an early stage (permitting stage) in order to adequately control their environmental impacts.

In this context, a useful source of information regarding the hazardous properties of these substances is provided by the current regulatory framework for chemicals. The European Regulation (EC) No 1907/2006 (EC, 2006b) on the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) provides the most recent scientific knowledge on chemical substances, which includes substance identification, the Life Cycle of intended uses, information on physicochemical, toxicological and eco-toxicological properties and environmental fate and potential. Complementary to REACH is Regulation (EC) 1272/2008 (EC, 2008) on the classification, labeling, and packaging of substances and mixtures (CLP). CLP applies to both substances and mixtures and sets the criteria for assessing hazard properties. Therefore, the information from both regulations provide a useful insight for the intrinsic properties of the chemicals used for flotation.

Chemical substances used for the concentration of metals from crushed ores are identified and grouped per treated ore. The identification of the chemicals also includes information such as broader chemical categories and their hazard class information derived from the recent scientific evidence of REACH and CLP regulations. The chemicals are subdivided according to the severity of their hazard properties. Chemicals with serious long-term health and environmental impacts, such as carcinogenicity and aquatic toxicity with long lasting effects, are highlighted to assist the industry to move towards the selection of less hazardous substances. In this way, risks from exposure to humans and the environment will be minimized.

Additionally, the environmental fate of the flotation substances is briefly described. Chemicals used in flotation are typically collected together with the desired metallic content. However, traces of these chemicals may be also found in effluents or tailings of the process. Since, every ore is treated by a unique combination of chemicals, it is difficult to find solid data on the quantities used and consequently on their released quantities. To overcome this obstacle, the present study attempts a quantification based on the typical dosages suggested in handbooks. A rough estimate is provided together with an evaluation of whether there is the need for a further assessment during the permitting stage.

5.2. Identification and Categorisation of Chemicals Used for the Concentration of Metals from Crushed Ores

5.2.1. Objectives

The objective of this chapter is the identification and categorisation of chemicals (substances or substance groups) used for the concentration of metals from crushed ores per mining sector and intended use. The enrichment process for each kind of ore, based on its different physicochemical characteristics and mineralogy, uses different types of chemical mixtures that are considered commercially confidential by producers and users. For this reason, the collection of data was mainly based on mining chemicals handbooks. The data collected from EU mining companies with respect to the quantities used and total quantities released were limited. However, a rough estimate of the typical quantities used, was retrieved from literature.

5.2.2. Types of Flotation Reagents

After the grinding of the mined ores, the extraction process of metals involves a number of chemicals, as shown in Figure 50 below, that are known as flotation reagents. At this stage of conditioning, chemicals are added to achieve hydrophobic surface charges on the particles to be separated. These are collected with the aid of bubbles that are formed by blowing in air or nitrogen, forming a froth on the surface of the flotation cell (Bach et. al.,2016). This section covers the various chemicals that are added between the stage of conditioning and the output from the flotation cell, which includes a dewatering stage. Flotation is one of the most delicate processes for the selective separation of minerals. This process separates materials based on their hydrophobicity. The chemical substances and particularly their combination is responsible for modifying the surface properties of the minerals, enabling them to attach to air bubbles in the flotation cell.

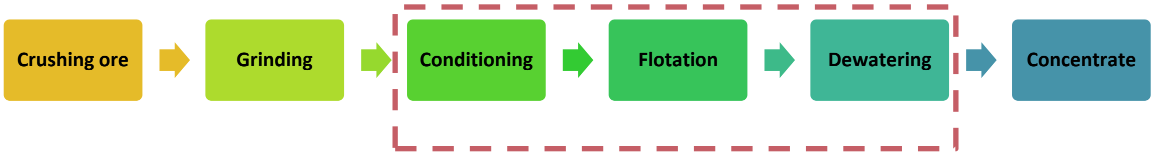

Figure 50: Extraction process of mining ores

Flotation reagents may be broadly classified according to their function and based on the stage at which they are added (Figure 51; Bach et al., 2016) into the following groups:

- Collectors and Promoters;
- Regulators or Modifiers (including depressants, activators, pH regulators and dispersants);
- Frothers; and
- Flocculants.

Although there are thousands of chemicals suggested for this purpose, today, there are only a few hundred of these chemicals that are widely used in flotation.

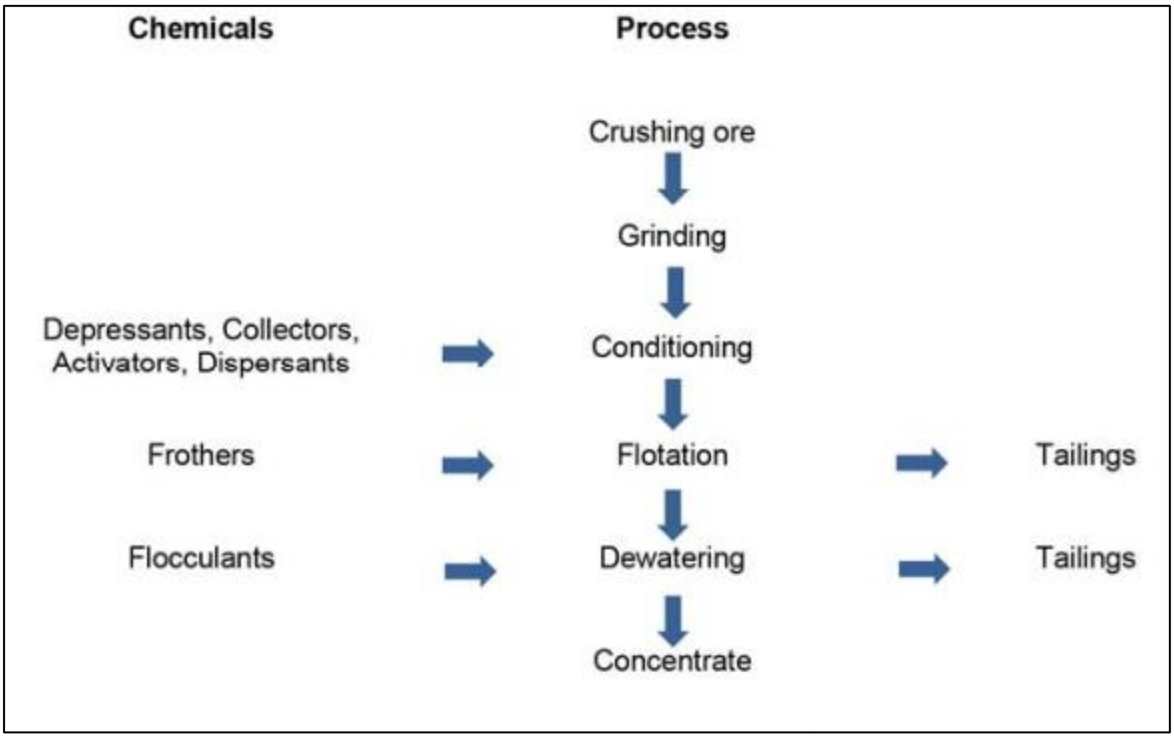

Figure 51: Uses of chemicals in mineral treatment process (Bach et. al.,2016)

Data from mineral processing across the world show that there are no two ores with exactly the same mineralogical characteristics. For this reason, each ore is expected to require a customised combination of chemicals during flotation. Furthermore, the quantities of the chemicals needed depend on various parameters, such as the nature of the ore, the purity of the process water, the viscosity of the pulp, etc. To overcome this difficulty, a table (annex L) with indicative ranges of used quantities from literature data for each wider category was prepared.

It should be noted that, all the values presented may not be considered as binding for each type of ore and may be used only as a reference for consultation. A rough estimate of the quantities released into the environment is related to the use of chemicals per treated ore.

5.2.3. COLLECTORS & PROMOTERS

Collectors and Promoters are a large group of organic chemical compounds, that differ in chemical composition and function. The basic purpose of the collector is to selectively form a hydrophobic layer on a given mineral surface in the flotation pulp and thus provide conditions for attachment of the hydrophobic particles to air bubbles and recovery of such particles from the froth produced. Collectors and the promoters are adsorbed onto the mineral surface (Garbarino et al., 2018). When the air bubbles with the attached mineral particles accumulate on the surface, a froth is formed that can be skimmed off for either collection or rejection (Bulatovic, 2007). In general, the promoters are added at the conditioning stage to provide the time needed for reaction with the pulp. Promoters are added ahead of the flotation, but at the end of the flotation they have the tendency to stick to the concentrate. Trace amounts may follow the tailings and effluent and for this reason, they will be analysed, although they do not pose a significant threat to the environment.

The common promoters for metal ore flotation are xanthates, alkyl and aryl dithiophosphoric acids and their alkali salts known as Aerofloats, modified xantogen formate known as Minerec, and thiocarbanilide. Most of them are not associated with properties of concern. Typical examples of widely used substance groups that are not associated with properties of concern to the present date is that of xanthates (Table 47 for details on their hazard properties). In any case, every substance that is used should be examined separately. Furthermore, hazard information should be re-evaluated annually for possible change of classification of a substance. However, this should always be assessed per substance.

Depending on the type and the quantity of mineral to be floatated, the quantity of promoter ranges from 5-100 g per treated ton of ore for sulfidic ore and 5 to 1500g for metallic minerals (Briggs, 2007), (Parekh and Miller, 1999).

Among the most employed chemical groups used as collectors in the separation of metal sulfides are the xanthates ranging from 300-500 g per t treated ore. There is wide range of xanthates, such as sodium ethyl xanthate (SEX), sodium isopropyl xanthate (SIPX), sodium isobutyl xanthate (SIBX), etc. The main concern for the use of most xanthates is attributed to their degradation product carbon disulfide[28], which is suspected to be toxic to reproduction and therefore needs to be further assessed. Most of the xanthates, due to their function as collectors will adhere to the product and thus are not expected to be released. Xanthates dissociate in water, for this reason there are no robust evidence on their exact releases to the effluents or the tailings. However, it cannot be ruled out that dissociation products of xanthates may be present at the tailings and the effluents. Recent published evidence on the industrial practice of water recycling shows that may reach up to 90% of the water used in the flotation cell. The loss of 10% of the initial water supply is expected to contain among other chemicals the dissociation products of xanthates (Muzinda, I., & Schreithofer, N., 2018).

Taking into consideration that the collectors and promoters are used for lead, zinc, copper and in some cases for gold processing, the annual average consumed amount of collectors and promoters was estimated. The average ore production for lead, zinc, copper, and gold in EU-27 was estimated to be ~144Mt according to the numbers given in Chapter 3.2.7 and Annex H.

$$\text{Estimation of Xanthates consumed in EU27} = \frac{500*10^{-6}t*144{,}404{,}143\ t}{1t} = \text{ 72202.07t ~ 72,000 t}$$

Additionally considering the remaining concentration of xanthates, the dissociation products and the water not recycled and remaining in the tailings the estimation gives a figure of 1% of the quantity of xanthates consumed releases to the tailings. This amount is equivalent to 720 t of xanthates that

[28] https://echa.europa.eu/el/substance-information/-/substanceinfo/100.000.767

is expected to be found in the form of their dissociation products in the tailings. Currently, the exact environmental fate and the quantity of xanthates or their dissociation product released are not known since they may be affected by local weather conditions.

5.2.4. Regulators or Modifiers

Regulators or else known as modifiers are used to alter the collector's behavior by increasing or minimising the water-repellant effect of the mineral surfaces. This aims to assist the selective flotation of minerals, especially in cases of complex ores where more than two metals need to be separated (e.g. Pb/Zn ores, Cu/Pb/Zn ores etc.) (Briggs D., 2007). Depending on their function, regulators may be subdivided into depressants, activators, pH-regulators and dispersants (Briggs D., 2007) (Haldar, 2018).

Depressants prohibit temporarily, or sometimes permanently, the flotation of certain minerals without hindering the flotation of the target mineral. Depressants are generally used in the grinding circuit or conditioner, usually before addition of promoters and frothers. A depressant prevents the adsorption of the collector to the mineral and thus facilitates the removal of the collector coatings from the desired mineral surface. For this reason, it is expected to follow the concentrate, rather than to be released to effluents and/or tailings. However, traces of depressants may be released from the flotation circuit to the wastes or effluents and for this reason they will be further analysed in this part of the study.

Lime, sodium sulfite, cyanide and dichromate are commonly used depressants. The addition of sodium cyanide or lime is known to depress pyrite and arsenopyrite. Other examples include zinc sulfate, sodium cyanide, and sodium sulfite, which depress zinc sulfide, sodium silicate, and tannin ('quebracho').

The quantity of depressants required depends on the quality of the ore to be treated, which typically is estimated by laboratory testing. Lime required to depress pyrite, for example, can vary from 0.45 kg to 4.5 kg per t of treated ore (Parekh and Miller, 1999)).

According to Article 13 EWD *Prevention of water status deterioration, air and soil pollution,* the concentration of weak acid dissociable cyanide in tailings at the point of discharge from the processing plant into the pond may not exceed 10 ppm (from 1 May 2018 on).

Given that this group of chemicals contains substances which are associated with properties of concern, they should be always assessed for their potential risk at a permitting stage.

Activators turn floatatable certain minerals that do not respond to collectors and promoters. They also help to make minerals that have been temporarily depressed in selective flotation floatatable again. The most commonly used activators are *copper sulfate* for Zn sulfide and Fe sulfide minerals, such as pyrite and pyrrhotite. When the latter contain valuable metals, such as Au, Ni and PGM elements. *Lead nitrate or lead acetate* is used for the activation of antimony sulfide minerals, such as stibnite. Sodium hydrosulfide is commonly used prior to collector addition for the activation of Cu, Pb, and Zn minerals and *sodium cyanide* acts as a surface cleaning agent or "activator" to improve the flotation of PbS (Briggs, 2007). The appropriate quantities may differ according to the nature of the treated ore, however indicative quantities are provided in Annex M per activator and treated ore.

pH regulators modify the ionic composition of the pulp in the flotation circuit. This is achieved by precipitating soluble salts in the pulp thus changing the hydrogen ion activity in the pulp. They are usually fed in at the grinding or the conditioning stage, before the flotation and the addition of collectors and activators.

Lime and soda ash are the most commonly used reagents for alkaline circuits. Sulfuric acid is the most used reagent for acid circuit flotation. Chemicals in this group are not typically associated with properties of concern, however, since traces may be released into the effluent and they affect the pH, it is advised to assess their synergistic action with the other hazardous substances that are used at each stage.

pH and redox conditions are variables that control the mobility of metals in the aqueous phase, making them available to the environment, it is advised to check the impact of pH regulators to the waste (Bourg & Loch, 1995).

Dispersants minimise the effect of “slimes” that is caused by the content of clays in the treated ore which are known to inhibit the flotation due to the formation of a coating around the target mineral. Dispersants reduce the pulp viscosity to allow the flotation to be conducted at a lower solids percentage and thereby reduce the residence time in the flotation circuit.

Commonly used dispersants may be both organic and inorganic viscosity reducing agents such as sodium silicate, soda ash, various polyphosphates, and low molecular weight polyacrylates (Briggs, 2007).

5.2.5. FROTHERS

Frothers are heteropolar surface-active compounds (such as -OH, -COOH, -CO, $-OSO_2$ or $-SO_2OH$) and a hydrocarbon radical, that lower the surface tension of water and adsorb on the air bubble–water interface. Their presence in the liquid phase increases the film strength of the air bubbles, thus providing better attachment of hydrophobic particles to the bubbles. The bubbles produced by the frother, at the end of the process are attached to the hydrophobic particles of the concentrate and thus are not expected to pose a significant threat to the environment.

There are two types of frothers, natural frothers such as pine oil and cresol, and synthetic frothers such as methyl isobutyl carbinol (MIBC) (Bach et al.,2016). The quantity of frother depends not only on the nature of the ore, but also on the purity of the process water. A typical dosage ranges from 5 g to 100 g per t of ore (Cytec, 2002). Taking into consideration that frothers are used on mixed sulfide ore and the average ore production for lead, zinc, copper, and gold, the average ore production for lead, zinc, copper, and gold in EU-27 was estimated to be near 144 Mt according to the numbers given in Chapter 3.2.6 and Annex L and is near to 144Mt.

$$\text{Frothers consumed in EU27} = \frac{100 * 10^{-6}\text{t} * 144{,}404{,}143\ \text{t}}{1t} = 14440.41 \sim 14{,}000\ \text{t}$$

Until now the environmental fate and the quantity of frothers released into the environment are not known. Assuming a worst-case scenario by releasing 0.1% to 1% of the maximum quantity of frothers consumed, up to 14 t to 140 t of frother may be released in the EU.

Until now the environmental fate and the quantity of frothers released into the environment are not known.

Therefore, the assessment of their risk at the permitting stage is advised.

5.2.6. FLOCCULANTS

Flocculants are natural or synthetic polymers with different polar groups that dissociate in water. They can be electrolytes and non-electrolytes. They increase the interfacial tension and, therefore, increase the molecular strain in the layer of water surrounding the particle. If two such mineral particles are brought together, the strain areas enveloping them will coalesce to reduces the surface tension forces to a minimum. In effect, the particles are drawn together. Many such contacts normally occur in a pulp before and during flotation, for this purpose flocculants have been further examined as part of this study for their release potential to the waste.

Typical examples of inorganic flocculants are: calcium salts (lime), aluminum salts (sulfates or sodium aluminate), Iron salts (ferrous sulfate and ferric chloride). Organic flocculants include: non-ionic polymers (polyacrylamide, polyacrylonitriles, polyethylene oxide), anionic polyelectrolytes (co-polymers of acrylates–acrylamides e.g. polystyrene – sulfonic acid, carboxymethylcellulose), cationic polyelectrolytes (e.g. polyethylene amines, polyvinyl amines and polyvinyl pyridines), Co-polymers (e.g. styrene and maleic acid, acrylic acid and maleic acid, vinylmethyl ether and maleic acid).

5.3. Collection of data related to hazard properties of chemicals used for the concentration of metals from crushed ores

5.3.1. Objectives

This chapter aims to summarise the collection of data related to hazard properties of chemicals used for the concentration of metals from crushed ores (Annex R). Following the task of creating a table that associates the groups of chemicals with their intended use per treated ore, this chapter further expands this activity by documenting the classes and categories of hazards per chemicals to evaluate their potential risk to human health and the environment.

5.3.2. Approach for the data collection of the Hazard Properties

The main reference point for the collection of data related to hazard properties of chemicals is the regulatory framework of chemicals in the EU. Recently, hazard properties of chemicals have become publicly available through the mandatory requirements of the REACH (EC, 2006b) and CLP (EC, 2008) regulations.

The main reference point for the collection of data related to hazard properties of chemicals is the regulatory framework of chemicals in the EU. Recently, hazard properties of chemicals have become publicly available through the mandatory requirements of the Regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (EC, 2006b) and Regulation (EC) 1272/2008 on the Classification, Labelling and Packaging of substances and mixtures (CLP) (EC, 2008).

The respective ore has been related to the typical dosage for each product category previously identified and its environmental fate of each commonly employed substance group.

For each identified chemical, the following information has been collected:

- Classification and labelling, including hazard classes and categories according to the maximum number of notifying companies,
- Harmonised classification and labeling entries from Annex VI of the CLP (EC, 2008), which are highlighted in light blue.
- Information on properties of very high concern related to persistence (P), bioaccumulation potential (B), toxicity (T), carcinogenic, mutagenic, reprotoxic (CMR), or endocrine disrupting behaviour, etc. Chemicals classified under the properties of very high concern have serious

adverse effects even in small quantities. Therefore, their examination is crucial for assessing environmental impacts and to comply with regulatory procedures of authorisation[29].

The results of the most commonly used chemicals per use and treated ore are presented in Tables 47 to 53 below. These tables contain a set of additional information, such as the typical dosages per substance as presented in handbooks and a comment on their environmental fate as a general approach of the substance group. Properties of concern as proposed by ECHA (https://echa.europa.eu/proposals-to-identify-substances-of-very-high-concern-previous-consultations) are also mentioned. These tables have been developed as practical examples to assist both industry and competent authorities in the evaluation of the potential risks to both human health and environment of releases of chemicals used in flotation. It should be also noted that since the classification and labelling of chemicals may change due to the frequent changes of the CLP regulation (EC, 2008) and the on-going process of harmonised classification, the current version reflects available information made by the 13th Adaptation to Technical Progress to CLP Regulation which is applicable from 1 May 2020.

The first example of chemicals is that of xanthates. As indicated in the table below most xanthates do not show high-risk properties, such as carcinogenicity. However, concerns may be raised over their degradation product carbon disulfide and their total estimated quantities. The blue colored rows in the following tables declare that the substance is entry in Annex VI CLP (EC, 2008), Table 3.1

Table 47: Hazard information of commonly used xanthates as collectors[30]

Relevant substances	Typical Dosage (g/tn)	Treated ore	Environmental fate	CAS no	EC no	Hazard properties according to CLP	Properties of concern
sodium ethyl xanthate	300-500	Cu, Ni, Pb, Au and Zn ores	Product (concentrate) traces in tailings and effluents	140-90-9	205-440-9	Flam. Sol. 2 Acute Tox. 3-H311 Acute Tox. 4-H302+H332 Skin Corr. 1C-H314 Eye Dam. 1-H318 STOT RE 2-H372 Aquatic Chronic 2-H411	Some consider this substance as Skin sensitising
sodium isopropyl xanthate	300-500	Cu, Ni, Pb, Au and Zn ores	Product (concentrate) traces in tailings and effluents	140-93-2	205-443-5	Acute Tox. 4-H302 Skin Irrit. 2-H315 Aquatic Chronic 2-H411	None identified
Potassium O-ethyl dithiocarbonate	300-500	Cu, Ni, Pb, Au and Zn ores	Product (concentrate) traces in tailings and effluents	140-89-6	205-439-3	Flam. Sol. 1-H228 Acute Tox. 4-H302 Acute Tox. 4-H312 Skin Irrit. 2-H315 Eye Irrit. 2-H319 STOT SE 3-H335 EUH018	None identified

Depressants contain a variety of substances, some of them are of low toxicity, e.g. tannic acid (Quebracho), while others are linked to properties of concern. For this reason, their hazard properties and their potential risk in a process to be permitted should always be assessed.

[29] The procedure of authorisation as presented in art. 55 of REACH aims to ensure that substances which pose critical hazard properties are adequately controlled or are progressively replaced by less dangerous substances or technologies where technically and economically feasible alternatives are available.
[30] The blue colored rows in the following tables declare that the substance is entry in Annex VI CLP, Table 3.1

Table 48: Hazard information of commonly used chemicals used as depressants

Relevant substances	Typical Dosage (g/tn)	Treated ore	Environmental fate	CAS no	EC no	Hazard properties according to CLP	Properties of concern
Lime	450-4500	Pyrite Pb/Zn	Product (concentrate) traces in tailings and effluents	1305-62-0	215-137-3	Skin Irrit. 2-H315 Eye Dam. 1-H318 STOT SE 3-H335 Respiratory tract	None identified
sodium sulfite	45-2000	Fe and Zn sulfides	Product (concentrate) traces in tailings and effluents	7757-83-7	231-821-4	Skin Corr. 1B-H314	None Identified
Sodium cyanide	25-100	Fe and Zn sulfides Pb/Zn ores	Product (concentrate) traces in tailings and effluents	143-33-9	205-599-4	Met. Corr. 1-H290 Acute Tox. 1-H300 Acute Tox. 1-H310 Acute Tox. 1-H330 STOT RE 1-H372(thyroid gland) Aquatic Acute 1-H400/H410 EUH032	None identified
Sodium Dichromate	450-1000	Galena Cu, Pb,Zn	Product (concentrate) traces in tailings and effluents	10588-01-9	234-190-3	Ox. Sol. 2-H272 Acute Tox. 3-H301 Acute Tox. 4-H312 Skin Corr. 1B-H314 Skin Sens. 1-H317 Acute Tox. 2-H330 Resp. Sens. 1-H334 Muta. 1B-H340 Carc. 1B-H350 STOT RE 1-H372 Aquatic Acute 1-H400 Aquatic Chronic 1-H410 Repr. 1B- H360FD	Carcinogenic Mutagenic Toxic to Reproduction Skin 141ft he141a141ed Respiratory sensitising
Potassium permanganate	45-900	pyrrite from arsenopyrite	Product (concentrate) traces in tailings and effluents	7722-64-7	231-760-3	Ox. Sol. 2-H272 Acute Tox. 4-H302 Aquatic Acute 1-H400 Aquatic Chronic 1-H410 Repr. 2-H361d	Toxic to Reproduction
tannic acid (Quebracho)	20-130	Wolframite	Product (concentrate) traces in tailings and effluents	1401-55-4	215-753-2	Eye Irrit. 2-H319	None identified

Chemicals used as activators, as presented below, may exhibit properties of concern, which is why it is necessary to determine their potential risk at the permitting stage.

Table 49: Hazard information of commonly used chemicals used as activators

Relevant substances	Typical Dosage (g/tn)	Treated ore	Environmental fate	CAS no	EC no	Hazard properties according to CLP	Properties of concern
Copper sulfate	100-450	Sphalerite, arsenopyrite, and tarnished gold	Product (concentrate) traces in tailings and effluents	7758-98-7	231-847-6	Acute Tox. 4 - H302 Skin Irrit. 2 -H315 Eye Irrit. 2 -H319 Aquatic Acute 1-H400 Aquatic Chronic 1-H410	None identified
Iron sulfate	200-700	Arsenopyrite and tetrahedrite containing cyanide and zinc sulfate	Product (concentrate) traces in tailings and effluents	10028-22-5	233-072-9	Met. Corr. 1–H290 Acute Tox. 4-H302 Skin Irrit. 2-H315 Eye Dam. 1-H318	None identified
Lead nitrate	200-700	antimony sulfide minerals stibnite	Product (concentrate) traces in tailings and effluents	10099-74-8	233-245-9	Acute Tox. 4-H302 Acute Tox. 4-H332 Eye Dam. 1-H318 Skin Sens. 1-H317 Carc. 2-H351 Repr.1A-H360 STOT RE 1-H372 Aquatic Acute 1-H400 Aquatic Chronic 1-H410	Toxic to Reproduction Skin sensitising
Lead di(acetate)	n.d.	antimony sulfide minerals	Product (concentrate) traces in tailings and effluents	301-04-2	206-104-4	Repr.1A-H360 STOT RE 2-H373 Aquatic Acute 1-H400 Aquatic Chronic 1-H410	Toxic to Reproduction

Table 50: Hazard information of commonly used chemicals used as pH regulators

Relevant substances	Typical Dosage (g/tn)	Treated ore	Environmental fate	CAS no	EC no	Hazard properties according to CLP	Properties of concern
Sodium hydroxide (caustic soda)	200-1400	sulfide and non-sulfide minerals	Effluent	1310-73-2	215-185-5	Skin Corr. 1A-H314	None identified
Calcium dihydroxide (Lime)	450-4500	pyrite Pb/Zn	Effluent	1305-62-0	215-137-3	Skin Irrit. 2-H315 Eye Dam. 1-H318 STOT SE 3-H335 Respiratory tract	None identified
sodium carbonate	450-2300	Pb/Zn	effluent	497-19-8	207-838-8	Eye Irrit. 2-H319	None identified
Sulfuric Acid	200-900	pyrite	effluent	7664-93-9	231-639-5	Skin Corr. 1A-H314	None identified

An evaluation of the hazard properties of dispersants is also advised at the permitting stage, since some of the relevant substances have properties of concern.

Table 51: Hazard information of commonly used chemicals used as dispersants

Relevant substances	Typical Dosage (g/tn)	Treated ore	Environmental fate	CAS no	EC no	Hazard properties according to CLP	Properties of concern
Docusate sodium	4-90	oxides & non-metallic minerals	Effluent/tailings	577-11-7	209-406-4	Skin Irrit. 2-H315 Eye Dam. 1-H318	None identified
disodium metasilicate	200-700	oxides & metallic Cu ores	Effluent/tailings	6834-92-0	229-912-9	Skin Corr. 1B-H314 STOT SE 3-H335	None identified

As discussed previously, the chemical category of frothers includes substances of concern, so it is important to determine their risks during the permitting phase. An indicative list of chemicals used as frothers is presented in Table 52.

Table 52: Hazard information of commonly used chemicals used as frothers

Relevant substances	Typical Dosage (g/tn)	Treated ore	Environmental fate	CAS no	EC no	Hazard properties according to CLP	Properties of concern
Creosote oil	20-90	Sulfide minerals	Product (concentrate) traces in tailings and effluents	61789-28-4	263-047-8	Carc. 1B-H350	Carcinogenic
Creosote	50-200	Sulfide minerals	Product (concentrate) traces in tailings and effluents	8001-58-9	232-287-5	Carc. 1B-H350	Carcinogenic
2-methylpentan-1-ol (Methyl Amyl Alcohol)	20-50	metallic and non-metallic	Product (concentrate) traces in tailings and effluents	105-30-6	203-285-1	Flam. Liq. 3-H226 Acute Tox. 4-H302	None identified
4-methylpentan-2-ol (Methyl Isobutyl Carbinol)	20-500	metallic and non-metallic	Product (concentrate) traces in tailings and effluents	108-11-2	203-551-7	Flam. Liq. 3-H226 STOT SE 3-H335	None identified
Reaction mass of α,α-4-trimethyl-(1S)-3-cyclohexene-1-methanol and α,α-4-trimethyl-(1R)-3-cyclohexene-1-methanol and 1-methyl-4-(1-methylethylidene)-cyclohexanol (Pine oil)	20-90	sulfide minerals	Product (concentrate) traces in tailings and effluents	-	701-188-3	Skin Irrit. 2-H315 Eye Irrit. 2-H319	None identified

Most of the chemicals used as flocculants are not associated with properties of concern. However, it is proposed to occasionally monitor their classification to early identify if they have been associated with properties of concern.

Table 53: Hazard information of commonly used as flocculants

Relevant substances	Typical Dosage (g/tn)	Treated ore	Environmental fate	CAS no	EC no	Hazard properties according to CLP	Properties of concern
Aluminium sulfate	50-300	Slimes	Product (concentrate) traces in tailings and effluents	0.1-0.5	0.1-0.5	Eye Dam.-H318	None identidied
Carboxymethyl cellulose sodium salt	5-20	gangue slimes in flotation of sulfides	Product (concentrate) traces in tailings and effluents	0.01-0.05	0.01-0.05	Not Classified	None identidied
Cellulose, 2-hydroxyethyl ether	5-20	non-metallic and iron ore	Product (concentrate) traces in tailings and effluents	0.01-0.05	0.01-0.05	Skin Irrit. 2-H315 Eye Irrit. 2-H319 STOT SE 3-H335 (respiratory tract	None identidied
Maltose	500-700	Slimes	Product (concentrate) traces in tailings and effluents	1.0-1.5	1.0-1.5	Not Classified	None identidied

Additional investigations on the identified high-risk chemicals were performed to produce a list of the Substances of Very High Concern (SVHC) that are used in concentrating metals from crushed ores. A SVHC is a substance that meets the criteria for a CMR substance, e.g. being Carcinogenic, Mutagenic or Toxic to Reproduction, for a PBT/vPvB substance, e.g. being Persistent, Bioaccumulating and Toxic/very Persistent and very Bioaccumulating substance, or a substance that gives rise to an equivalent level of concern. Since this is an active and ongoing procedure in the EU, when a classification of a property of concern is confirmed, the substance is added to the Candidate List for Authorisation. The inclusion of a substance in the Candidate List creates legal obligations in particular with respect to Articles 7, 31 and 33 of the REACH Regulation (EC, 2006b) for companies manufacturing, importing or using such substances. In practice, this means that in case the substance has been included in Annex XIV of REACH (EC, 2008) and the defined phase-out date has passed, the substance may not be placed onto the market for use or used without the prior authorisation of the European Commission unless the use is exempt from authorisation.

In order to assist companies and authorities to prioritise the chemicals used in the flotation of metals, that may be identified as SVHCs already requiring authorisation, or that are substances listed in the Candidate List published in accordance with Article 59(10) of REACH, the respective substances are presented in separate Annexes S and T. Dates of inclusion have been noted to allow to prepare for further action, such as to apply for authorisation or consider possible alternatives as substitutes. However, only a limited number of SVHCs and Candidate substances are used in flotation. It is important to note, that these lists should be regularly updated to check, if a substance has recently been listed under a property of very high concern. The Candidate List of substances is officially updated in January and June every year (CEFIC, 2013)

It should be noted that under these regulatory procedures companies using substances with properties of concern are expected to explore their substitution. Substitution is the elimination or replacement of hazardous chemicals in products or processes by less hazardous alternative processes that do not use chemicals. Aiming to assist companies in this respect, ECHA and the Swedish Chemicals Agency (KEMI) have published simplified guidance documents on how to substitute. KEMI addressing to companies concerned, summarised the process of substitution in the following in five steps (Figure 52):

1. Gather information on chemicals used
2. Identify unwanted substances
3. Find available alternative substances or new technical solutions
4. Evaluate and select alternative substances or technical solutions
5. Develop new alternative chemicals or technical solutions

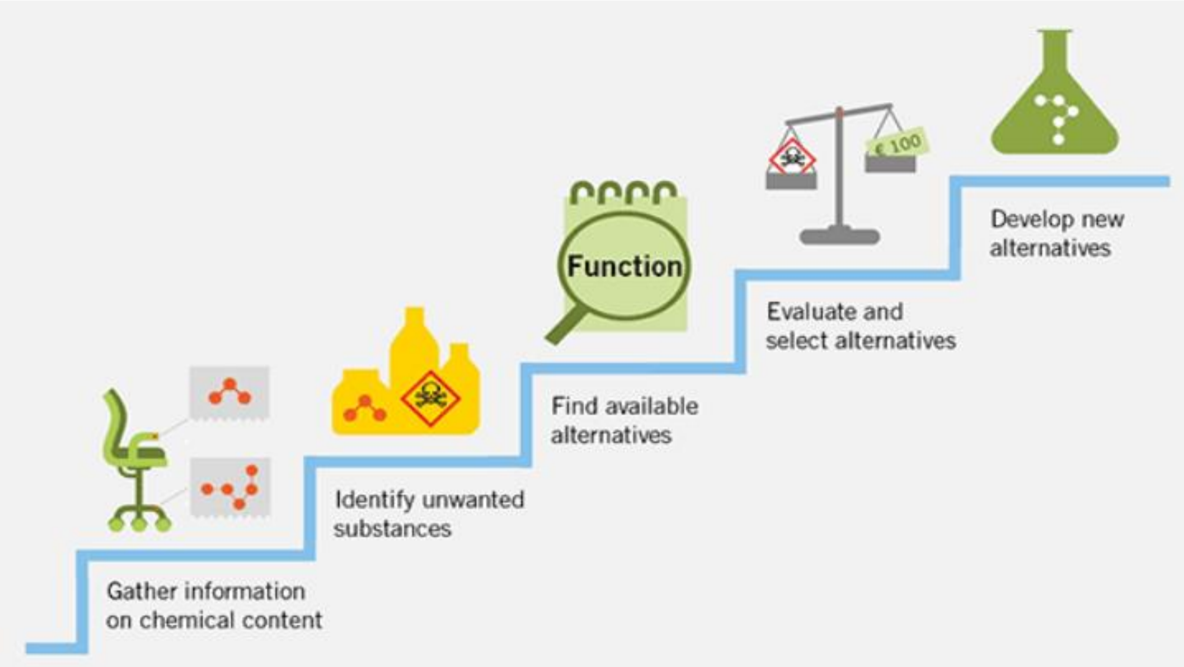

Figure 52: Steps in the substitution process, KEMI

The first step, gathering information, advices companies to prepare an inventory of the chemicals they use. The second step is the identification of substances that can and need to be substituted. Prioritising of substances that are considered as being most hazardous and may be subject to regulatory actions is advised[31]. The third step involves the preparation of an inventory of available alternatives for identifying substances with an equivalent function. The fourth step is the collection of sufficient information to compare the alternatives to select the substitute for a particular use. At this step, hazardous properties of the substitute, relative exposure, technical performance, Life Cycle Assessment (LCA) and cost should be taken into consideration. The fifth step of the substitution process is the development of new sustainable substances or techniques. In case there are not available alternatives, companies need to explore innovations and/or new techniques[32].

KEMI has developed the PRIO tool for risk reduction of chemicals to assist companies in the assessment of health and environmental risks. The tool provides information on hazard properties at the two levels of prioritisation, namely phase-out and risk reduction of substances[33].

The criteria by which a substance is assessed as belonging into either of these categories are[34]:

- **Phase-out substances:**
    - CMR (Carcinogenic (H350),
    - Mutagenic (H340) or toxic to Reproduction (H360), Category 1A and 1B,

[31] https://echa.europa.eu/inform-your-supply-chain-substitution
[32] https://www.kemi.se/en/chemical-substances-and-materials/substitution-of-hazardous-substances
[33] https://www.kemi.se/en/prio-start/criteria/overview-table
[34] The hazard statements (H-phrases) are provided according to CLP Regulation

    - PBT/vPvB (persistent, bioaccumulating and toxic/very persistent and very bioaccumulating),
    - particularly hazardous metals (mercury (Hg), cadmium (Cd), lead (Pb) and their compounds),
    - endocrine disruptive, or ozone-depleting (H420, EUH059) ones;
- **Priority risk-reduction substances:**
    - Very high acute toxicity (health)(H300, H310, H330, H370),
    - Allergenic (H317, H334),
    - mutagenic, Category 2 (H341),
    - high chronic toxicity (health) (H372),
    - environmentally hazardous, long-term effects (H410, H413),
    - potential PBT/vPvB.

In particular, in the case of several commercially available chemicals intended for the same use in the processing of metals, a risk assessment should be made to examine their short- and long-term effects on the environment and humans. Based on a case-by-case evaluation, the use of the least hazardous chemical should be preferred, provided that it has similar performance characteristics for the ore in question.

5.3.3. RECOMMENDATIONS FOR THE ASSESSMENT OF ENVIRONMENTAL IMPACTS OF CHEMICALS TO BE TAKEN UNDER CONSIDERATION AT PERMITTING STAGE OF A METAL MINE

Chemicals used for the flotation of crushed minerals may have hazardous properties as described in paragrapgh 5.2. The amount of chemicals used is negligible, however, if compared with the amount of the enriched ore and the amount of the waste produced. For example, according to the report for the EWMP of Garpenbergsgruvan by Boliden Mineral AB, the amount of added chemical, which is in principle proportional to the amount of ore that is enriched, is one or more orders of magnitude below the limit values for hazardous waste. Even if it is conservatively assumed that all chemicals used in the flotation will end up in the waste and the hazards of all chemicals are additive, there may not be enough hazardous chemicals to classify the waste as hazardous (Eriksson & Bohlin, 2017).

The current permitting practice is to list the chemicals and the quantities used for the treatment of crushed ores, without any further evaluation, since these small quantities of chemicals may not affect either the hazard properties of the wastes or the products. Wastes are also evaluated during the permitting stage with focus on the releases of contaminants, such as heavy metals, cyanides etc. Given that the environmental fate and impacts of flotation substances are not yet fully understood and that some of the chemicals used may have properties of high concern and may not be easily detected in tailings or effluents, it is reasonable to check the classification and labeling of the substances used and perform a risk assessment at an early stage (permitting).

This risk assessment approach, if applied at an operation permitting stage, will allow to compare commercial chemicals that are available on the market for the same use and to conclude early on their short- and long-term effects. Provided that the chemicals to be compared are suitable and efficient for the ore to be treated, the examination of their hazard properties may be an additional criterion for minimising their environmental effect. Thus, this will gradually lead to the selection of the least hazardous chemical.

CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

The tender "ENV.B.3/ETU/2017/0039 - Study supporting the development of general guidance on the implementation of the Extractive Waste Directive (EWD)" has been launched following the findings of the EWD implementation report, published in 2016. According to that report it was concluded that the majority of Member States (MS) have adopted the measures needed to implement the EWD. There are, however, a number of obstacles to the European Commission assessing the implementation of the EWD. The EWD implementation report identifies that 1) the incomplete and inconsistent set of data is a major obstacle for the European Commission to assess the implementation of the EWD, and 2) the diverging interpretations of the EWD are a likely source of inconsistencies in the data reported by MS.

The project focussed on a reliable description of the material streams resulting from the extractive sector and their management that might lead to an exchange with MSs towards a more uniform understanding and application of the EWD. Objectives were:

- To develop a coherent description of the metal mines in EU-27 with plausible and matching figures for the amounts of extractive waste generated and corresponding numbers of extractive waste facilities.
- To collect, determine and present aggregated figures for each Member State of the production streams of industrial minerals, construction minerals and aggregates, subdivided into commodities, such as kaolin, perlite and feldspar etc., per Member State, as well as to collect information on the amounts of associated extractive waste and their category per main waste streams.
- To estimate the number of operating EWFs, based on the assumption, that a given waste facility receives waste only from one mine.
- To collect data and estimate the amounts of tailings that are not deposited into EWFs, but are used as material for filling excavation voids.
- To list the number of EWF that were initially included in the inventories of closed and abandoned EWF, but that have been rehabilitated since.
- To prepare Country Fact Sheets that provide an overview of the national mining sectors, related waste management information, and the implementation of the EWD.
- To assess the potential environmental impact of chemicals (substances or substance groups) used for the concentration of metals from crushed ores (flotation) per mining sector and intended use.

To achieve the objectives described, a variety of information was gathered, mainly through a data collection process, dialogue with MSs, engagement with stakeholders (industry, academia, NGOs), and three workshops with representatives of these stakeholders. The output of this Study is a set of 27 Country Fact Sheets, a description of the extractive sector and of main material streams representative for the period 2015-2017. The potential impact of substances used in flotation was assessed by estimating, on the basis of literature data, the amounts used, their partitioning into products and wastes, and their respective hazardousness. The state of closed and abandoned EWF previously listed in the inventories was assessed through questioning the responsible organisations in the MS. MS were also asked whether they used the assessment scheme proposed by the Commission and whether it was considered useful.

1) Bottlenecks

When gathering data (i.e. production data, volumes of generated waste, number of extractions site and/or extractive waste facilities) different problems however have been encountered:

- With respect to production data, no unique description of the different commodities exists.
    - There is a confusion concerning the different materials reported as 'aggregates'.
    - Data related to hard rocks may subsume dimension-stone and crushed rock.
    - Double or multiple counting of, for instance, dolomite and limestone since these commodities are used for various purposes (e.g. crushed-rock aggregates, cement production, industrial or agricultural applications). Data for limestone are reported as such, but also included under crushed rock, resulting in double counting.
    - The split between limestone for cement, for industry, as ornamental stone and limestone for other purposes is not easy to identify, as quarries often sell different grades of output for different uses;
    - For solid energy minerals many different terminologies are used to distinguish between the different types of minerals. MS report different aggregations of different coal-types (e.g. lignite vs. brown coal).
    - A breakdown of oil & gas data is very difficult. Not all data reported distinguish between onshore/offshore production or individual wells.
    - Depending on the source, different units were used in data reporting, sometimes m^3 or tons. Different conversion factors (e.g. specific weights) are applied by different sources. Therefore, conversion from one unit to the other is not straightforward.
    - Peat production: the percentage breakdown for energy vs. horticultural use is not always made;
    - Data on gravel may include crushed rocks as well.
    - Not all countries report production data for all commodities due to confidentiality issues.

To overcome these problems, a variety of 'third party' sources were queried and these data then were compared with national data, if available.

- For non-metallic minerals, the number of production sites per commodity could not be determined for all countries, since it is not always clear, whether the reported numbers relate to individual mining sites or to mining companies. Particularly also for peat, several companies may extract from the same deposit and not all companies cover the whole value-chain, e.g. a company may only market the output of several actual extractive companies. In other cases the output does not reach the market as such, but is converted directly into a product, such as certain clays or limestones for cement production.
  For the metallic minerals the number of the active mines turned out to be a very challenging effort since the meaning of "active" is influenced by the license to operate and not from the ore/concentrate production during the time period 2015-2017 that the current study was focused. There were some cases that the boundary between active and closed was not clear.

- Data collection in relation to waste classification
  Many efforts were made to collect as many original data on extractive waste as possible. Unfortunately data on extractive waste generated in individual MSs according to the LoW are not easy to retrieve or are not available at all.
  Although alternative sources of data are available, these are not always coherent. Causes of inconsistencies are:
    - Reporting at different administrative levels
    - One mine may have more than one EWFs or one EWF is used by more than one mine.

- The different types, amounts and properties of waste generated at extraction sites depend on the resources being mined, the process technology used and the local geology. Different geological and mineralogical conditions mean that waste volumes cannot be reliably extrapolated from the volumes of primary extraction.
- The generation of different types and volumes of waste during each stage of the mining project life-cycle.
- EU waste codes may subsume the extraction of different types of minerals.
- Practical and traditional implementation of the concepts of Circular Economy: Materials originally considered waste are no longer considered so and, hence, do not appear in the statistics.

Therefore, waste/material flows were calculated based on information collected from operators, literature, market analyses and expert knowledge for the metallic minerals per mines. Evidence of data collection through e-mails and phone calls with specific persons in the MS is not included in this report due to personal data protection. A general overview has been delivered to DG ENV.

2) Calculation of waste / material flows

The calculations of the waste / material flows were based on:

- the yearly ore production as derived from the data gathered in the present project;
- the assumed stripping ratios;
- the ore grade or the concentrate production (metallic minerals);
- the ratio between tailings and concentrate produced;
- information provided by operators, experience of the consulting team and literature review.

3) Re-use of extractive waste

Re-use of extractive waste in the aggregates and dimension stones sector is common practice for the purpose of construction and landscaping on site. In general, no data are available that quantify this re-use at site level. Metallic extractive waste (waste rock or tailings) is sometimes re-used for filling (and stabilising) excavation voids, but in general only when it concerns inert/non-hazardous material (and according the procedures described in the environmental permit).

4) Extractive waste management plans

Extractive waste management plans appeared to be in practice only accessible at a local or at best at regional level, but in general not at national level (not normally through publicly accessible websites). EWMPs are normally only written in the local language.

5) Estimation of the number of EWF (CAF and non-CAF)

- Estimation of the number of EWF linked to the metal mineral ores and classification as CAF or Non-CAF

  This work is subdivided into two phases. At the beginning the expected number of EWFs in operation was estimated based on the number of active mines. The task was based on the assumption that a given facility receives waste only from one mine focusing on the management of tailings and not on the material that may be assigned under the waste code

01 01 01 “wastes from mineral metalliferous excavation”. The material that is generated after accessing and extracting the ore (for the purposes of the current study this stream is named *Rock*) in some cases is not considered as a waste stream, but as a material that partly or totally may be utilised by the operator for (a) filling the excavation voids for rehabilitation and construction purposes, (b) construction purposes outside the mine, and (c) landscaping. It is often unclear which percentage of *Rock* stream may be fed to EWFs and which is utilised for the aforementioned uses. For this reason, the *Rock* stream is presented as the amount that was initially intended to be mined, without characterizing it as waste or non-waste. This methodology led that 58 EWFs are operating in EU-27 (theoretically this number reflects mainly the operating beneficiation plants). As far as the classification of the EWFs as CAF or non-CAF is concerned this was based on some assumptions that were made for the classification of the extractive waste according to the Decision 2014/955/EU and not on the safety/ stability of the construction of the EWF (1st criteria at Annex III of EWD). For the purposes of this study, it was assumed that if an EWF receives hazardous extractive waste, given that this facility receives waste only from one mine, then the threshold 50% according to Article 7 of the Decision 337/2009/EC is satisfied and the EWF is classified as CAF (worst case scenario). Afterwards, this task was enriched with information that were collected through the list provided by the MS to the Commission presenting the EWFs that are operating in their territory and communication with MS and operators, as result, 40 Category A facilities (CAF) and 61 non-CAF were identified.

- For the non-metallic a total number of EWF 12 Category A facilities were identified (Cherrier et al., 2017) and updated with recent data from Finland (2020) and Hungary (2019) and 3381 non-CAF non-metallic EWF (Cherrier et al., 2017).

6) Identification of closed or abandoned EWFs being rehabilitated and obstacles to rehabiliation

The inventories of closed or abandoned EWFs have been compiled over long periods of time, often pre-dating the EWD. When an imminent threat to the environment or people was identified, typically emergency measures were undertaken to make the sites safe. In consequence, MS do not seem to have seen a need for further action, so that the inclusion into the inventories did not automatically triggered a need for action. Therefore, no sites that had been included in the inventories could be identified as having been rehabilitated. The underlying reasons are likely the lack of funds for actions with perceived low priority.

7) Environmental impact of chemicals used for the concentration of metals

Chemicals used for the flotation of crushed minerals may have hazardous properties. Data for the commonly used flotation agents used to concentrate metals was collated, covering their substance group, their specific use concentration, their hazard properties, and their environmental fate. On this basis, likely concentration ranges for these chemicals in the waste were estimated, together with the total amount arising in the EU. The amount of chemicals used is negligible if compared with the amount of ore, enriched ore, and waste produced. Even if it is conservatively assumed that all chemicals used in the flotation will end up in the waste and the hazards of all chemicals are summed this sum in most cases does not classify the waste as hazardous. However, it is reasonable to check the classification and labelling of all commercially available chemicals for the same use and perform a risk assessment at an early stage (permitting) to conclude early on their short- and long-term effects.

8) Recommendations

- Reporting of production data,
  A general reporting system in the EU should be developed, including the application of:
    - unique commodity codes;
    - uniform units;
    - number of individual extraction sites instead of the number of mine companies.

- Improvements in reporting non-metallic mining waste streams: Non-metallic extractive waste should be registered at MS level per non-metallic commodity.

  While the project did not reveal major differences in the interpretation of the definitions of 'waste' and 'treatment' between the MSs, there are concrete and justified differences in the reporting on the generation of quantities of extractive wastes – even within the same MS or for the same commodity.

  To facilitate future reporting of extractive waste by MSs, the following recommendations can be formulated:
    - Development of EU Guidance on which waste codes (see Decision 2014/955/EU, EC, 2014a) to include in the reporting according to the EWD (EC, 2006) and how to complete the reporting format;
    - Launch an EU-funded collaborative project between MSs to digitise the reporting data across all levels, from the local to the national and EU-wide level;
    - Ensure an adequate level of staffing in the responsible authorities;
    - Seek to adapt the Eurostat waste codes with a view to facilitate more meaningful reporting under the EWD (EC, 2006);
    - Align reporting periods (if not annual);
    - It is clear from the study, that historically there has been a mismatch of activities covered by the various waste statistics, but that perhaps there are not so many grave inconsistencies in reality as it appeared to be in 2016. It is understandable that Eurostat and national statistical offices will be reluctant to change their waste codes for fear of losing historical comparability due to the resulting hiatus. However, this study has made it clear, that such adaptations are needed in order to make the statistical reporting a meaningful tool for assessing the performance of the extractive sector as a basis for systemic and well-informed policy-making on natural resource management.
    - Provide a uniform data management structure with common categories for Eurostat, National Statistical Offices, Regional offices,….Initiate a process to make definitions of wastes etc. uniform across the EU, which should result in the elimination of the effects of different interpretations of EU regulations and guidance.
    - A more streamlined EU-wide system of waste codes that is oriented towards industry as well as regulators' and policy-makers' needs will avoid ad hoc changes to the classification of wastes and thus inconsistencies in reporting.
    - Define detailed waste codes to separate data for individual minerals/rock types, both for primary and secondary resources to enable comparison of volumes of waste with the volumes of extraction.
    - Require reporting of data from individual deposits (both, production as well as waste generation data) instead of reporting data per mine or business entity.

- Obstacles for the rehabilitation of abandoned and/or closed EWF

- To obtain a more realistic picture of the real risk situation at legacy sites, it would be desirable, if all MSs exchanged further information on the actual level of risk and their method of prioritisation for further action.
- It would be helpful for an improved exchange of technical and scientific information between Member States and the EU, if routes of exchange with the responsible technical agencies on EW arisings and on legacy sites could be made more transparent and direct, meaning that the Commission or its agents can exchange directly with the relevant technical agencies at (sub-)national level, rather than with the designated official contact point In order to avoid policy-interpretation confusions and similar, precise domains of exchanges and competences will have to be defined for this purpose.
- To understand whether lack of funding for the rehabilitation of legacy sites is a quantitatively relevant obstacle, MS could exchange further information on the status of ownership of the sites listed in the inventories.

- Given that the environmental fate and impacts of flotation substances are not yet fully understood and that some of the chemicals used may have properties of high concern and may not be easily detected in tailings or effluents, the following approach is recommended:
  - check the classification and labelling of the substances used
  - Perform a risk assessment of the commercial chemicals that are applicable at an early stage (permitting) and select the least hazardous chemical.

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Annex A: Minutes Of The Workshops

- 11/04/2019 – Meeting with experts
- 31/03/2020 – Technical workshop
- 8, 10 & 11/06/2020 – Final workshop
    - 8/06/2020 – Production and waste reporting
    - 10/06/2020 - Financial guarantees and extractive waste management plans
    - 11/06/2020 – Sustainable and transparent management of extractive waste

Distribution: Restricted

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Date :	10/05/2019	Ref.	RMA/1810454/IVK-BL-JB-PC/20190510
From :	Project coordinator	Annexe(s):	
To :	EU Project Officer		
Copy (CC) :	Consortium		

Study supporting the development of general guidance on the implementation of the Extractive Waste Directive (EWD) – Minutes of the Meeting with Experts

Service contract no. ENV.B3/ETU/2017/0039
When: 11 April 2019, 10:00 to 16:30
Location: DG ENV, Brussels

LIST OF ACRONYMS

BGS	British Geological Survey
BMNT	Austrian Federal ministery of Sustainability and Tourism (Bundesministerium für Nachhaltigkeit und Tourismus
CA	Competent Authorities
CAF	Category A Facility
CATAPA	The social movement that denounces the impact of mining
Ceram-Unie	The European Ceramic Industry Association
EC	European Commission
ECJ	European Court of Justice
EFG	European Federation of Geologists
EW	Extractive Waste
EWD	Extractive Waste Directive
EWF	Extractive waste Facility
EWMP	Extraction Waste Management Plan
FNI	Federation of Norwegian Industries
IED	Industrial Emission Directive
IMA-Europe	Industrial Minerals Association Europe
MS	Member State
MWEI BAT	Best Available Techniques (BAT) Reference Document
ORAMA	Optimising data collection for Primary and Secondary Raw Materials
PROSUM	Prospecting Secondary raw materials in the Urban mine and Mining wastes
RMSG	Raw Materials Supply Group
TAC	Expert group
UEPG	European Aggregates Association
USGS	U.S. Geological Survey
WMD	Waste Management Directive

1. Attendees

- EC:
  - EC - DG Env (Chair);
  - EC – DG Grow - JRC

- Consortium
  - VITO
  - Eco-Efficiency
  - Euromines
  - MEERI
  - TBL
  - WEFalck

- Associations
  - CATAPA
  - Ceram-Unie
  - EFG
  - Eurogypsum
  - IMA-Europe
  - UEPG
  - FNI

- Member States
  - Austria
  - Belgium
  - Croatia
  - Czech Republic
  - Estonia
  - Finland
  - Germany
  - Hungary
  - Ireland
  - Latvia
  - Lithuania
  - Malta
  - Poland
  - Spain
  - Sweden.

2. Welcome & objectives of the project (EC-DG ENV., Project Officer)

2.1 Welcome

The Chair welcomed the delegates and explained the purpose of the meeting to the expert group on extractive waste.

NB. Administrative issues:
The ToR for the study was not send to all invitees because of the invitations of 2 groups. Initially, the ToR was distributed with the 1st invitation, but this went to an outdated TAC/RMSG list. The 2nd invitation did not contain the ToR. Therefore, it may be that some delegates or members of the RMSG, have not yet received the ToR. Austria asked that all documents that were shared be also sent to all participants of the meeting so that they have a chance to respond. The background document was sent to those who accepted the invitations.

2.2 Objectives of the meeting

The purpose of the meeting was to inform delegates about the project with the intention to ask and motivate them to share with the EC and the consultants information on 1) how the EWD is applied in the different MS (and across the different sub-sectors), 2) how the key concepts of the EWD are applied and 3) to motivate the participants to enter into a dialogue and provide data and advice to the consultants to achieve the objectives of the project.

2.3 Objectives of the project

Two previous studies[1] did not provide sufficient information for the EC to assess the implementation of the EWD in MS. This project focuses on the key concepts of the EWD and how are they applied, notably:

- What is considered an Extractive Waste (EW), what is not?
- What is a Category A Facility (CAF), and what is not?
- Which are the tricky elements in the EWD?
- Why does the implementation miss some points?
- How many extractive sites are present in EU28?
- Which flows go were?
- What are these flows?
- Why is some excavated material not designated as waste? What precautions of safe use of those materials have been taken?

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[1] EC (2016) Report from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions on the implementation of Directive 2006/21/EC on the management of waste from extractive industries and amending Directive 2004/35/EC. Report d.d. 06/09/2016, with reference 6.9.2016, COM(2016) 553 final
http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1489760330450&uri=CELEX:52016DC0553

Cherrier V., Luscombe D., Calero J., Zotz F., Weißenbacher J. Pelsy F. & Dupont C. (2017) Assessment of Member States' performance regarding the implementation of the Extractive Waste Directive; appraisal of implementation gaps and their root causes; identification of proposals to improve the implementation of the Directive – Final report. Report d.d. 28/08/2017, with reference KH-01-17-904-EN-N.
https://publications.europa.eu/en/publication-detail/-/publication/f39af478-8d2e-11e7-b5c6-01aa75ed71a1/language-en/format-PDF.

- Heterogeneous implementations of the EWD across the EU were illustrated by discrepancies in the reported statistics, for example:
  - Overreporting in some MS and underreporting in others:
    - There is no correspondence between the numbers of Category A Facilities (CAFs) and the numbers of metal mines:
      - 1 MS with no metallic mines reports the presence of 100 CAFs;
      - Severel MS with a number of metallic mines do not report the presence of CAFs;
      - In 3 years there have only been 7 non-compliance reports;
  - Only limited reporting on incidents and accidents: One accident of note has been reported over the last 3 years. What is an accident / incident that MS consider need to be reported? The EC needs experts to give information on this. The EC is also interested to discuss early warning signals and to identify relevant indicators to get a common understanding.

This project broadens the discussion to all material flows in the extractive sector to get a better understanding of 1) how the relevant definitions of the EWD are applied, 2) the number of operations per MS (i.e. a comprehensive list of all metal mines and an aggregated overview on MS level with respect to the other commodities, 3) the volumes of ore, their materials flow and the way they are designated (waste, others) and 4) the precautions taken with respect to human health and the environment when applying “non-waste” material streams.

All information gathered by the consortium and compiled in country sheets will be screened by the EC and will be evaluated in the framework of possible improvements to the EWD.

3. Project background (VITO)

The first part of the project is focussed on developing an inventory of the entire primary raw materials supply sector. Differences have been noticed in the way different Member States report or categorise the different mined commodities. The second part of the project focuses on fostering a uniform understanding of the key concept, which corresponds to the dialogue decribed by the EC. Furhermore two more workshops are foreseen, i.e. a technical workshop and a final meeting.

Discussion / Questions project background:

- Indicative timeline:
  - Duration of project: 24 months, 15/09/2018 – 14/09/2020;
  - Gathering data with respect to the overview of the extractive sector, the waste generated and the identification of CAFs:
    - Desktop study is largely finished,
    - Country visits will commence as of June and continue until Sep/Oct 2019.
  - Expert Meeting: ~month 6;
  - Technical workshop: month17
  - Final workshop: month 20
- How to finalise the data collection without having contacted the stakeholders?
  → *<u>Comment by VITO:</u> The data collection will continue in parallel with dialogues with MS. The inventory is designed to identify all side-flows (and therefore potential waste streams) from the excavated rock onwards, to the level of single mines if possible. In some cases, we know, that this will not be possible, so we will have to be pragmatic, but at least we want to go into a very high level of detail for metal mines.*

4. Meeting overview / Agenda

See Annex 1

5. Description & preliminary findings of task 1 & 2

5.1 Task 1, Overview of the extractive sector in the EU (VITO)

With respect to task 1, for which VITO is still collecting data for the differet MS, a deskstudy has been carried out. At first an internet search was carried out on global, publicly available, mining data (i.e. BGS, Eurostat, BMNT, USGS). Subsequently, websites from national geological services, mining authorities and statistical agencies were consulted. Furthermore data was also collected from sector associations (e.g., IMA-Europe, UEPG, EURACOAL, etc), other European projects and individual reports from mining companies.

When gathering the data, different problems have been encounterd:

- Depending on the source, different units were used in data reporting, sometimes m^3 or tons – and it not straightforward to convert from one unit to the other;
- Data on the mine sites are sometimes not clear;
- There is confusion about the different materials included in "aggregates" reporting;
- Most statistics only relate to materials shipped from the mine and not to materials managed within the site;
- The split between limestone for cement and limestone for other purposes is not easy to identify;
- For the metal mines, the situation is also quite complex – due to the changing and unclear status of each mine (operating, suspended, etc) - the information gathered so far comes from the internet and Euromines.
- For solid energy minerals many different terminologys are used to distinguish between the different types of minerals e.g. MS report different aggregations of different coal-types.
- A breakdown of oil & gas data could not be found: onshore/offshore or individual wells.

Discussion / Questions Task 1

- Austria requested that the consortium also consult with the MS – not only the industry associations.
  → Comment by EC-DG Env.: In the ToR it is stated that at first a deskstudy will be carried out. Easily available data will be explored, when necessary different parties (MS, sector organisations, etc) will be contacted. These contacts are further worked out during Task 6 (country visits).
- IMA-Europe cautioned against mixing up origins of material and uses of materials. E.g. "lime" and "bricks" should not be referred to as excavated materials, because nobody excavates these things – they are products.
- Austria suggests the use of the material is not relevant – the task should be limited to those materials that are actually excavated.
  FNI supported the comment from Austria.
- Ireland asked if the project was working on an "Extractive Directive" or an "Extractive Waste Directive" and suggested the scope should be limited to the correct management of EW.
  → Comment by EC-DG ENV.: The study does deliberately look at extraction in order to arrive at a better implementation of the EWD.

Discussion / Questions Task 1 (continued)

- As a compromise, IMA suggested the work be phased. First, only look at the materials that are excavated. Later, as a second step, look at uses to understand differences in the characteristics of the different waste streams generated.
  → *<u>Comment by EC-DG ENV.:</u> The work is also limited by the availability of information and, indeed, how to structure it.*
- FNI raises the reference to marine aggregates. In the MWEI BAT discussions, it was clearly stated that waste from marine aggregates excavation is not covered by the EWD.
  → *<u>Comment by EC-DG ENV.:</u> The scope of this study is not limited to the scope of the EWD.*
- Ireland referred to:
  - the inconsistencies mentioned at the beginning of the workshop. The approach that the study seems to be taking is to make it more complex and more ambiguous. It is key that we focus on the EW. The need for this Directive arose from failures of tailings facilities. We need to maintain that focus. Let's collect information on the EW and be consistent about it. If there is a use for the material, it is not an EW – let's be clear about that.
  - concerns about inclusion of the hydrocarbons (oil & gas) sector in this work. This sector is very different, it is currently under siege and we should not be making decisions about it in their absence (outside of the VITO consortium, there were no hydrocarbon experts present at the Workshop). If you are looking for statistics on the products and wastes from mining, the competent authorities are the source. All the global and geological survey data got their data from the CAs. So, for the data, come to the CAs. Let's keep the focus on the EW and the tailings dams in particular.
    → *<u>Comment by EC-DG ENV.:</u> The coverage of hydrocarbons is limited to a small set of sub-tasks that are not included in the agenda of the workshop. The TWG of the MWEI BREF was engaged in time-consuming discussions of the difference between EW and non-EW and these discussion must not be repeated in this project. One cannot understand what is EW if you do not also look at the non-EW. That is why the study deliberately looks wider than the EW. The consortium has so far done the desk study, and now the reason for inviting TAC members to this Workshop is to gather the data that the CAs are providing.*

5.2 Task 2, Material streams and types of waste generated during extraction of aggregates, construction, industrial and energy minerals (MEERI)

After consulting different sources (EU, national and regional statistics, EU projects, mining companies, literature) it is primarily concluded that data on waste is lacking. The question is whether there is no waste related to the extraction of aggregates, construction, industrial and energy minerals or the data has not been reported. EW may result from 1) ongoing mining/quarrying activities, , 2) processing stockpiled materials and/or 3) re-processing of deposited wastes – therefore generation of EW can depend on which material has been processed. Findings from previous EU projects (ORAMA, PROSUM) suggests that it could be that the desired dis-aggregated data is simply not reported.

Therefore MEERI focussed on Poland as a case study and tried to gather data mine by mine individually. Poland has 16 Voivodships (~provincies) that report volumes according to the Polish waste code.

Comparable to task 1 several uncertainties has popped up:

- Statistics with apparently the same year and title differed across the data-providers.
- Most of the data discovered was very general. Where detailed data can be found for the different types of coal produced from individual mines, it is not possible to find any mine-by-mine data on volumes of waste generated (e.g., Greece).
- When referring to less official sources, the reported statistics are difficult to understand with reference to the EWD. E.g., “total waste intended for re-use” (Czechia).
- Waste codes are not aligned with definitions of the EWD. MS applies different waste codes.
- Single companies report EW from several mines.
- There is no distinction between waste originating from respectively primary & secondary production.
- Eurostat reports on extractive sector, but the extractive sector is is much more than extraction site and covers much more than waste from the extractive industry.
- In Poland:
    - the relevant stakeholders do not classify any material streams from lignate extraction ex extractive waste, apart from a small amount of waste that is generated by further downstream processing to yield a by-product. Otherwise, all materials handled in the open-cast mine are either product or by-product. This partly arises from the fact that in Poland, overburden that is properly managed without leaving the site is not classified by Polish law as waste. Such overburden is systematically used for site reclamation in the open-cast lignite mining sector.
      The project should describe the reasoning of this assessment.
    - In the Polish hard-coal sector, 25Mt of waste is generated to produce 60Mt of hard coal. In this sector, even though 93% of the waste is re-used industrially or for landscaping, it is reported in the waste statistics – perhaps because it is an equivalent to “tailings” in that it is the result of size-separation processing of the ore (commonly called coal “washing” or “cleaning”).
    - Mine-by-mine data is available for industrial minerals, resulting in an unworkably large database. Splitting up the site-based data into commodity-based classifications is extremely difficult because of the variation in products coming from the different mines.
    - Similarly to the open-cast lignite mines, the majority of open-pit industrial minerals operations do not report EW because all of their processing is located within the pit.
    - When trying to split the waste into hazardous and non-hazardous categories, it is necessary to go to the regional level to find the necessary detail (in Poland, the 16 Voivodships). The country-level Eurostat data includes wastes from smelting as well as mining (in other words, Eurostat implicitly includes smelting in “the extractive sector”.

Discussion / Questions Task 2

- Extractive waste, secondary product, by-product?
    - Austria asked that it will be recorded that it is unacceptable that the European Commission present such a mistrust of the Member States. It is understandable to seek coherence between Eurostat and other reported data. It is a matter of fact that the situation of quoted statistics is a direct result of a misunderstanding of what is defined as EW. The solution is to provide clear guidance to Member States within the scope of the EWD – not outside of it. The way that MEERI presented the situation is exactly right. Austria requested that the European Commission sticks to the scope of the Directive and when taking a broader view, keeps the compliance checking to a workable minimum.

Discussion / Questions Task 2 (continued)

- Poland explained that data on overburden in the open-cast lignite mining is not hidden. Overburden is reported and left in open pits – so in this case we don't speak about "waste".
  → *<u>Comment by MEERI:</u> The overburden seems to be reported as a product, rather than a waste.*
- Ireland also expressed the hope that the European Commission was not mistrusting MS CAs. It is important to be clear that if material is used within the mine, it is not waste and does not enter the scope of the EWD.

→ *<u>Comment by EC-DG ENV.</u>: (cf. earlier discussion) The goal of the project is to go beyond of the limitations of the EWD. The purpose is to find out whether the "absence" of extractive waste is correct. If excavated material, other than the ore, is not waste, it has to be addressed to product legislation. If not, there is the risk that the excavated volumes are falling between existing legislations.*

- Statistical discrepancies:
  - IMA-Europe confirmed that it is even difficult to decide under which NACE code to report – due also to the artificial split that Eurostat makes between excavation and processing. Further, also in the industrial minerals sector, many of the mines are multi-mineral – e.g., producing both kaolinite and perlite. IMA warned against extrapolating generic product:waste ratios because the variation amongst individual mines can also be significant.
    → *Comment by MEERI: MEERI tries to smooth out differences due to geology by taking statistics over the whole lifetime of a mine, but agrees that one cannot extrapolate from one mine to others.*
  - JRC considers the "material flow approach" adopted by the consultants to be the best approach. The issues mentioned are not unique to Poland. There is an historic legacy of the different statistical rules adopted at different times. Mining companies have to report data since 2004. In the beginning mining companies also included waste related to lubricants, workers' clothes, etc in the mine waste statistics. The reductions in reported waste quantities are partly due to a better separation of these elements over time. JRC further recalled the relevant ECJ rulings that define what is a by-product in these sectors.
  - Ireland indicates that data on waste are reported by Eurostat. These data however exclude extractive waste. There is no obligation on MS with respect to reporting extractive waste.
- Contribution of invitees to project:
  - Sweden was puzzled about the purpose of this study, so would like to receive the Terms of Reference. Even now, Sweden has difficulty to understand what response the European Commission is seeking – written comments after the meeting? Or simply participation in the subsequent dialogue?
  - Finland requested concrete advice on how to proceed after the meeting. What information has already been provided for Finland, what more is required and by when.
  - Spain expressed a willingness to contribute to the project, but expressed doubt about whether the information on waste that the consultants are seeking exists. To generate it, might require starting from scratch and taking time to run a bottom-up process.
  - Austria can provide some background data to assist with interpretation of the WMD.

  → *Comment by EC-DG ENV.: The objective of the workshop is to motivate CAs to enter into dialogue with the consultants and to share the necessary information through individual contacts (cf. task 6: country visits, telephone conferences, mailing).*

6. Description & preliminary findings of Task 3 (Eco-Efficiency)

Within Task 3 focus is given to the generation of waste related to operational (i.e. producing) mining sites extracting metallic mineral ores. According to the desk study, taking into account data collected under Task 1 and additional data originating from mining associations, SNL database, USGS data, BMNT (World Mining Data), Euromines, technical reports from companies and communication with industries, a list of metal mine sites[2] reported as operational in the last five years was obtained. These sites can contain several mines, but one central EWF. Subsequently, the amount and the category of the extractive waste (EW) per metallic mineral ore mine, as well as the Uranium and Thorium mines, in operation, has been estimated, on the basis of the yearly extraction of ore, the ore type and the ore grade or the grade of concentrate. An overview per MS is given.

Issues encountered are:

- Some metal mines have converted themselves into industrial mineral mines.
- Differences in reported statistics between annual reports.
- Differences between data reported directly by companies and that reported by the MS CAs.
- Depending on the source, different units were used in data reporting, e.g. m^3 or tons. Unit convertions therefore have to be carried out, which are not straightforward.
- Classification of activities comes up again as an issue in certain cases like, for example, in Greece where an aluminium smelter is still fully integrated with an alumina plant. If separated, the red-mud would be reported as EW. As they are not separated, the red mud is reported as waste from the smelting activity and not as EW.
- Ore stripping ratios can vary from mine to mine, but also from one phase of the operation to the next and this results in different EW estimates. The great range of stripping ratios affects the calculated extractive waste.

Discussion / Questions Task 3 (Material streams metallic ore mines)

- Elements mentioned by Austria:
  - Austria explained that the changing of data in a statistical year book is normal for the reporting of all statistics, because statistics evolve through preliminary estimates, refined estimates, through to final confirmed & reported data (e.g., China revised five years worth of coal production data looking back 5 years resulting in a difference of 300Mt).
    → *<u>Comment by Eco-Eff.:</u> The result is that final confirmed waste statistics can be double the initially reported estimates.*
  - Statistical codes are not distinguishing between ore and concentrates, it's important therefore to cross check imported data with exported data. Austria can provide data from the last 5 years. Method is connecting to economical geological facts. Method does not include concept of circular economy. Please contact MS to come to detailed data on extractive waste.
  - Austria pointed out that imports statistics mix imported ores and imported concentrates. It is not possible to disaggregate the two from the national imports statistics. Imports of bauxite could be decisive. Imports of other metals are mostly concentrates – not ores. Austria asks the consortium to discuss with the CAs to arrive at the relevant quantities. The preliminary calculation for Austria is 30% too high.
    → *Comment by Eco-Eff.: It is not the intention to capture imports of concentrates – only imports of ores.*

[2] According to MWEI BREF, a site is defined as "all land at a distinct geographic location under the management control of an operator"

Discussion / Questions Task 3 (Material streams metallic ore mines, continued 1)

- Austria mentioned the application of magnesite as industrial mineral instead of metallic mineral.
- Austria is open to organise a discussion with the consortium together with the companies, but the national associations should then also be involved.
- Austria requested that all presented data be clearly referenced in order to check these kind of issues.
  → *Comment by Eco-Eff.: All references are given in the full Excel datasheet.*
- Austria also raised the reality that the rights of single operators in a country to confidentiality of business-sensitive information must be respected.
  → Comment by EC-DG ENV.: We are aware of this issue, if an operator does not want to make data public, it will be accepted. If data are not reported, it will be indicated as such. Therefore, we aim to achieve the objectives of the study with dialogue.

- Finland asked why Kemi mine is listed as importing "chromium"? Kemi received imported concentrate for production of cobalt, not chromium.
  → *Comment by VITO: this information is mentioned in the background document under task 1.6, it will be checked and corrected*
- FNI commented on the different data sources listed on slide 50 and questioned why MS are not listed. Why not go to the horse's mouth?
  → Comment by EC-DG ENV.: (cf. discussion Task 1) In the ToR it is stated that a desk study will be carried out to identify the different data sources before contacting the MS.
- Poland alerted that there could be differences between numbers of companies, production plants and deposits. One authority reports per deposit. Companies may report on five deposits worked by three mines.
  → *Comment by Eco-Eff.: Because of this difference in reporting, the name of the mine will be included. Special attention will be given to the confirmation of the data from CA's since some MS do this by counting the number of permits, while others by counting the number of physical locations etc.*

  → *Comment by Poland: For Poland all mines mentioned are active mines*
- Sweden asked about the main purpose of the study. If the purpose is to determine wastes arising, that data is usually available within the CAs. If the purpose of the study is slightly different, it will need different data. Some sites are 'treating mineral resources' are therefore generating EW even though there is no actual mine present on the site.
- Ireland:
  - asked the project team to describe how the calculations are made. Furthermore, she doesnot understand how is it possible the amount of calculated concentrate to be greater than the amounts of excavated material.
    → *Comment by Eco-Eff.: Ireland has one excavation site (Tara Mine) and two processing plants, one that receive ore from the Tara mine (mixed sulphide) and one which produce alumina from imported bauxite. The calculations were based on the technical report of Boliden for the Tara Mine and the alumina production of Ireland from the USGS.*

Discussion / Questions Task 3 (Material streams metallic ore mines, continued-2)
○ asked again what the overall objective was, and quoted that one of them at least was to arrive at reliable estimates of quantities of EW and numbers of EWFs. This should be the focus. One could collect lots and lots of data and eventually run foul of confidentiality requirements, but at the end of the day it seems most important to know where the tailings facilities are, how big they are, what's going into them etc. Ireland asked if it would be useful for each of the Member States to explain what they mean by "extractive waste" and check first if that can already solve the inconsistencies seen in the data so far – rather than collecting even more ambiguous and confusing data. → *Comment by EC-DG ENV.: The objective is to come closer to the effective operation to obtain a wider picture. For example, with respect to the open-cast lignite mines and metal mines, it is suggested to check why non-EW materials are classified as such and how. Furthermore it is advised to check the safeguards that are put in place for the management of the non-EW. The intention is to achieve a level of detail that is necessary to understand the main issues and not get lost in the details – in the end the defining constraint will be the project budget.* ○ clarified that it is not frightened of disclosing information, it is just concerned that the study asks the right questions to achieve its purpose.

7. Description & preliminary findings of task 1, 3 & 4 – Discussion.

7.1 Task 1.6, Imported materials that may generate extractive waste when processed (VITO)

Presentation was skipped because the issue had been tackled already during the presentation and discussion of the material streams and types of waste generated during the extraction of metallic mineral ores (Task 3).

7.2 Task 3, Identification of Category A Facilities (CAFs) linked to the extraction of metallic mineral ores (Eco-Efficiency)

The estimation of the number of CAFs linked to the extraction of metallic mineral ores is not straightforward because of:

- the low awareness of the rules in some companies, where for instance when handling inert material the EWF is regarded as "not Category A";
- a constantly growing list of hazardous substances;
- automatically classification of hazardous waste as Cat A.

Discussion / Questions Task 3 (CAFs metallic ore mines)
• EC-DG ENV. recalled that the European Commission's implementation report concluded that there is a mis-match between the quantities of hazardous EW and numbers of CAFs reported by individual M States. CW expressed the expectation that all "tailings facilities" should be candidates for categorisation as a CAF.

Discussion / Questions Task 3 (CAFs metallic ore mines, continued)

- Sweden asked why the consultant's preliminary estimates do not seem to include the information reported to the European Commission in 2018. Sweden further pointed out that even in the consultant's slides, the importance of "incorrect operation" is diminished when compared to "structural integrity", whereas the relevant COM DEC gives equal weighting to both. For Sweden, the COM DEC is very clear that classification as Cat A can be quite independent of the reactivity or hazard classification of waste. Sweden's view is that a material can have relevant hazardous properties even if it is not classified as hazardous (the Swedes call this a reactive waste).
  → <u>Comment by Eco-Eff.:</u> The "incorrect operation" aspect is difficult to assess in a desk-study – it requires an on-site assessment. As a compromise, this will have to be dealt with in discussions with MS CAs.
  → <u>Comment by Sweden:</u> Such a desk study cannot be sufficient and it seems the consultant is trying to characterise the waste instead of the company characterising the waste.
- Austria mentioned that the only question to the MS is whether their procedures for identifying CAFs satisfy the requirements of the Directive. Are the procedures for classification of CAFs in line with the EWD. If there are descrepancies, focus on these. The European Commission should not be checking all EWFs.
- Poland did not agree that it was the intention that all tailings facilities should be categorised as CAF. The intention was always that the identification of CAFs would be based on a Risk Assessment. As a result of the risk assessment, in Poland 1 tailing pond is categorised as a CAF, the other not.
- IMA pointed out that Baia Mare calamity (Romania) did not result from the properties of the waste, but from the lack of correct operation of the facility.
  → <u>Comment by EC-DG ENV.:</u> The approach followed, which is not a complete or perfect approach, was required by the ToR. The remaining gaps however, will be filled through the dialogue with the MS.
- Ireland mentioned that CAFs only apply to those facilities where there is an operation. Legacy mines are dealt with under other Articles of the Directive.
- FNI also expressed concern about a disproportionate focus on chemical characteristics of the waste, whereas the overriding issue should always be the physical stability issues. All delegates agreed that it is possible to have a CAF for inert EW.
- Sweden asked why the information / data reported on extractive sites and CAFs in 2018 has not been integrated in the slides?
  → <u>Comment by EC-DG ENV.:</u> The structure for the work is laid out in the European Commission's implementation report in 2016. This sets a starting point and, yes, a desk-based study might focus on some issues more than others, but that's why the Workshop is taking place and the <u>feedback of the experts is valued.</u>

7.3 Task 4, Identification of Category A facilities not linked to the extraction of metallic mineral ores (Euromines)

The aim of Task 4 is to identify Cat A facilities associated with non-metallic minerals by looking at facilities lumped by produced commodities. At this stage of the project, reported data of 6 MS has been looked to in detail. To allow a risk evaluation of individual CAFs for each of the distinguished commodity categories (i.e. aggregates, construction minerals, industrial minerals and energy minerals) a checklist has been compiled. Specific attention is given to elements that are relevant to address the consequences of failure or incorrect operation to some potentially sensitive receptors. Feedback on the checklist by the experts will be highly appreciated.

Also within Task 4 several data issues have to be dealt with:

- For many of the industrial mineral and aggregate operations, production data is not published and the data is confidential.
- For the hydrocarbon sectors, contact with the relevant associations can be taken, but voluntary contributions from the MS CAs would also be very welcome.
- As mentioned earlier, reasonable good production data is available per country and sometimes even per per region, but publicly available EW is scarce. A very rough estimate can be proposed on information available by Euromines and the sector organisations. The results can be discussed and checked with the MS CA.

Discussion Task 4 (CAFs non-metallic ore mines)

- JRC referred to the in-theory application of the Seveso Directive to the higher risk EWFs. Based on the very low number of Cat A EWFs, can we conclude that there are no Seveso sites in the primary raw materials supply industry?
  → *<u>Comment by Euromines</u>: We need to check.*
- IMA-Europe confirmed that none of its members' EWFs are Seveso installations because the relevant threshold is not reached.
- Spain asked if the consortium will go to the sites. If so, the CA would like to be involved.
  → *<u>Comment by Euromines:</u> Within the timeframe and budget of the project, it is not possible to visit individual sites. Visits are foreseen to a selection of MS – CAs.*
- IMA-Europe supported the screening approach: identify the "nos", the "yeses" and the "maybes" for checking.
- Sweden was concerned that "incorrect operation" and non-hazardous non-inert waste will be included in the considerations of the screening. Will the consultant apply the whole of the relevant Article?
- FNI suggested to add average rainfall and basal structure (i.e. geological setting) to the checklist.

8. Description Task 6 – Discussion

8.1 Permit Status of selected waste facilities (EC-DG ENV.)

In order to get a better picture of the application of the EWD, various points of attention are brought forward with regard to the face-to-meetings with the MS-CA:

- How many EWMPs are established?
- How many production sites are operating on an approved extractive waste management plan? Is there a permit? To what extent is EU legislation taken into account or is the site operating without a environmental permit and why?

- To what extent is EWD applied: for ACI, energy minerals, does the site have an extractive waste management plan?
- Is the EWMPs an important tool for metal mines? Is this the only tool?
- To what extent is the Seveso Directive applied to metal mine EWFs?
- To what extent are other directives (e.g. IED and Water Directive) applied to metal mine EWFs?
- How many permitting authorities are involved?
- According to the reporting only 25% of CAFs have an external emergency plan in place. What is the latest status? What are the main issues? 100% of CAFs should have an emergency plan.
- To what extent and how is Annex I of the Seveso Directive applied to EWFs? Should equivalent accident prevention planning be given more focus in implementing the EWD?

8.2 Organistion Country Visits (Euromines)

The objectives and time schedule of the country visits was explained (Table 1). Not only face to face meetings for a selection of MS (Bulgaria, Finland, Greece, Poland, Romenia, Spain and Sweden), but also telephone conferences are foreseen. With respect to the interviews, a questionnaire will be prepared taking into account issues per MS in function of the results obtained from the desk study. If phone conferences are not satisfying, a follow up visit can be organised. The goal of these visits and the phone conferences is to check on the results obtained during the desk study and to fill the gaps from mising data and information. Finally, the findings will be summarized in country sheets.

Table 1: Overview of countries initially selected for the country visits – indicative timing

Selected countries	Indicative timing
• Bulgaria	May/June 2019
• Finland	End of September/beginning October 2019
• Greece	September 2019,
• Poland	September 2019
• Romania	May/June 2019
• Spain	June 2019
• Sweden	September 2019

Discussion / Questions on country visits

- Sweden asked about the purpose of the Country Fact Sheets and the number of visits
  → *<u>comment by Euromines:</u> Drafts will be prepared for all 28 Member States with no preference amongst them. However, country visits will only occur in a shorter list of Member States – not all 28. 1 visit is foreseen to every MS. Of course different contacts can be organised.*
- Spain: Will the project team also visit the EWF? Their ministry would like to participate in this effort.
  → *<u>comment by Euromines: It is not within the scope of the project to visit the field sites</u>*
- UEPG:
  - What is the timeline for the compilation of the country sheets?
    → *<u>comment by Euromines:</u> Drafts are foreseen in November 2019*
  - Are only visits foreseen to the MS? It is advised to also contact sector organisations.

9. Conclusions expert feedback & additional issues

- Do not rely on desktop study only, but contact the CA, sector organisations and others to collect reliable data & information
- Common understanding of the problems
- Country fact sheets are part of the final report
- All of you will receive the ToR.

Discussion / questions on additional issues

- Delegates asked about the procedure for review and finalisation of any reports coming out of the study. Austria, Poland, Sweden, Ireland, Sweden, Finland and Estonia expressed their interest in reviewing the final report.
  → *Comment by EC-DG ENV.: The next deliverables will be 1) draft Country Fact Sheets, 2) background document for the Final Workshop and 3) final Report of the study. The delegates interested in reviewing the final report will be added to the mailing respect with respect to this deliverable.*
- EC-DG ENV. also announced that a tender has been accepted for a study related to Financial Guarantees (FG) required by the EWD, which is another follow-up to the 2016 implementation report and 2017 workshop with MS. EC-DG ENV. considers that the existing COM DEC falls short of a very detailed checklist for how to calculate the FG. EC-DG ENV. suggested that, if things can be synchronised, there might be an opportunity to present some of the deliverables of this FG study at the final workshop of this VITO-led project.

10. Wrap up and closing remarks (EC-DG ENV.)

- Workshop is considered as a success because of:
  - Cooperative stakeholder community;
  - Participants indicated their willingsness to share information;
  - Mistakes were mentioned;
  - Some missing elements were indicated.
- Waste can only be understood if non-waste is understood
- This study will more likely result in a “fact checking” than a “compliance promotion”, to support a future decision by the new Commission as to whether general guidance is desirable, or rather a review of the Directive. Another possible outcome is a revision of the COM DEC that lays out the reporting questionnaire, to convert it to a Country Fact Sheet-based system of reporting and/or eventually a public reporting rather than reporting directly to the European Commission.

Annex A: Agenda

Study supporting the development of general guidance on the implementation of the Extractive Waste Directive

Expert meeting on the preliminary findings of the study

DG Env (BU5), Brussels, 11 April 2019

Meeting Room C

Draft Agenda

	Registration & Welcome
09:30 – 10:00	**Security & Registration (Coffee)**
10.00 – 10:15	Welcome & objectives of the project (key concepts)
10.15 – 10:30	Project background
10:30 – 10:40	Meeting overview and practical issues
	Description and preliminary findings of tasks 1&2
10:40 – 10:55	**Task 1**: Overview of the extractive sector in the EU
10:55 - 11:30	**Task 2:** Material streams and types of waste generated during extraction of aggregates, construction, industrial and energy minerals; Data on extractive waste generated and numbers of extractive waste facilities
11:30 – 11:45	**Discussion**
11:45 – 12:00	**Coffee break**
	Description and preliminary findings of task 3: Metallic mineral ores
12:00 – 12:35	Material streams and types of waste generated during the extraction of metallic mineral ores, In depth description of types of waste generated during the extraction of metallic mineral ores
12:35 – 12:50	Discussion
12:50 – 13:50	**Lunch**
	Description and preliminary findings of tasks 1, 3&4 (continued)
13:50-14:00	**Task 1**: Imported materials that may generate extractive waste when processed
14:00-14:10	**Task 3**: Identification of Category A facilities linked to the extraction of metallic mineral ores
14:10-14:20	**Task 4**: Identification of Category A facilities not linked to the extraction of metallic mineral ores
14:20–14:40	Discussion

Agenda *continued*

	Description of task 6
14:40 – 15:00	**Task 6**: Permit status of selected waste facilities
15:00 – 15:10	Discussion
	Organisation Country Visits
15:10 – 15:25	Overview & preliminary planning
15:25 – 16:00	Discussion
16:00 – 16:20	Conclusions expert feedback & additional issues
16:20 – 16:30	Wrap up and Closing remarks
	End

Annex B: Presentations

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MEETING WITH EXPERTS
PRELIMINARY RESULTS OF THE STUDY SUPPORTING THE DEVELOPMENT OF GENERAL GUIDANCE ON THE IMPLEMENTATION OF THE EXTRACTIVE WASTE DIRECTIVE (ENV.B.3/ETU/2017/0039)
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PROJECT BACKGROUND
PROJECT COORDINATOR
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BACKGROUND OF THE STUDY

- Implementation report EWD
  - The majority of Member States have taken the necessary measures to implement the directive
  - The EU experiences difficulties in evaluating the implementation of the guidelines by the individual member states
  - Incomplete and inconsistent set of data
  - Diverging interpretations are a likely source of inconsistencies in the data reported

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OBJECTIVES OF THE STUDY

- Develop a coherent description of the extractive sectors and the main waste streams in view of delivering plausible information on the amounts of waste generated and the corresponding waste facilities
- Foster a uniform understanding of the key concepts of the Directive by Member States
- Contribute to making reporting on the implementation of the Directive more effective and efficient

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OUTLINE OF THE STUDY – PART 1: DATA COLLECTION AND ASSESSMENT MAT. FLOWS

Task 0 (VITO)

Project coordination

Task 1 (VITO)	Task 2 (Meeri)	Task 3 (Eco-Eff)	Task 4 (Euromines)
Overview extractive sector EU	Overview waste generated during extraction of non metallic minerals	Overview / Description of waste generated during extraction of metallic ores	Identification of category A facilities for non metallic ores

Task 5 (VITO)

Discussion preliminary findings tasks 1-4 & key concepts directive 2006/21/EG (with experts from member states)

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OUTLINE OF THE STUDY – PART 2: DIALOGUE & EVALUATION

Task 6 (Euromines)	Task 7 (Eco-Eff)	Task 9 (WEFalck)
Dialogue with member states - Compilation of country fact sheets	Overview of substances used for flotation and their potential environmental impact	Inventory & rehabilitation of closed and abandoned waste facilities (mainly mining metal ores)

Task 8 (VITO)

Technical Workshop with respect to the implementation of the Directive (with experts and stakeholders from memberstates)

Task 10 (Euromines)

Final workshop

Task 11 (VITO)

Final report

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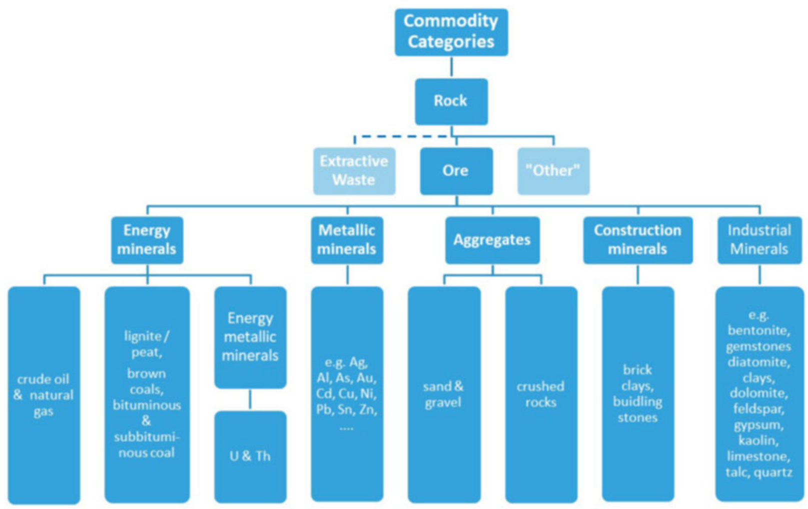
APPROACH: STRUCTURE OF THE EXTRACTIVE SECTION IN EUROPE



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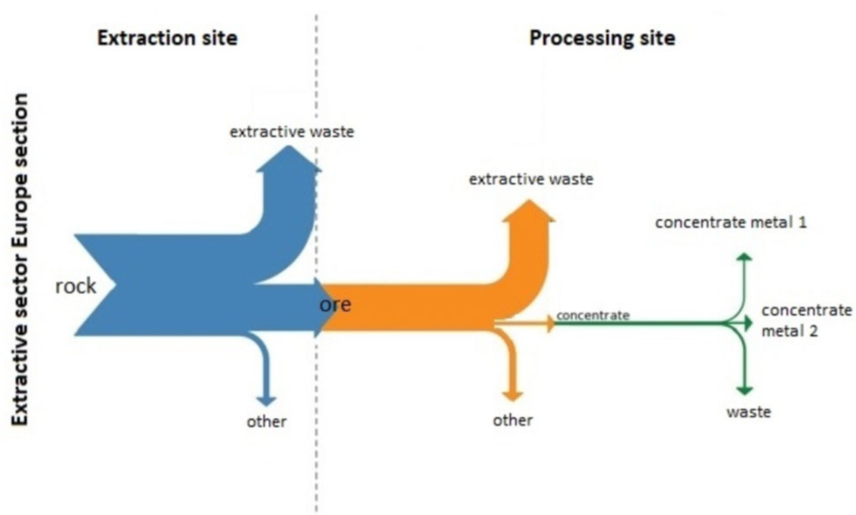
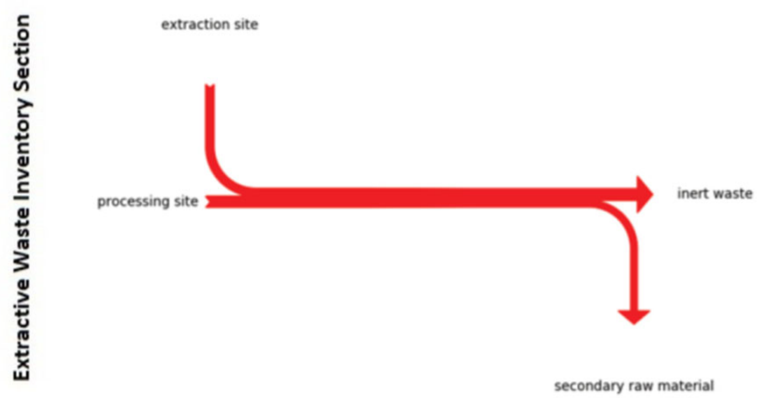
APPROACH: MATERIAL FLOWS WITHIN THE EXTRACTIVE INDUSTRY



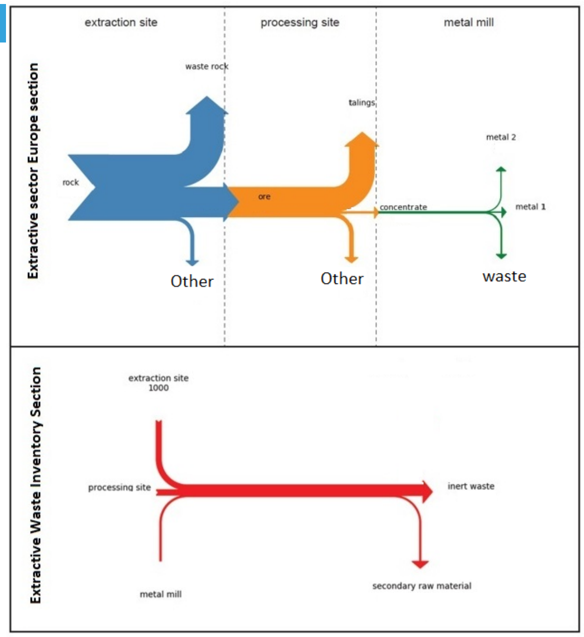
APPROACH: WASTE GENERATED WITH THE EXTRACTIVE INDUSTRY IN THE EU

- Amount and type
- Associated extractive waste facilities

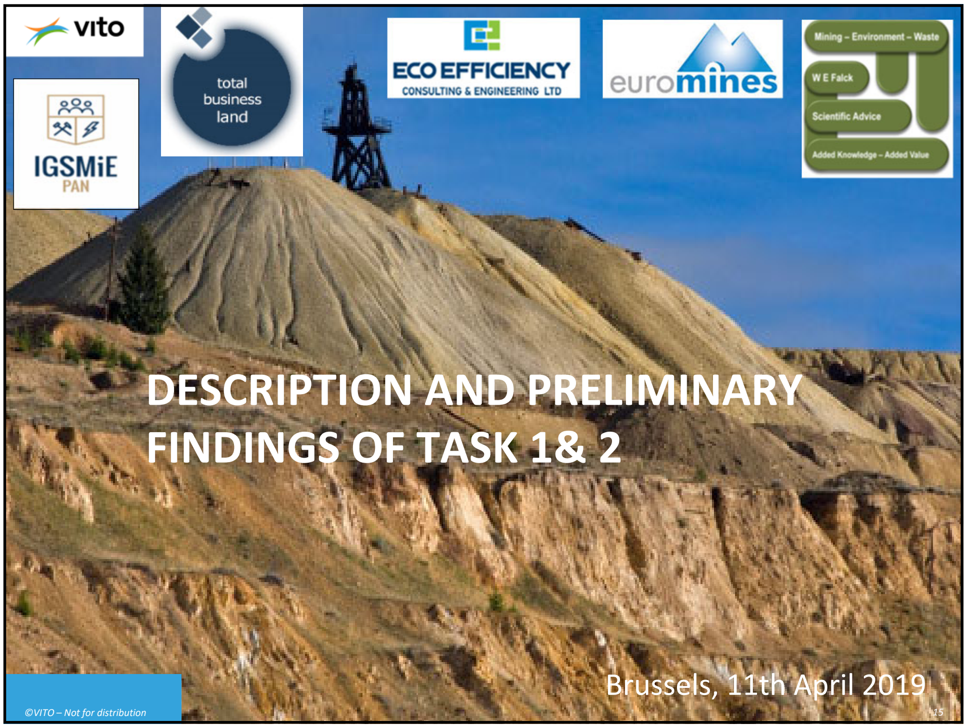


APPROACH: SCOPE OF DATA COLLECTION AND ASSESSMENT OF MAT. FLOWS

- Inventory of active mining in Europe
  - At Members State level for aggregates, construction minerals, industrial minerals and energy minerals
  - At the level of individual mining sites for metallic minerals mines + U & Th
    - Active ore extraction
    - No active ore extraction but active processing of stock-pilled / already excavated material
- Inventory of the waste streams
- Inventory of former and still active extractive waste facilities
- From different data sources and own evaluation based on extraction technique, ore/commodity and processing
- Dialogue with the Member States s through direct contact, questioning and expert meetings



extraction site
processing site
metal mill
Extractive sector Europe section
waste rock
talings
metal 2
rock
ore
concentrate
metal 1
Other
Other
waste
Extractive Waste Inventory Section
extraction site
1000
processing site
inert waste
metal mill
secondary raw material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total business land
ECO EFFICIENCY
CONSULTING & ENGINEERING LTD
euromines
Mining – Environment – Waste
W E Falck
Scientific Advice
Added Knowledge – Added Value
IGSMiE PAN
DESCRIPTION AND PRELIMINARY FINDINGS OF TASK 1& 2
Brussels, 11th April 2019
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TASK 1: OVERVIEW OF THE EXTRACTIVE SECTOR IN THE EU
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TASK 1: DATA COLLECTION

- The aim of the data collection is to collect recent, coherent and representative data as much as possible:

Global Data	National Data	Sector organisation	European Projects	Others
• BGS • BMNT (world mining data) • Eurostat • USGS	• Geological Surveys • Mining Authorities • Statistical agencies	• UEPG • EURACOAL • EULA • IMA • ICSG	• Minerals4EU • Minerals4EU • MINVENTORY • Promine • Osrama	• Commercial databases • Company reports

Different sources
→ Different data
→ Different description of commodities
→ Different report layout
→ Different units

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TASK 1.3: OVERVIEW OF EXTRACTION SITES FOR "ACI" MINERALS

- Data on the total number of extraction sites
  Not always available per commodity (check database)
- Data on the amount of excavated rock used on site
  Rare to find data about it
- Data on the amount of excavated rock stock piled
  Yet, no data found
- Data on waste generated (per type of waste).
  Yet, no data found

Column 1
- Clay (general)
- Bentonite
- Kaolinite
- Vermiculite
- Sand & Gravel
- Crushed Rock

Column 2
- Marine Aggregates
- Feldspar
- Graphite
- Gypsum
- Calcium carbonate
- Lime
- Talc

Column 3
- Asbestos
- Baryte
- Diatomite
- Fluorspar
- Graphite
- Sepiolite
- Silica
- Magnesite
- Perlite
- Potash
- Salt
- Sulphur

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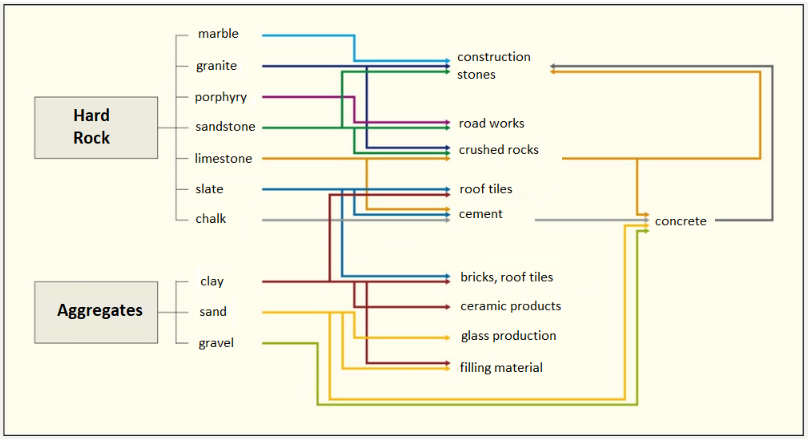
TASK 1.3: OVERVIEW OF EXTRACTION SITES FOR "ACI" MINERALS

Because of the overlap in applications, individual data on aggregates and construction minerals are nearly not available



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TASK 1.3: OVERVIEW OF EXTRACTION SITES FOR "ACI" MINERALS

Large difference in numbers:

Example Austria

AT	Crushed rock		Sand & Gravel	
In Mt	UEPG Est.	BGS	UEPG	BGS
2016	33	24,86	63	29,35
2015	33	24,74	63	29,45
2014	33	26,95	63	30,28
2013	33	25,97	63	30,12
2012	32	26,35	62	31,29

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TASK 1.3: OVERVIEW OF EXTRACTION SITES FOR “ACI” MINERALS - BELGIUM

Belgium
- Federal state
- 3 regions
- Different methodologies for reporting data

Brussel capital region
- No extractive industry

Flanders
- Data on gravel, sand, clay and loam extraction
- Numbers on volumes per extraction site are confidential, only aggregated data can be reported
- Report in m³ ↔ other sources in tons

Wallonia
- Crushed rock and industrial carbonate rock for cement industry
- Actually, there is no monitoring system with an accurate estimation of the yearly extracted volumes.
- Crushed rocks
  - Different sources = different data
  - Difference in definition of commodities?

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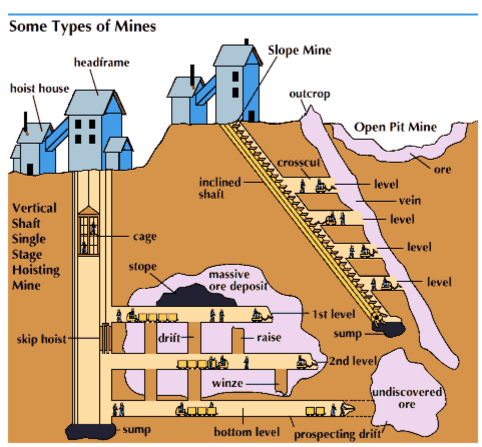
TASK 1.4: LIST OF ACTIVE METALLIC MINERAL ORE MINES WITH MS28

Data gathering of metal mines = complex
- Open pit ↔ underground mining
- Several ore bodies
- 1 mining company, different extraction locations (“sites”)

Activity status may vary from one year to another, not always clearly indicated
- Active
- Operating
- Construction phase
- Development phase
- Care & Maintenance

→ Not always clear



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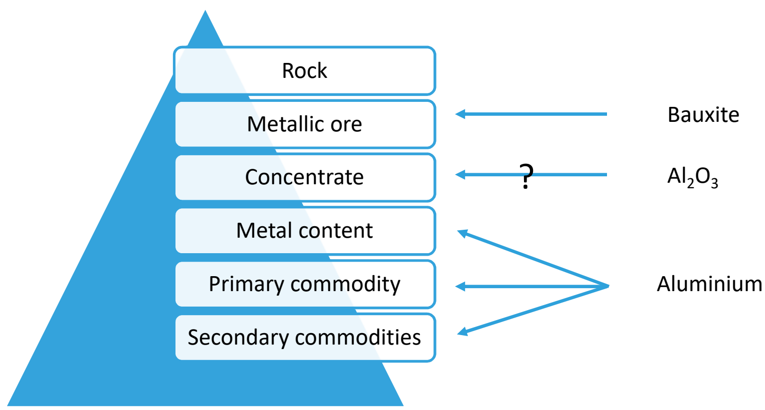
TASK 1.4: LIST OF ACTIVE METALLIC MINERAL ORE MINES WITH MS28

Difference in reporting commodities



Al: production data are mentioned, but there are no active bauxite mines anymore (import of bauxite?)

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TASK 1.4: LIST OF ACTIVE METALLIC MINERAL ORE MINES WITH MS28 (STATUS 21/03)

NUTS	No	Element	Comment
AT	2	Fe, W	Mittersill & Erzberg
BE	0		Pb, Zn in the past
BG	20	Cu, Au, Ag, Fe, Zn, Pb	Relatively small
CY	1	Cu, Au	
CZ	0 ?	Li, Sn, W, K, Nb, Ta, Au, Co, Cu, Ag	4 mines active but not in operation
DE	1	Fe (Al?)	Barbara Erztbergbau
DK	0		
EE	0		
EL	25 (?)	Ag, Al, Au, Cr, Ni, Pb, Zn	Important – many sites in 1 region f.e. bauxite
ES	10	Au, Ag, W, Co, Cu, Ni, Pb, Zn	Important - extraction sites still missing?
FI	13	Au, Ag, Co, Cr, Cu, Ni, Pb, Pd, Zn	Important sector – Care & Maintenance?
FR	0	Au, Ag, Cu, Pb, Ag, Tin, W	0 active – 6 under investigation/explo
HR	0		
HU	1	Mn, Al	Bauxite + Mn, no other MM in exploit.? tbc
IE	1	Ag, Au, Pb, **Zn,** Al	Zn (Pb) prod. Important
IT	0 ?		Al, Pb import?
LT	0		
LU	0		
LV	0		
MT	0		
NL	0		
PL	5 (4)	Ag, Au, Cu, Ni, Pb, Pt, Zn	Important – Glogow – tbc
PT	5 (4)	Au, Ag, Cu, Sn, Ti, Zn, W	Moderate – Corga: 2 sites - tbc
RO	3	Au, Ag, Al, Cu, Pb, Zn, W	
SE	15	Au, Ag, A:, Cu, Pb, Zn (Bi, Te)	important Maintenance – expansion – tbc
SI	1	Al	known for MM **Only 1 in prod.**,
SK	4?	Ag, Au, Al, Cu, Pb, Zn	tbc
UK	1	Ag, Al, Au, Pb	Drakelands

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TASK 1.5: SOLID ENERGY MINERALS

WHAT'S IN A NAME?

- Lignite
- Peat
- Brown coal
- Sod turf
- Hard coal
- Sub-bituminous
- Bituminous
- Anthracite

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TASK 1.5: OIL & GAS

- What to do with sulphur and pyrite form petroleum refining and/or natural gas, f.e. in BE?

Onshore versus offshore

No information on production wells

Total production

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URANIUM- AND THORIUM-MINING IN THE EUROPEAN UNION (T)

- Currently no Th-mining in EU
- No U-mining activities after 2016
- Ongoing rehabilitaion U-mines:
  < 120 t/year
- Czech republic
  - Activities stopped in 2016
  - Data 2017: ongoing rehabilitation & treatment of tailing ponds discharges
- France
  Effluent - discharge treatment U-EWFs
- Germany
  Treatment excess flooding waters from Königstein deep mine & discharges from tailing ponds
- Romania
  Treatment discharges tailing pond

Country	2014	2015	2016	2017
Bulgaria	0	0	0	0
Czech Republic	154	152	138	70
France	3	3	3	3
Germany	33	0	40	40
Hungary	2	4	4	5
Portugal	0	0	0	0
Romania	80	75	0	0
Slovenia	0	0	0	0
Spain	0	0	0	0

- Data on closed uranium mine tailings facilities in Eastern European (former) producing countries?

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TASK 1: WORKSHOP TARGETS, QUESTIONS & (DATA) GAPS

Aggregates, Construction minerals and Industrial Minerals (ACI)

- Distinction aggregates (gravel, sand, crushed rocks) ↔ construction minerals
  - Many MS: aggregates are part of the construction minerals and are not reported separately.
  - Do you have individual data for this commodity?
- For ACI: Data on the amount of excavated rock used on site and excavated rock stock piled at quarry level? We report not on quarry level for these materials
- Marine aggregates are in principle not incorporated, what with the volumes used for beach nourishment?

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TASK 1: WORKSHOP TARGETS, QUESTIONS & (DATA) GAPS

Metallic mineral & active metallic mines

- With respect to the metallic minerals it is not always clear for which “commodity type” data are reported: “rock”, “ore“ or “concentrate”. Where can we get information on this issue?
- Fe, Al & Cu ore: It is not always clear if the reported data relates to ore or to processed ore?
- For some countries it is difficult to find national data (i.e. Austria, Germany, Estonia, Ireland). What websites do we have to consult? Who should we contact?
- Phosphate rocks in Finland: are they also used for the extraction of metallic minerals?
- Data reports on combined commodities, e.g. FI: talc & Ni

Energy minerals

- Italy reports on the amount of mined asphalt and bitumous rocks. Does single data exist for respectively native asphalt and bituminous rocks?
- No data can be found on closed uranium mine tailings facilities in Eastern European (former) producing countries. Who do we have to contact in the Czech Republic, Romania and Bulgaria for these data?
- Data on production wells of oil & gas?
- Is it possible to get individual data on onshore production of oil & gas?

IGSMiE PAN

Overview of waste generated during the extraction of non-metallic minerals – challenges in the management of data on extractive waste, the Polish case

ENV.B3/ETU/2017/0039

Task 2 - Material streams and types of waste generated during extraction of aggregates, construction, industrial and energy minerals; Data on extractive waste generated and numbers of extractive waste facilities

11 April 2019

EU definition

According to EC definition of extractive waste

Waste resulting from the prospecting, extraction, treatment and storage of mineral resources and the working of quarries, but excluding:

- **waste which is generated by the prospecting, extraction and treatment of mineral resources and the working of quarries, but which does not directly result from those operations;**
- **waste resulting from the offshore prospecting, extraction and treatment of mineral resources;**
- **injection of water and reinjection of pumped groundwater as defined in the first and second indents of Article 11(3)(j) of Directive 2000/60/EC, to the extent authorised by that Article.**

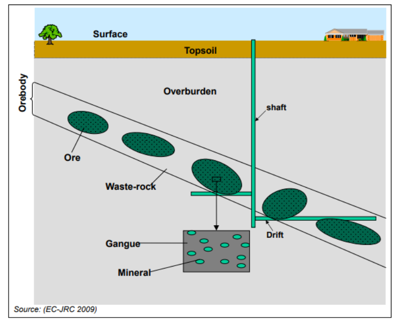


Figure 8.1: Schematic drawing of an orebody

There is no database on extractive waste facilities at EU level and such could not be created following the current reporting mechanism of the Directive 2006/21/EC (Orama)

Interpretation of EU definition

Inconsistent interpretation of EU definition concerning „extractive waste"
Report *Best practice in regulating onshore oil and gas operations (including shale gas)* of the EU Network for the Implementation and Enforcement of Environmental Law (IMPEL) – different interpretations of the application of the definition of "extractive waste" to specific substances were different

Substance	Extractive waste? (percentage of participants saying yes)
Drilling muds	60
Drill cuttings	60
Waste cement	25
Flowback fluid mixed with formation minerals and salt	40
Produced and formation waters	33
Proppants such as sand removed from flowback fluid	40
Waste gas for flaring	17
Waste oil	33
Waste suspension and spacer fluids	40
Discarded condensates	33
Testing or well stimulation fluids	40
Waste gases, including fugitive emissions	17

More detailed descriptions are necessary to define if particular types of waste are considered as extractive waste

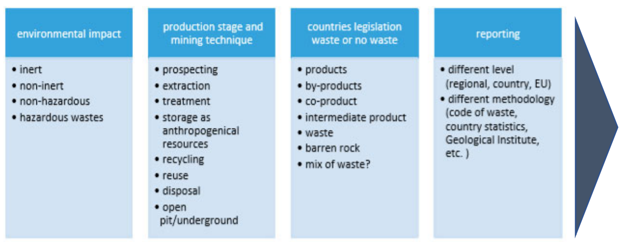
operational phase
after-closure phase
re-processing

'treatment' = mechanical, physical, biological, ***thermal or chemical process*** or combination carried out on mineral resources, including from the working of quarries, including size change, classification, separation and leaching, and the re-processing of previously discarded waste, but excluding smelting, thermal manufacturing processes (other than the burning of limestone) and metallurgical processes

Type of waste and its reporting

33 /17

- Different types, amounts and properties of waste produced at extraction sites depending on the resource being mined, process technology used and local geology,
- Different types of waste generated during each stage of mining project lifecycle,
- Different standards for the reporting of extractive waste depending on countries legislation (statistic offices, regional and EU database),
- Several unofficial systems for mining waste exist. Each system has its own unique classification, harmonisation, collecting and reporting tools - the input datasets in existing systems are scarce, dispersed and non-comparable (Orama project).
- Lack of data on the amount of mining waste information collected in the scope of the Directive 2006/21/EC (Prosume Project),
- Code of waste do not allow to identify group (metal, energy, industrial) of waste from extractive industry.



Waste is considered to be a waste when they are moved out of the quarry ?

Figure: Overview of waste categorisation as a function of environmental impact, production stage & mining technique

Objectives

34 /17

Main objective

To collect, compile and improve quality of available data on the type and amount of waste generated during the extraction of:

- Aggregates
- Other construction minerals
- Industrial minerals subdivided by commodity such as kaolin, perlite and feldspar
- Energy minerals, subdivided into peat, coal, lignite, crude oil and natural gas

Poland – case study coal and some industrial minerals collected by Code of waste and by individual company - some industrial minerals - hazardous versus non-hazardous

Extractive waste data collection - Identification of gaps

1. **Different sources of data**

   in Poland data about all waste in different database in EU and PL statistics, databases, EU projects, literature,

2. **Different numbers for total waste generated in Poland presented by Eurostat, Polish Central Statistical Office and other sources,**
3. **Different waste classification in particular databases with no possibility of detailed comparison**
4. **Different scope of data presented by different countries:**
   - **for Poland detailed data in regional statistics and individual mine/company level, waste streams reported by waste code which do not go down to the level of a single raw material, waste code without separation of waste from primary and secondary resources, waste reported by companies (not deposits or mines)**
   - **only general level of data for other countries – we can not find any detailed data**

Examples of data concerning Poland (2014, mln tonne)

EUROSTAT

Hazardous and non-hazardous total waste	179,2
Chemical and medical wastes (subtotal)	2,5
Recyclable wastes (subtotal, W06+W07 except W077)	13,9
Equipment (subtotal, W077+W08A+W081+W0841)	0,2
Animal and vegetal wastes (subtotal, W091+W092+W093)	3,1
Mixed ordinary wastes (subtotal, W101+W102+W103)	23,6
Common sludges	0,6
Mineral and solidified wastes (subtotal)	135,2

Generation of waste by economic activity	
Mining ang quarring	75,7
Manufacturing	31,4

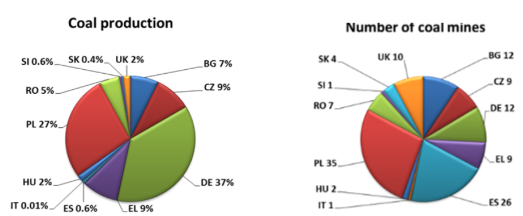
Polish Central Statistical Office (GUS)

Total waste incl. municipal	141,6
Waste generated and accumulated excl. municipal	131,3
of which:	
Waste from washing and cleaning of minerals	36,0
Waste from floatation dressing of nonferrous metal ores	30,6
Dust-slag compounds from wet treatment of furnace waste	12,0
Waste from mineral nonmetalliferrous excavation	5,2
Coal fly ash	3,8
Soil and stones	4,0
Mixtures of fly-ash and solid waste originating from lime-stone methods of desulphurisation of waste gases	3,2
Wastes from the processing of slag	3,3

Coal production in EU versus waste

- **128 coal mines in 12 Member States:**
  - **79 hard coal mines – the largest in Poland and Czech Republic**
  - **49 lignite and brown coal mines – the largest in Poland, Germany, Bulgaria and Romania**
- **Coal annual production of approx. 500 million tones**

Source: EU Coal regions – opportunities and challenges ahead – study JRC 2018; https://publications.europa.eu/en/publication-detail/-/publication/de175603-896a-11e8-ac6a-01aa75ed71a1/language-en



GREECE - 5 lignite open cast mines

2 leading centers: Ptolemais-Amynteo (LCPA) and Megalopolis (LCM)

No data on production detailed information on production per mine, no data on waste

Lignite / brown coal in EU member states

CZECH REPUBLIC - Mines in Czech Republik

Total production in 2017 – over 39 mln Mg
4 producers: SD (21.7 Mt), VUAS (7.5 Mt), SU (6.9 Mt) and Sev.en (3.2 Mt)
Total annual waste generation (Severní energetická a.s., Důl Kohinoor a.s.) - 1,4 mln tones, the hazardous waste category - under 16% of total waste.
The disposal of 0,2 mln tones of railway sleepers accounted for the largest proportion (almost 83%) of hazardous waste produced.

No detailed data on mines, production and waste

GENERATION OF WASTE IN THE EXTRACTION AND PROCESSING OF COAL (ČSA MINE AND KOMOŘANY COAL PREPARATION PLANT, CENTRUM MINE, SEV.EN WT, A.S.)

		2013		2014			2015		
	Unit	Severní energetická a.s.	Důl Kohinoor a.s.	Severní energetická a.s.	Důl Kohinoor a.s.	HUMECO, a.s. from 1 July to 31 December 2014	Severní energetická a.s.	Důl Kohinoor a.s.	Sev.en WT, a.s. (formerly HUMECO, a.s.)*
TOTAL waste generated	**t**	**6,311.8**	**216.86**	**38,800.61**	**156.0**	**874.22**	**1,064.692**	**290.35**	**779.549**
Of which:									
generation of "other" waste	t	5,953.3	215.19	38,633.05	154.8	874.05	880.652	288.25	778.653
generation of "hazardous" waste	t	358.5	1.67	167.56	1.2	0.172	184.04	2.1	0.896
Waste management method in the given year:									
total quantity of waste intended for reuse	t	6,247.5	204.76	38,747.33	81.6	902.511*	916.248	230.01	755.106
total quantity of waste delivered to other companies for disposal	t	64.3	12.10	53.28	74.4	29.234*	148.444	60.34	47.461

The summary table of environmental indicators presents figures on the internal generation of waste by individual companies in the given year. Figures on the quantity of waste delivered for use or disposal may also include waste generated in previous years that was in temporary storage.
* There is more reused and handed-over waste than waste generated because, at the end of the year, a larger quantity of waste generated in the previous year was handed over and reused on a one-off basis.

Lignite / brown coal in other EU countries

GERMANY - 10 lignite open pit mines

The Rhine	Central German	Sorbian
Garzweiler	Amsdorf	Welzow-Sud
Inden	Profen	Janschwalde
Hambach	Vereinigtes Schleeeinbain	Nochten
		Reichwalde

Leading producer - ca 18% of the world production
Total extraction in 2016 - over 170 mln Mg, incl. Rhine basin - over 90 mln Mg and - the Lusatian basin (near the Polish border) - over 60 mln Mg

BULGARIA - 4 lignite open pit mines

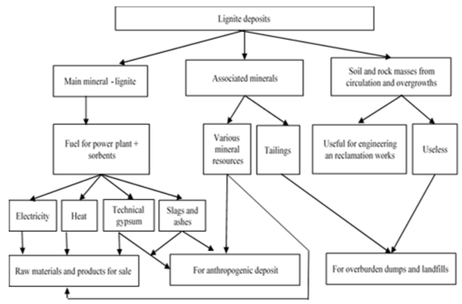
Troyanovo-1, Troyanovo-North and Troyanovo -3 in Maritsa Iztok basin

Total production in 2013 – over 25 mln Mg
Huge volume of dump materials generated by mining works in the basin with potential to lead to environmental problems (according to the largest producer of lignite in Bulgaria - Mini Maritsa Iztok EAD report not overburden nor waste)

No detailed information on production per mine, no data on waste

Lignite / brown coal in Poland – open pit

- Different possibilities of lignite waste management and classification
  but
- Almost no waste from extractive industry during lignite mining in Poland, only from the biggest mine the owner reported small amounts of waste with code 01 04 12



Source: Scheme for the management of raw minerals and products in the lignite-based mining-energy sector (Reproduced from Uberman 2017)

PGE Górnictwo i Energetyka Konwencjonalna SA, Bełchatów , ths. tones, 2017

Production of lignite	42 600
Extractive waste ^ generation	19
Extractive waste ^ recovery	21

^01 04 12 washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11

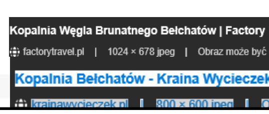
Reported extractive waste generation of 19 ths. tones cames from the Aggregate Production Plant (accompanying minerals out of a mining area)

Lignite / brown coal in Poland

Reasons of no waste from extractive industry during lignite mining in Poland

1. Overburden is not classified as waste if stored in the mining area and managed according to Geological and Mining Law,
2. Intergrowth/interlayer in deposit is treated as overburden,
3. Soil and rock mass moved within excavation is not classified as waste from extractive industry if proper document (concession or local plan for mining area or mining plan) defined conditions for its management,
4. Associated minerals (by-product) sold or to be sold in the future, i.e. gravel and sand are not classified as waste.

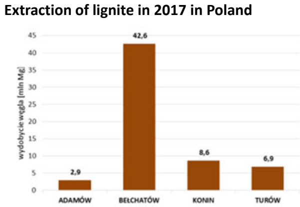
Source



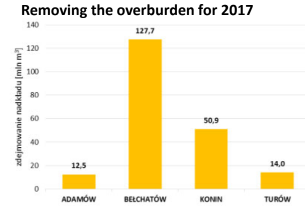
Lignite / brown coal in Poland – open pit

4 lignite open pit mines in Poland – stripping ratio 6,56 Adamów, 5,47 Konin, 3,86 Bełchatów, 2,4 Turów (average the whole mine life)

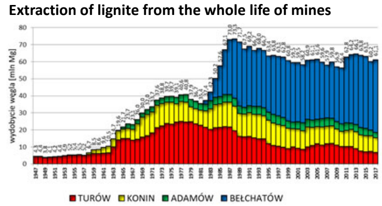
Extraction of lignite in 2017 in Poland



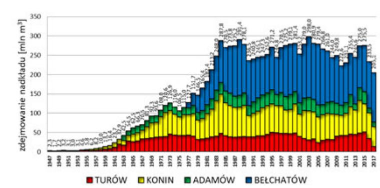
Removing the overburden for 2017



Extraction of lignite from the whole life of mines



Removing the overburden for the whole life of mines



Source: Kasztelewicz Z. Raport o stanie branży węgla brunatnego w Polsce i w Niemczech wraz z diagnozą działań dla rozwoju tej branży w I połowie XXI wieku

Hard coal in Poland

- **Extraction of hard coal in Poland – ca 60 mln tones in the Upper Silesian coal basin, and over 7 mln tones in the Lubelskie coal basin**
- **Hard coal mines - the biggest producers of waste (rocks from mining and preparatory works) with annual production of 25,2 mln Mg (2017)**
  - **The extraction of 1 Mg of coal accompanied by 0,25-0,35 Mg of waste (in the 80's – 0,5 Mg)**
  - **Ca 93% of waste produced during exploitation and processing of coal are economically used – out of which 30% used industrially and 70% is applied to ground levelling and other engineering works**

Table 15: List of Polish hard coal mines

POLSKA GRUPA GÓRNICZA
KWK Bolesław Śmiały
KWK Ziemowit
KWK Sośnica
KWK Ruda (3 jednostki po fuzji: KWK Bielszowice, KWK Pokój, KWK Halemba-Wirek)
KWK ROW (4 jednostki po fuzji: KWK Jankowice, KWK Marcel, KWK Chwałowice, KWK Rydułtowy)
Katowicki Holding Węglowy S.A.
KWK Wieczorek
KWK Wujek
KWK Mysłowice-Wesoła
KWK Murcki-Staszic
Jastrzębska Spółka Węglowa
KWK Borynia -Zofiówka
KWK Budryk
KWK Knurów-Szczygłowice
KWK Pniówek
Lubelski Węgiel "BOGDANKA" S.A.
ZAKŁAD GÓRNICZY ZAGŁĘBIE Sp. Z o.o.
PRZEDSIĘBIORSTWO GÓRNICZE "SILESIA" Sp. z o.o.

Hard coal in Poland

Two main groups of wastes from the mining and processing of hard coal:

1. **Mining wastes – up to 20% of total, coming directly from preparatory mining works**
2. **Processing wastes – coming from hard coal processing, depending on the type of processing equipment used and the applied technologies divided into three subgroups:**
   - **coarse-grained wastes from dense medium gravity separation**
   - **fine-grained wastes from jiggers**
   - **very fine-grained flotation wastes**

The basic way to manage mining and processing waste was to deposit them on dump close to the mine or central one. Significant part of waste was used for filling natural or anthropogenic depressions, and treated as land reclamation. Some of them are used as aggregates and material for construction and building industry.

No	Waste generation in 2017		Recovery in installations and devices	Recovery outside installations and devices	Disposal of waste in installations and equipment	Waste transfer to persons or organizational units, not entrepreneurs, for their own needs
	Waste holder	Waste generated [Mg]	Waste recovered [Mg]	Waste recovered [Mg]	Waste recovered [Mg]	Waste recovered [Mg]
01 Wastes from mineral excavation						
01 01 02 Wastes from mineral non-metalliferous excavation						
1.	ZAKŁAD GÓRNICZY ZAGŁĘBIE Sp. Z o.o.	2 371		2 371		
2.	POLSKA GRUPA GÓRNICZA Sp. Z o.o.	133 234	28 008	16 507		
3.	Katowicki Holding Węglowy S.A.	6 949				
4.	Jastrzębska Spółka Węglowa S.A.	120 428		98 654	20 327	
5.	PRZEDSIĘBIORSTWO GÓRNICZE "SILESIA" Sp. z o.o.	7 757	7 757			
01 04 12 Washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11						
1.	POLSKA GRUPA GÓRNICZA Sp. z o.o.	7 984 688	1 580 765	845 490		
2.	Katowicki Holding Węglowy S.A.	6 949	940	2 769		
3.	Jastrzębska Spółka Węglowa S.A.	10 199 544	347 629	5 356 879	3 773 820	
4.	Lubelski Węgiel "BOGDANKA" S.A.	5 693 662			3 010 924	24 457
01 04 81 Waste from coal flotation enrichment						
1.	POLSKA GRUPA GÓRNICZA Sp. Z o.o.	302 875	2 186	78 539		
2.	Jastrzębska Spółka Węglowa S.A.	784 680	66 461	387 870	242 209	
01 04 99 Waste not otherwise specified						
1.	POLSKA GRUPA GÓRNICZA Sp. Z o.o.	1				

Waste from industrial minerals in Poland

- **Some open pit industrial minerals producers do not report extractive waste – minerals are processed within excavation, in that case only contaminated soil and rock mass could be reported as waste**

<u>Examples of such industrial minerals producers:</u>

1. **BENTONITE - PGP „Bazalt" S.A. in Krzeniów**
   - **- bentonite „co-/byproduct is used for the production of sorbents, reclamation of mining and technological heaps**
2. **FELDSPARS - Strzeblowskie Kopalnie Surowców Mineralnych Sp.z.o.o**
   - **produce rock with very fine grain size <700 mm are used**

Source: Strzeblowskie

3. DOLOMITES
- **Żelatowa S.A. Chrzanów – all extracted materials are remanufactured and sold**
- **Jaroszowiec CEMEX – processing in excavation and used for reclamation**
- **Ząbkowice DOLOMIT S.A. - all materials are used**

4. KAOLIN - Grudzień-Las
- **kaolin produced from modling sands, exploited deposit and processing plant in excavation**
-



Source: Kaolin Grudzeń Las

Hazardous and non-hazardous waste in Poland

EUROSTAT

Total generation of waste and hazardous waste from extractive sector in 2014

Member State	Category A facilities in operation	Total Waste Mg	Haz Waste Mg	Non haz Waste Mg	% haz Waste
PL	1	75,736,488	6,821	75,729,667	0,0%

REGIONAL STATISTICS

Generation of hazardous waste - group 01 - resulting from exploration, mining, quarrying, physical and chemical treatment of minerals in 2017

Hazardous waste with code	Amount Mg	Company Name	Company Mg
01 03 04 *- acid-generating tailings from processing of sulphide ore	0.101	PHU AST Andrzej Janiszek (Wielkopolskie)	0.10
01 05 05*- oil-containing drilling muds and wastes	1 124.1	Polskie Górnictwo Naftowe i Gazownictwo S.A - SANOKU (Małopolskie)	19.40
		PETROGEO - PRZEDSIĘBIORSTWO USŁUG LABORATORYJNYCH I GEOLOGICZNYCH (Podkarpackie)	0.03
		Polskie Górnictwo Naftowe i Gazownictwo S.A - SANOK (Lubelskie)	42.1
		Polskie Górnictwo Naftowe i Gazownictwo S.A. Oddział Geologii i Eksploatacji w Warszawie (Lubuskie)	252.13
		Polskie Górnictwo Naftowe i Gazownictwo S.A (Zachodniopomorskie)	810.39
		PETROGEO - PRZEDSIĘBIORSTWO USŁUG LABORATORYJNYCH I GEOLOGICZNYCH - (Podkarpackie)	0.03
01 05 06* - drilling muds and other drilling wastes containing hazardous substances	43.4	Polskie Górnictwo Naftowe i Gazownictwo S.A- ODDZIAŁ GEOLOGII I EKSPLOATACJI W WARSZAWIE (Wielkopolskie)	42.49
		Polskie Górnictwo Naftowe i Gazownictwo S.A. (Zachodniopomorskie)	0.90

Workshop target's

1. There is no data available to create database about waste from extractive industry in EU - the same scope of data to be available for individual countries
2. More detailed definitions are needed to avoid different interpretation of EU reports
3. Analysis is needed about legal assessment when „waste/run of mine/co-by-product" is not reported as a waste,
4. Unification of presented data – total volume of waste from extractive industry should be verified (Eurostat, National Statistical Office, regional offices)
5. If data from companies are available, it is usually for short period of time
6. There is a need to change waste codes, to separate data for individual raw materials (coal and industrial minerals)
7. Data about volume of extraction from deposit can be available by Geological Institute , but data about waste – if available – are given only by company (1 company often more then 1 deposit and 1 mine)
8. There is no information in any statistics if produced waste come from primary or secondary sources
9. There are different reporting periods – sometimes yearly sometimes every second year, or other

Do you have in your country data available according to code of waste for individual companies as presented in Poland?

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Task 3: In Depth description of waste generated during the extraction of metallic mineral ores

ENV.B3/ETU/2017/0039

Expert meeting on the preliminary findings of the study

11 April 2019

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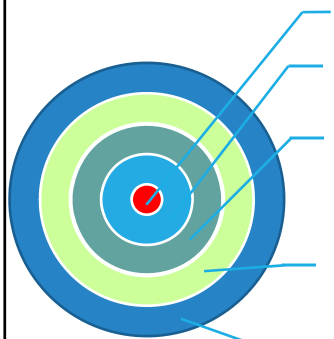
Task 3: In Depth description of waste generated during the extraction of metallic mineral ores

Targets of the Task



1. Estimation of **the amount** and **the category** of **EW**
2. Estimation of the **numbers** and the **category** of **EWF** for the above EW
3. Assessment for each Member State (MS):
   - Total amounts of EW (by commodity)
   - Expected number of EWF in operation
4. Correlation of the results with the EWF list provided by MS
5. The overall comparison with the figures reported by Member States (from 2014 to 2017) and with the amounts of hazardous and, where informative, the amounts of non-hazardous EW generated from mining reported to Eurostat

Task 3: In Depth description of waste generated during the extraction of metallic mineral ores

Task 3 covers

- Critical parameters of the ore: the grade and the type
- Estimation of the extractive waste generation
- Estimation of the expected categories of EW
- Estimation of the number of EWF in operation per site
- Estimation of classification of the facility in Category A or not
- Correlation of the EWF' list provided by MS with the results of Task 3
- Overall comparison with the figures reported by MS (from 2014 to 2017) and the amounts of hazardous and, where informative, the amounts of non-hazardous extractive waste generated from quarrying and mining reported to Eurostat

Task 3: In Depth description of waste generated during the extraction of metallic mineral ores

Data collection

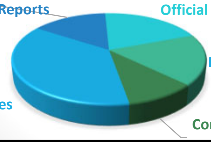
- Technical reports from companies (internet)
- SNL Database (S&P Global)
- Data from USGS
- World-Mining-Data
- Communication with industries
- Collaboration with National Mining Association

Data Evaluation

- Yearly ore production
- Estimation of amounts of EW by commodity
- Estimation of expected categories (inert, non – inert non hazardous, hazardous) based on
  - Decision 2014/955/EU (list of Waste)
  - Decision 2009/360/EC
  - Decision 2009/359/EC
- Data gap analysis & verification

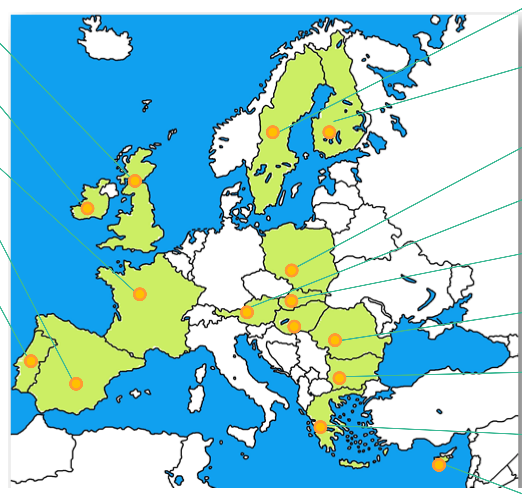
EWF data evaluation

- Estimation of the number of EWF in operation per site
- Classification of the EWF based on Decision 2009/337/EC



In Operation Metal Sites in Europe (preliminary results)

UK	1 site
Ireland	1 sites
France	1 sites
Spain	9 sites
Portugal	3 sites
Sweden	13 sites
Finland	11 sites
Poland	4 sites
Austria	2 sites
Slovakia	3 sites
Romania	3 sites
Bulgaria	20 sites
Greece	10 sites
Cyprus	1 site



<u>82 in operation metal mining sites</u> (under further investigation)

In Operation Metal Sites in Europe (preliminary results)

Country	Sites
Austria	Erzberg, Mittersill
Bulgaria	Assarel Panagyurishte, Assarel-Zapad, Dundee Precious Metals Chelopech, Ellatzite, Varba-Batantsi, Obrochishte, Sedefche, Assarel Milin Kamak, Dundee Precious Metals Krumovgrad Chan Krum, Grancharitsa Center, Djurkovo, Gudurska, Androu, Zlatograd Marzyan, Dimov Dol,Petrovitsa, Crushev Dol, Govedarnika, Chala, Byalo
Cyprus	Skouriotissa
Finland	Kittila, Jokisivu, Orivesi, Pampalo, Pyhasalmi, Kemi, Pahtavaara, Talvivaara, Kevitsa, Kylylahti, Raahe
Greece	Parnassos region (10 sites), Gkiona region (13 sites), Olympiadas, Mavres Petres – Stratoni, Evoias island (5 sites, Agios Ioannis (4 sites), Kastoria (3 sties)
Ireland	Navan Tara Mines
Poland	Lubin, Polkowice-Sieroszowice, Rudna, Pomorzany
Portugal	Panasqueira, Aljustrel, Neves-Corvo
Romania	Rosia Poieni, Manaila, Baita Plai
Slovakia	Horná Ves, Banská Hodruša, Nižná Slaná
UK	Drakelands
Spain	Los Santos, Atalaya mining, Las Cruces, Matsa aguas tenidas, Kinbauri boinas (asturias), Carles skarn, Pacific strategic, Valoriza mineria, Minera del duero (barruecopardo)
Sweden	Boliden Area (4 mines), Garpenberg, Aitik, Lovisa, Gruvberget, Leveäniemi (Svappavaara), Kiruna, Malmberget, Zinkgruvan, Bjorkdal

In Operation Metal Sites in Europe (preliminary results)

Country Name	Property Name	Primary Commodity
Austria	Erzberg	Iron Ore
Austria	Mittersill	Tungsten
Bulgaria	Assarel Panagyurishte Mining and Processing Complex	Copper
Bulgaria	Assarel-Zapad	Copper
Bulgaria	Dundee Precious Metals Chelopech	Gold
Bulgaria	Ellatzite	Copper
Bulgaria	Varba-Batantsi	Zinc
Bulgaria	Obrochishte	Manganese
Bulgaria	Sedefche	Gold
Bulgaria	Assarel Milin Kamak	Gold
Bulgaria	Dundee Precious Metals Krumovgrad Chan Krum	Gold
Bulgaria	Grancharitsa Center	Tungsten
Bulgaria	Djurkovo	Zinc
Bulgaria	Gudurska	Zinc (ZnS)
Bulgaria	Androu	Zinc
Bulgaria	Zlatograd Marzyan	Zinc
Bulgaria	Dimov Dol	Zinc
Bulgaria	Petrovitsa	Zinc
Bulgaria	Crushev Dol	Zinc
Bulgaria	Govedarnika	Zinc
Bulgaria	Chala	Gold
Bulgaria	Byalo	Gold

In Operation Metal Sites in Europe (preliminary results)

Country Name	Property Name	Primary Commodity
Greece	Mount Parnassos region (10 sites)	Bauxite
Greece	Mount Giona region (13 sites)	Bauxite
Greece	Olympias	Mixed Sulphuric Compounds
Greece	Mavres Petres	Mixed Sulphuric Compounds
Greece	Evoia's sites	Ferrous nickel ore
Greece	Agios Ioannis (4 sites)	Ferrous nickel ore
Greece	Kastoria (3 sites)	Ferrous nickel ore
Ireland	Navan Tara Mines	Zinc
Poland	Lubin	Copper
Poland	Polkowice-Sieroszowice	Copper
Poland	Rudna	Copper
Poland	Pomorzany	Zinc
Portugal	Panasqueira	Tungsten
Portugal	Aljustrel	Zinc
Portugal	Neves-Corvo	Copper
Romania	Rosia Poieni	Copper
Romania	Manaila	Polymetalic
Romania	Baita Plai	Polymetalic

In Operation Metal Sites in Europe (preliminary results)

Country Name	Property Name	Primary Commodity
Slovakia	Horná Ves	Precious Metals (Silver)
Slovakia	Banská Hodruša	Precious Metals (Gold, Silver)
Slovakia	Nižná Slaná	Iron
Spain	Los Santos	Tungsten
Spain	Atalaya Mining (Rio Tinto)	Copper
Spain	Las Cruces	Copper
Spain	MATSA Aguas Tenidas, Magdalena, Sotiel	Copper
Spain	El Valle-Boinás/Carlés	Gold, Copper
Spain	Pacific Strategic	Tin, Tantalum
Spain	Minera del Duero (Barruecopardo)	Tungsten
Sweden	Boliden Area (4 mines)	Zinc, Lead, Copper
Sweden	Garpenberg	Zinc, Lead, Copper
Sweden	Aitik	Copper
Sweden	Lovisa	Zinc
Sweden	Gruvberget(Svappavaara)	Iron Ore
Sweden	Leveäniemi (Svappavaara)	Iron Ore
Sweden	Kiruna	Iron Ore
Sweden	Malmberget	Iron Ore
Sweden	Zinkgruvan	Zinc, Copper
Sweden	Bjorkdal	Gold
UK	Drakelands	Tungsten

Clarifications in Operation Metal Sites in Europe

- Years of collected data : **2015, 2016, 2017**
- **Site** is all land at a distinct geographic location under the management control of an operator (glossary from MWEI BREF)
- Metal mines producing **ore only as additives** for chemical, pharmaceutical or cement industry **are not covered**, for example:
  - Iron ore mines in Germany
  - Magnesite
  - Potash minerals
- Beneficiation plants using imported ore are not included in the figure, but are covered in Task 3:
  - France Alumina Plant at Gardanne
  - Ireland Aughinish Alumina Ltd

Data gathering process

Conflicting information from different sources

- Presentation of different output for the same metal mine, from the same source in different annual newsletter

USGS, 2014

TABLE 1
BULGARIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity[2]		2010	2011	2012	2013	2014
METALS						
Aluminum, metal, secondary		12,257 [r]	10,263 [r]	--	--	--
Bismuth, metal	kilograms	2,179	4,191	--	--	--
Cadmium, metal, smelter		457	428	360	411	382
Copper:						
Ore:						
Gross weight	thousand metric tons	27,581	28,214	26,700 [r]	25,600 [r]	24,600 [e]
Concentrate, Cu content		81,009	84,535	78,653	75,307	72,419

USGS, 2016

TABLE 1
BULGARIA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise noted)

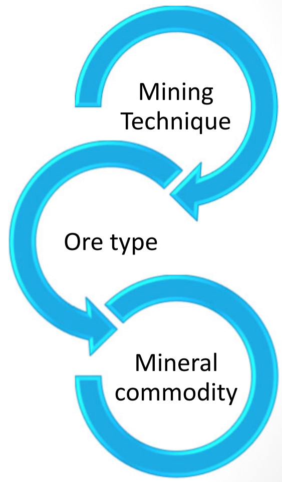
Commodity[2]		2012	2013	2014	2015	2016
METALS						
Aluminum metal, secondary		8,538	8,071	7,537	8,620	9,445
Bismuth, refinery production, metal	kilograms	4,750	5,156	5,042	4,280	4,300 [e]
Cadmium, refinery production, primary, metal		360	411	382	340	362
Copper:						
Mine production:						
Gross weight, ore	thousand metric tons	18,987	18,119	18,250	17,628	17,643
Concentrate, Cu content		78,653	75,307	72,419	71,748	70,573

Correlation of the findings and Estimation of the amounts of EW

Every metal mine is almost unique and, therefore,
- the type,
- the amounts
- the characteristics

of the extractive waste differs, depending on the **deposit**, the **geology**, the **choice of mining technique** (open-pit vs underground) and the **process technology** applied for the mineral processing

The metallic minerals extractive sites have been divided into groups in order to facilitate the calculation process, in:
- **Open-pit mines and underground mines**
- **Ore type**
- **Mineral commodity**



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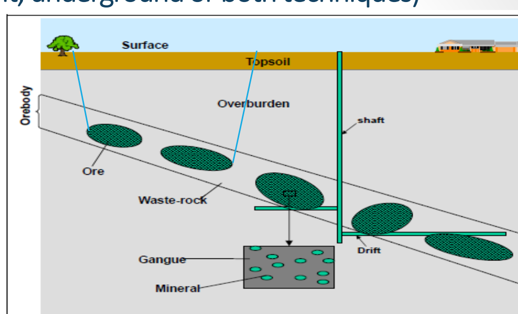
Mining technique (open pit, underground or both techniques)

Open pit

Rock = Excavated Material = Topsoil + Overburden + Waste Rock+ Ore

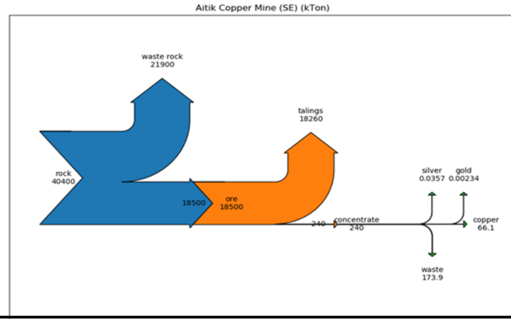
From MWEI BREF: *The part of the co-excavated materials or co-processed materials which is not sold or further processed will constitute **an extractive residue.***

Waste rock The material that extractive operations move during the process of accessing an ore or mineral body



Source: (EC-JRC 2009)

Aitik Copper Mine (SE) (kTon)



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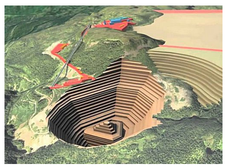
Mining technique (open pit, underground or both techniques)

Open pit



- In order to reach the mineral top-soil, overburden and waste rock should be extracted
- According to MWEI BREF a stripping ratio for open pit varies from **2:1 to 8:1**, depending primarily on the geometry of the deposit
- time reference and the ore characteristics are important factors for calculation

Example

According to the Technical Report published for Atalaya (Rio-Tinto) for 2017 the ore mined is reported as 9.3Mt and the waste mined 19.8Mt, respectively.

Taking into consideration the stripping ratios from MWEI BREF the following apply

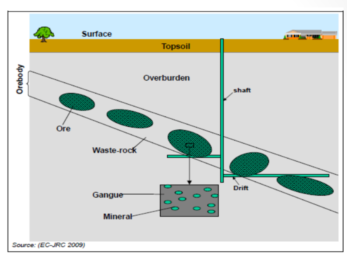
Ratio	Excavated Material
2:1	18,600,000 t
3:1	27,900,000 t
4:1	37,200,000 t
5:1	46,500,000 t
6:1	55,800,000 t
7:1	65,100,000 t
8:1	74,400,000 t

19,800,000t was reported by the company

Mining technique (open pit, underground or both techniques)

Underground

According to MWEI BREF for underground extraction a stripping ratio will usually be less than 0.5:1



Example

According to data provided by the company Delphi Distomon (Mytilyneos S.A.) the average **production** for 2015, 2016 and 2017 of **bauxite was 636,399 t** and the **generation of extractive residue was 316,703t**.

Production of extractive residue provided by company

Average = 316,703t

Realistic result

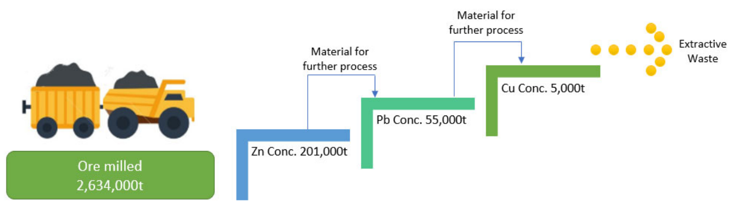
Calculated Extractive residues (stripping ratio 0.5:1)

Average 318,199t

Correlation of the findings

Potential obstacles for Task 3

- The provided data typically are given for a group of mines and not per individual mine
- Estimation of the amount of extractive waste from the extractive material
- Classification of the tailings as hazardous or not-hazardous
- Inaccurate results for polymetallic minerals



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Correlation of the findings

Examples of Assessment

Austria: (Erzberg - VA Erzberg GmbH)

Corporate Website
- Open pit mine
- Rock :12 Mt/y
- Ore:3 Mt/y

USGS (average 2015, 2016, 2017)
- Gross weight: 2,65 Mt
- Fe Content

Assessment
- Extracted Residues = 9Mt/y
- Processing waste = 346kt

- Most of the information are provided and this example does not include hypothetic scenarios
- From the total Extracted Residues 9,000,000t which quantity shall be used under **the waste code 01 01 01 wastes from mineral metalliferous excavation?**
- **Which code is best suitable for the tailings?**

  a) 01 03 05* other tailings containing hazardous substances

  b) 01 03 06 tailings other than those mentioned in 01 03 04 and 01 03 05

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Correlation of the findings

Examples of Assessment

Sweden: Svappavaara (Gruvberget and Leveäniemi) , Kiruna, Malmberget – LKAB

- From the technical report “2016 Annual and Sustainability Report - LKAB”

MINE PRODUCTION

CRUDE ORE MILLION TONNES	PRODUCTION BY OPERATING LOCATION		
	Kiruna	Malmberget	Svappavaara
2016	26.9	16.4	6.1
2015	26.1	16.3	4.6

Svappavaara (**open pit**):
Extractive Residues = from 10,000,000t to 42,000,000t

Which result is realistic?
Which quantity is under the waste code 01 01 01?

Malmberget (**underground mine**):
Extractive Residues = 8,200,000t
From this which quantity belongs to the waste code 01 01 01?

**01 01 01 wastes from mineral metalliferous excavation*

Correlation of the findings

Available data vs Degree of data reliability

MS	# Sites	# Sites with data	excavated material (t)		Ore production average (t)	Conentrate production (t)	Estimated extracted Residue (t)	Tailings from processing (t)	Tailings Waste Code	Degree of data reliability
			min	max						
Austria	2	2	12,400,000	16,500,001	6,546,760	2,657,203	7,453,240	3,889,557	01 03 05* or 01 03 06	Average
Bulgaria	20	4	51,000,000	71,000,000	18,255,750	1,167,480	53,832,520	17,088,270	01 03 07*	Poor
Cyprus	1	0			1,250,000	550,000		700,000	01 03 07*	Poor
Finland	11	9	30,000,000	83,000,000	12,461,018	3,028,718	32,538,982	9,432,300	01 03 07*	Average
France	1	1			927,500	350,000		577,500	01 03 09 or 01 03 10*	Average
Greece	10	9	13,781,406	29,506,406	3,601,568	64,287	18,042,338	171,678	01 03 05* or 01 03 06	Good
Ireland	2	1	3,555,500	3,555,500	7,557,267	2,241,333	1,185,167	5,315,933	01 03 07* and 01 03 09	Average
Poland	4	4	45,210,000	46,260,000	30,140,000	1,973,600	15,070,000	28,166,400	01 03 07*	Average
Portugal	3	2	4,103,550		2,735,700	140,156	1,367,850	2,595,545	01 03 07* or 01 03 06	Poor

Correlation of the findings

Available data vs Degree of data reliability

MS	# Sites	# Sites with data	excavated material (t)		Ore production average (t)	Conentrate production (t)	Estimated extracted Residue (t)	Tailings from processing (t)	Tailings Waste Code	Degree of data reliability
			min	max						
Romania	3	*	27,500,000	82,500,000	9,166,667	na	45,833,333	na	na	Poor
Slovakia	3	0	na	na	na	na	na	na	na	Poor
Spain	9	6	57,336,161	65,177,395	25,790,607	2,664,196	31,545,554	23,126,411	01 03 05* or 01 03 06 or 01 03 07*	Poor
Sweden	13	11	220,972,500	236,177,500	110,162,667	27,841,333	110,809,833	82,321,334	01 03 05* or 01 03 06 or 01 03 07*	Average
UK	1		2,085,000	6,255,000	695,000	5,000	1,390,000	690,000	01 03 05* or 01 03 06	Poor

* The calculations are based on the Romanian total production of gross weight of copper

Conclusions – Future Targets

- The provided data are predicted quantities of extractive residues and tailings taking into consideration some data which are available publicly
- The next steps of the task 3, with the support of the other tasks of the project are to investigate further:
  1. The yearly ore production
  2. Critical parameters for calculation of the extractive waste
  3. incorrect calculations for the amount of waste generated (incorrect stripping ratios or ore grade)

vito

SUPPORT EWD

TASK 1.6: OVERVIEW OF IMPORTED MATERIALS THAT MAY GENERATE EXTRACTIVE WASTE WHEN PROCESSED

- Usually not clear to give correct interpretation and to deduce how many imported materials relate to **excavated material** and not to already **processed material**. How to derive extractive waste from it?
- "Aluminum": no big Bauxite mines anymore in MS? Most of bauxite/Al_2O_3 imported?
- We will estimate import from outside the EU28. But also between MS?

- QUESTION:
  - What are the most relevant imported ores in your country? Are these ores subsequently processed or further exported?

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Task 3: In Depth description of waste generated during the extraction of metallic mineral ores

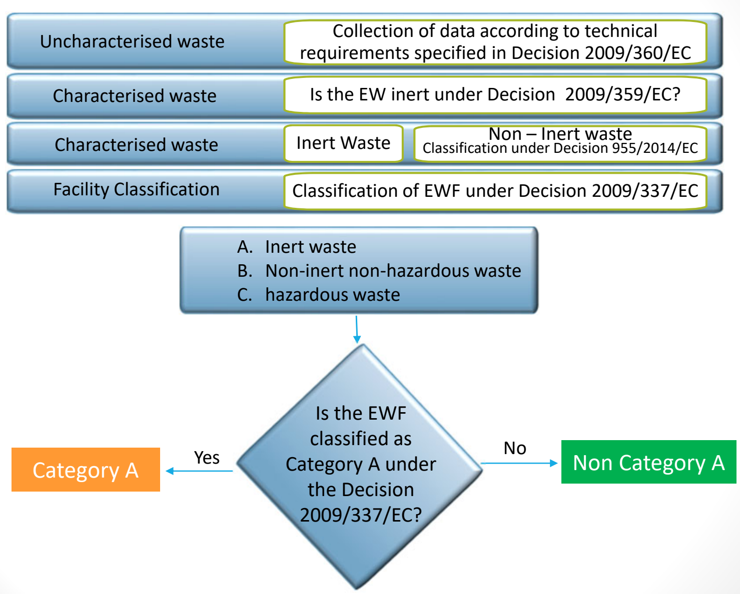
Identification of Category A facilities linked to the extraction of metallic minerals ores

ENV.B3/ETU/2017/0039

Expert meeting on the preliminary findings of the study

11 April 2019

Extractive Waste Characterisation & Legal Requirements for EWF



A waste facility shall be classified under category A if:

- a failure or incorrect operation
  - If the predicted consequences in the short or the long term of a failure due to loss of structural integrity, or due to incorrect operation of a waste facility could lead to: (a) non-negligible potential for loss of life, (b) serious danger to human health and (c) serious danger to the environment
- It contains waste classified as hazardous under Directive 91/689/EEC above a certain threshold
  - Ratio = all hazardous waste deposited in the EWF/waste expected to be present in the end of planed period
  - Where the ratio > 50 %, the facility shall be classified as Category A
  - Where the ratio is between 5 % and 50 %, the facility shall be classified as Category A. (However EWF may not be classified as Category A where it is justified on the basis of a site specific risk assessment)
  - Where the ratio < 5% the facility is not to be classified as Category A on the basis of the contents of hazardous waste
- it contains substances or preparations classified as dangerous under Directives 67/548/EEC or 1999/45/EC above a certain threshold
  - for each substance and preparation, the yearly quantities used in the process shall be estimated
  - for each substance and preparation, it shall be determined whether it is a dangerous substance or preparation within the meaning of Council Directive 67/548/EEC and of Directive 1999/45/EC
  - for each year of planned operation, the yearly increase in stored water (ΔQi) within the tailings pond shall be calculated under steady state conditions
  - for each dangerous substance or preparation identified in accordance with point (c), the maximum yearly concentration (C max) in the aqueous phase shall be estimated according to the formula set out in Annex II.

Identification of EWF in the Task 3

Criteria for classicisation	**Is it possible to be assessed?**
Loss of structural integrity	✗
Characteristics of the waste deposited in the EWF (*e.g. slurry form*)	✓
Identification of the waste category (*e.g. hazardous entry*)	✓

Identification of EWF in the Task 3 (preliminary assessment)

- From the gathering data process:
  - 3 Category A Facilities (in Spain, Greece, Poland)
  - 17 Non Category A Facilities (in Spain, Greece, Austria)

- Although the above number is not realistic with the number of extractive sites in Europe, since one EWF may accommodate waste from two or more sites for example:
  - Hellas Gold S.A. owns the EWF “Kokkinolakkas”, which is a Category A Facility that hosts extractive waste from the two sites Mavres-Petres and Olympiada
  - KGHM Polska Miedź SA owns the Żelazny Most" Waste Facility - Category A, and the extractive waste comes from three sites Lubin, Polkowice-Sieroszowice and Rudna

Conclusions – Future Targets

- The provided data are preliminary findings of the hazardousness of some extractive waste and consequently to EWF classification
- The next steps of the task 3, with the support of the other tasks of the project are to investigate further:

  1. The realistic risk from the deposition of extractive waste
  2. Critical parameters of the extractive waste deposited
  3. Data concerning the form of extractive waste deposition

TASK 4: IDENTIFICATION OF CATEGORY A FACILITIES NOT LINKED TO THE EXTRACTION OF METALLIC MINERAL ORES
LEAD PARTNER: EUROMINES

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TASK 4: IDENTIFICATION OF CATEGORY A FACILITIES NOT LINKED TO THE EXTRACTION OF METALLIC MINERAL ORES LEAD PARTNER: EUROMINES

OBJECTIVES

- Identifying the remaining Category A facilities, which may be associated with the extraction of aggregates, other construction minerals, industrial minerals and energy minerals.

Activities:

- Developing a tool comprising a simplified risk evaluation methodology and check-list that will allow this Study to identify Category A facilities for the non-metallic extractive materials and their waste facilities that should have Category A classification, including any that have not been permitted as such. The risk evaluation and the check-list includes all criteria laid out in the directive and the corresponding Commission decision.

European Association of Mining Industries, Metal Ores & Industrial Minerals www.euromines.org 78

Workshop targets

- To arrive at a common understanding of the key criteria for assessing extractive waste on non-metallic mineral mines and quarries for identification of Category A facilities;
- To exchange with experts on the challenges in gathering data that allows independent identification of such Category A facilities by the VITO consortium;
- To gather input from experts on which non-metallic commodities may typically give rise to Category A facilities.

Assessing the minerals concerned EU 28 production data completed

- Aggregates
- Other construction minerals
- Industrial minerals
- Oil and gas
- Lignite
- Hard coal

Proposed CHECK-LIST

- Mine type (surface or underground)
- Type of mineral and prediction of waste arising or not
- Longitude & Latitude
  - ✓ Related seismic zoning
  - ✓ Related topographic slope
  - ✓ Proximity of water-courses
  - ✓ Proximity to settlements
  - ✓ Proximilty to Natura 2000 sites
- N° of EWFs
- N° of EWFs already reported as Category A

Proposed CHECK-LIST

- Ore(t) extracted & year
  - o Typical angle of repose of the ore
- Prod. Conc.(t) & year
- By-prod. Conc. (t) & year

- Waste(t) reported & year
  - o Hazardous Waste(t) reported & year
  - o Typical angle of repose of the resulting waste
- Applicable examples of BAT
- Associated reagents
- Associated REACH Authorisations

If Category A…

- • Art.6.2: Major-Accident Hazard Identification in;
  - - Design & Construction,
  - - Operation & Maintenance,
  - - Closure & After-care
- • Art.6.3: Emergency Planning and a Safety Management System

Aggregates

	Total Number of Producers (companies)	Total Number of Extraction Sites (Quarries and Pits)	Sand & Gravel (millions tonnes)	Crushed Rock (millions tonnes)	Marine Aggregates (millions tonnes)	Recycled Aggregates (millions tonnes)	Re-Used on Site (millions tonnes)	Manufactured Aggregates (millions tonnes)	Total Production (millions tonnes)
EU 28	**14106**	**24627**	**1036**	**1223**	**55**	**204**	**11**	**61**	**2590**

Industrial minerals

Commodity	EU 28 production in 2016 in t	Chemical composition	potential issues
Barytes	172.373	BaSO4	impurities in filterdust
Bentonite	2.237.079	silica (SiO2), alumina, (Al2O3), iron (Fe2O3), calcium (CaO) and potassium (K2O), sometimes sodium (Na2O), titanium (TiO2) and phosphorus (P2O5)	impurities in filterdust
Diatomite	279.131	SiO2 · nH2O (80–90% silica, with 2–4% alumina and 0.5–2% iron oxide)	impurities in filterdust/ respirable silica?
Feldspar	8.799.567	AT4O8 in which A = potassium, sodium, or calcium (Ca); and T = silicon (Si) and aluminum (Al), with a Si:Al ratio ranging from 3:1 to 1:1.	impurities in filterdust/ respirable silica?/ radioactivity?
Fluorspar	204.083	CaF2	flotation tailings?
Graphite	502	C	impurities in filterdust
Gypsum	21.417.803	CaSO4. 2H2O	filter dust
Kaolin	11.259.626	Al2Si2O5(OH)4	filter dust, tailings, TiO2 > 1%?
Magnesite	2.111.152	MgCO3	impurities in filterdust
Perlite	977.410	70–75% Silicon Oxide: SiO2,12–15% Aluminum Oxide:Al2O3, 3–4% Sodium oxide: Na2O, 3–5% Potassium Oxide: K2O, 0.5-2% Iron oxide: Fe2O3, 0.2–0.7% Magnesium oxide: MgO, 0.5–1.5% Calcium oxide CaO 3–5% .	impurities in filterdust
Phosphate	338.230	PO43-	flotation tailings?
Potash	3.826.372	Caustic potash or potash lye potassium hydroxide KOH Carbonate of potash, salts of tartar, or pearl ash potassium carbonate K2CO3 Chlorate of potash potassium chlorate KClO3 Muriate of potash (MOP) potassium chloride KCl:NaCl (95:5 or higher)[1] Nitrate of potash or saltpeter potassium nitrate KNO3 Sulfate of potash (SOP) potassium sulfate K2SO4 Permanganate of potash potassium permanganate KMnO4	filter dust
Salt	40.111.241	NaCl	filter dust
Sulfur	4.245.922	naturally occurring sulfur compounds include the sulfide minerals, such as pyrite (iron sulfide), cinnabar (mercury sulfide), galena (lead sulfide), sphalerite (zinc sulfide) and stibnite (antimony sulfide); and the sulfates, such as gypsum (calcium sulfate), alunite (potassium aluminium sulfate), and barite (barium sulfate).	filter dust
Talc	1.101.778	$Mg_3Si_4O_{10}(OH)_2$	filter dust, flotation tailings with metallic content?

Petroleum, oil shale and natural gas

Country	Oil in t	Oil shale in t	Gas in Mm3
Austria	809.189	169	1.253
Bulgaria	22 600		80
Croatia	684.000		1.680
Czech Rep.	116.000		169
Denmark	6.924.112		4.460
Estonia		15.857.700	
France	81.600	2.000	40
Germany	2.355.028	492.777	8.608
Greece	173.486		9
Hungary	732.702		1.823
Ireland			2.750
Italy	3.746.000		5.785
Lithuania	63.500		
Netherlands	1.273.800		47.463
Poland	957.050		5.073
Romania	3.801.000		9.811
Slovakia	9 490		93
Slovenia	379		4
Spain	139.176		6
UK	47.872.100		41.607
EU 28 total	69.729.122	16.352.646	130.714

Wastes from oil and gas

- Produced Waters account for 96 to 98 percent of all oil and gas wastes
- Drilling fluids account for about 2 to 4 percent of oil and gas wastes.
- Associated wastes are produced including well completion, treatment and stimulation fluids; sediment, water, and other tank bottoms; oily debris; contaminated soils; and produced sands. They amount to about 0.1 percent of oil and gas wastes.
- In addition, naturally occurring radioactive material (NORM) such as radium may also be brought to the surface with crude oil.

Production data for by-products

- Production data for by-product materials can be very difficult to obtain because often it is not recorded by the producing companies as they are focused on the primary products, which is of most importance to their business. Hence the data often simply does not exist. It can be difficult to track where a material has been shipped from/to for processing because it is often obscured in trade data by a description that does not mention the potential by-product.

TASK 6 – ORGANISATION COUNTRY VISITS

Brussels, 11th April 2019

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TASK 6: TECHNICAL SUPPORT TO THE COMMISSION FOR COMPLIANCE PROMOTION LEAD PARTNER: EUROMINES

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Task 6: TECHNICAL SUPPORT TO THE COMMISSION FOR COMPLIANCE PROMOTION
Dialogue with MS - Compilation of country fact sheets
LEAD PARTNER: EUROMINES

Objectives:

- to increase the understanding as well as
- to improve the reporting on the implementation of the Mine Waste Directive in the future.

Actions:

- an in-depth dialogue with Member States, in particular but not only on the classifications of waste disposal sites. This task intends to foster the compliance and uncover mistakes/ misunderstandings/interpretations or complications that might have led to incorrect permitting or reporting.

Task 6: TECHNICAL SUPPORT TO THE COMMISSION FOR COMPLIANCE PROMOTION
Dialogue with MS - Compilation of country fact sheets
LEAD PARTNER: EUROMINES

- Data collection and contacts with local authorities
- Organisation of
  - country visits to Bulgaria, Finland, Greece, Poland, Romania, Spain and Sweden and
  - telephone conferences foreseen in the project with the MS of the priority countries to be complemented physical meetings with the authorities of the mentioned MS to complete the discussions and collect additional relevant information where needed.
- Action foreseen in months 9-14.
- The other project partners will assist with visits/discussions and with country specific data and analyses.

Euromines will be responsible for the overall data collection, but the individual consortium partners will contribute based on their expertise

Country	Responsible partner	Country	Responsible partner
Austria	Wefalck	Italy	Wefalck
Belgium	VITO	Latvia	MEERI
Bulgaria	Euromines	Lithuania	MEERI
Croatia	Euromines	Luxembourg	VITO
Cyprus	Ecoefficiency	Malta	Euromines
Czech Republic	Euromines	Netherlands	VITO
Denmark	VITO	Poland	MEERI
Estonia	MEERI	Portugal	Euromines
Finland	MEERI	Romania	Total Business Land
France	Wefalck	Slovakia	Euromines
Germany	Wefalck	Slovenia	Euromines
Greece	Ecoefficiency	Spain	Euromines
Hungary	Euromines	Sweden	VITO
Ireland	VITO	United Kingdom	Euromines

Envisaged time lines for country visits

Bulgaria	May/June 2019
Finland	end of September/beginning October 2019
Greece	September 2019,
Poland	September 2019
Romania	May/June 2019
Spain	June 2019
Sweden	September 2019

DELIVERABLES

- Country Fact Sheets that provide an overview of the national mining sector, related waste management and the implementation of the Directive. They should be considered as a model response for a revised reporting from Member States.
- An update to the Commission's inventory of extractive waste facilities

Distribution: Restricted

Date :	31/03/2020	Ref.	RMA/1810454/IVK-BL-JB-PC/20200331
From :	Project Coordinator	Annexe(s):	
To :	EU Project Officer		
Copy (CC) :	Consortium		

Study supporting the development of general guidance on the implementation of the Extractive Waste Directive (EWD) – Minutes of the Technical Workshop

Service contract no. ENV.B3/ETU/2017/0039
When: 13 February 2020, 09:30 to 16:30
Location: VlEVA (Liaison Agency Flanders-Europe),
71 Kortenberglaan – 1000 Brussels, Belgium Brussels

LIST OF ACRONYMS

CEMBURAU	European Cement Association
DG ENV	Directorate-General for Environment
DG GROW	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
EC	European Commission
EW	Extractive Waste
EWD	Extractive Waste Directive
EWF	Extractive waste Facility
GTK	Geological Survey of Finland
IMA-Europe	Industrial Minerals Association Europe
JRC	Joint Research Centre
MS	Member State
OJ	European Commission Official Journal
PRODCOM	List of PRODucts of the European COMmunity 2017
TBL	Total Business Land
UEPG	European Aggregates Association

1. Attendees

- EC:
    - EC - DG Env.
    - EC – DG Grow.
    - EC – JRC

- Consortium
    - VITO
    - Eco-Efficiency
    - Euromines
    - MEERI
    - TBL
    - WEFalck

- Associations
    - CEMBUREAU
    - Eurogypsum
    - IMA-Europe
    - UEPG

- Member States (MS)
    - Austria
    - Croatia
    - Cyprus
    - Czech Republic
    - Estonia
    - Finland
    - France
    - Ireland
    - Italy
    - Latvia
    - Poland
    - Spain
    - Sweden

2. Welcome & objectives of the project (EC-DG ENV.)

EC-DG ENV. (chair) welcomed the delegates and explained the purpose of the meeting to the expert group on extractive waste.

The agenda of the technical workshop (TW; Annex A) stems from the March 2017 workshop that took place with Member States to explore potential issues of a harmonized interpretation of the Directive (to arrive at the correct number of Category A facilities). The 2016 Implementation Report from the Commission announces that "general guidelines" will be developed. Commission Guidelines provide interpretation of EU legislation and require a formal approval by the College of Commissioners. Therefore, the term "general guidelines" has been chosen to have more flexibility.

The outcome of the study supporting the development of general guidance on the implementation of the Extractive Waste Directive (EWD) will be a set of 27 Country Fact Sheets and a comprehensive listing of all metal mines in Europe including figures on material flows. These Country Fact Sheets will be presented and discussed at the final workshop on 14 May 2020 (VLEVA, Brussels).

DG Environment would like to use the Country Fact Sheets as the basis for a new reporting questionnaire for Member States in order to get a more complete picture of the extractive waste (EW).

The slides to stear the discussions during the workshop are given in Annex B. The background document of the TW was sent to those who accepted the invitation of the Technical Workshop.

3. Implementation of the Extractive Waste Directive

3.1 Definition of reactive waste

A short introduction is given by Eco-Efficiency.

The definition of reactive waste has been raised by Member States and the consortium asked Member States a series of questions (see slides Annex B).

→ Discussion:

Ireland: ‘reactive waste’ is generally considered during permitting (initial or renewal). If authorities are required to consider it on a more continual basis, that would raise a series of questions about how often etc.

IMA-Europe: Hazardous-non-hazardous criteria are known in the legislation. It would be better to ask what criteria are used to decide whether “hazardous - non-hazardous” waste is reactive or not. Furthermore, the issue of reactive waste is not relevant to industrial minerals. The legislation criteria are hazardous,......

Eco-Efficiency: The first question would be, whether the term “reactive waste” is used. Some MSs use the term and others do not.

Sweden: Also confused by the first question. For Sweden, the categorization of extractive waste facilities (EWFs) contains three indents. The first indent combines both consequence of loss of structural integrity and incorrect operation. Only the second indent refers to hazard classification. So, reactive waste should only be considered when assessing consequences of ‘failure’, which is actually independent of hazard classification. Irrespective of hazard classification, reactive waste can affect structural integrity and/or consequences of ‘failure’. In Sweden, most reactive waste tends to be acid generating wastes, but in other MSs they may be reactive in other ways. Reactive waste can either be hazardous or non-hazardous. Even COM DEC 2009/337/EC states that potential hazards of EWFs containing reactive wastes “regardless of the classification of the waste as hazardous or non-hazardous”.

***DG ENV:** “What are the most common/important kinds of reactive wastes in your country/sector? How does Sweden ensure correct operation of EWFs containing acid-generating waste over time?*

Sweden: The potential for acid-neutral metal leaching is evaluated as well as how best to manage the waste in the EWF over the short and long term.

IMA-Europe: The acid generation potential is assessed whether the waste is hazardous or not, without necessarily using the term "reactive waste".

DG ENV: "Is the same evaluation done for residues placed back into voids".

Ireland: The term "reactive waste" is not used, but aspects of reactivity are included in the hazard classification of the wastes in Europe. Backfill is a product (as is concentrate), which is designed for use in the void through analysis of its composition and its behaviour *in-situ* (e.g., in combination with cement) and is therefore not classified as waste (hazardous or non-hazardous).

DG ENV: "If backfill is not a waste, what about the use of additives (e.g. fly ash or cement). You might argue, for example, that a cement additive raises or neutralizes the pH of the raw backfill. Is the behaviour of the backfill in use assessed? Do you evaluate whether criteria for contruction materials have been met or not?

Ireland: The first crucial product criterion for backfill is physical stability. It must be physically stable to enable continued mining of ore. So, such physical stability (e.g., compressive strength testing) is definitely assessed. From a chemical perspective, Ireland is fortunate in that backfilling takes place within a limestone bedrock (Ca/Mg carbonate), so acid generation is not likely to either take place or cause impacts in such geological conditions. At two recently closed mines, the voids have been flooded and monitoring wells have been installed within the mine workings and around the mine and no evidence of a groundwater plume has been found. For all these reasons, the composition of backfill as a product is very important.

Austria: Agrees with Ireland. When backfill is considered as a product, it must fulfil certain product criteria. In Austria, these criteria are set by the Ministry of Environment, so any backfill must not cause environmental harm in use. For example, at the Austrian tungsten mine, the mineralogy of the scheelite ore is such that contaminant release is not an issue. If however, part of the extractive material will be applied as backfill material (with or without additives), the product has to meet certain standards for application as backfill.

DG ENV: According to the discussion it is difficult to judge whether sufficient attention is paid by MSs to the potential risks posed by reactive waste.

Spain: The issue of reactive waste is very important to Spain and Spain would be interested in an harmonized approach.

Eco-Efficiency: On the one hand we may have waste, on the other hand we may have a backfill product. In both cases, we categorise the material using waste codes? Do the product criteria include application of the Classification, Labelling and Packaging Regulation? [**Note:** backfill produced and used on site may fall under CLP considering worker exposure].

Austria: "thermodynamically unstable" is not really a helpful phrase in the current definition, but the issues raised by Sweden are what needs to be addressed. Even limestone is thermodynamically unstable on geological timescales.

DG ENV: "Do we really need the "reactive waste" term? It seems to come from US EPA with reference to general waste streams. Do we have enough with the definitions "hazardous – non-hazardous" and "inert-non-inert""

Sweden: "Reactive waste" is not only relevant for structural integrity, but also for evaluating incorrect operation. For example, in the case of acid generating material, you need to ensure that you have appropriate measures in place and operated correctly. If we were to rely only on the hazardous/non-hazardous classification, how would you ensure correct long-term operation of EWFs containing non-hazardous waste?

Euromines: Does correct characterization of the waste (e.g., according to the available CEN standards) cover these issues without needing the term "reactive waste"?

IMA-Europe: "Reactive waste" seems to refer to delayed risks, which are already referred to in the legislation. Do we rather need a specific requirement to address the acid generating waste? According to the "Decision 1357/2014/EE; HP 15", MS may characterise a waste as hazardous by HP 15 based on other applicable criteria, such as an assessment of the leachate. The latter referring to delayed risks.

3.2 Major accident prevention

A short introduction is given (Ireland). The perspective of the Irish Inspector is that Ireland has transposed the requirements of the EWD *verbatim* into operators' licences and the EWMP required therein. Major Accident Prevention Policy is required when dealing with Category A tailings facilities (e.g., Auguinish alumina plant) and usually features in a general section on incidents, accidents and emergency planning. External Emergency Planning documents are short and high-level for the public (e.g., 2 pages, Annex C). The licence also requires that a safety management system and safety manager be in place. Annex I of the Directive specifies all the elements that need to be taken into account. The Irish EPA has also published guidance on management of waste from the extractive industries.
https://www.epa.ie/pubs/advice/waste/extractive/Guidance-On-The-Waste-Management-Regulations-2009-WEB.pdf

The Irish EPA suggests it would be good to have a little more guidance on Safety Management Systems and what constitutes an adequate Safety Manager. The Irish guidance can be used as an example.

→ Discussion:

DG ENV: "Do other Member States have guidance on safety management systems for EWFs?"

Austria: In Austria, the authorities are aware when an EWF becomes a Seveso site and all the associated information is published on the internet in German. Austria has general safety management guidance pertaining to all sectors including mining (also available on the website).

Sweden: The Swedish Civil Contingency Agency is responsible for guidance on and inspections of safety management at Category A EWFs and Seveso sites. Although Sweden has extractive industries classified as Seveso site, the Agency is not aware of any EWFs in Sweden that fulfil the criteria for falling within the scope of the Seveso III Directive.

DG ENV: Does Annex I add value to what Sweden already has in place on national level?

Sweden: Will respond to this question later on, after the technical workshop.

Ireland: There is one Category A EWF that is also a Seveso site in Ireland. Safety aspects are the competence of the COMA agency and they must notify the EPA, if they determine an EWF to be a Seveso site since their permit is reviewed by the EPA.

3.3 Interpretation of CEN standards on sampling of extractive waste and implications for the characterisation of waste

A short introduction on the existing CEN standards and their field of application was given by Euromines. Attention was hereby given to the fact that the CEN standards are not freely available, but need to be purchased.

→ **Discussion:**

DG ENV: Are these standards picked up? by the MSs?

Austria and Sweden have bought the standards. In Ireland, the purchase of the standards rests with the companies.

Sweden: Sweden has bought the standards and refers to the official mandate given to the CEN by the Commission (Annex D), which states that the standards will be made available to the Commission in three languages and published in the Official Journal – and asks whether the Commission has now published them and made them available.

DG ENV: Need to clarify the exact details of the mandate. Perhaps this requirement of the mandate refers only to the "standards", rather than the Technical Reports. After checking, DG ENV confirmed that publishing of the standards is not the routine. What is published in the OJ is a statement that the prepared standards have met the mandate.
DG ENV asked whether it should use its mandate to make the use of the standards mandatory.

Ireland: Ireland relies on the companies to use them as it is them that are responsible for the characterization. Ireland has noticed them in the hands of companies applying for licences.

Euromines pointed out that there are standards, technical reports and technical specifications.

3.4 Inventory & rehabilitation of closed and abandoned EWFs

A short introduction was given by WEFalck. It is mportant to note that there is a considerable difference between MSs. Italy reported several hundred EWFs, while some MSs known to have had significant mining activities claim to have "0" EWFs under Article 20. This discrepancy may be the result of a definition problem. What is meant by abandoned or closed EWFs respectively? See further §4.4.

→ Discussion:

Poland: The authority responsible for the inventory (i.e. Polish Geological Institute) is not present at this meeting. The inventory was prepared following a methodology developed to prepare it. A possible future review of the inventory is now under discussion. Most sites in the inventory are really considered to be abandoned in the past, so it does not include sites with remaining permits or identifiable owners.

Finland: when the first inventory was prepared, the EU Guidance was used. Now, two projects have been undertaken by GTK (Geological Survey of Finland), which concluded that there was not enough information available to determine whether all the facilities meet the "seriousness" criterion. The first inventory, based on sites that have the potential to meet the "seriousness criterion", included 53 EWFs (revised later to 41 mine sites). Subsequently, 11 facilities that were confirmed to contain inert waste were removed from the inventory. Presently, some budget has been set aside for investigation of the sites to further confirm whether they belong on the inventory or not.

DG ENV: What does it mean to be listed in the inventory? What follow-up is being undertaken?

Finland: GTK has provided recommended follow-up actions – mostly related to investigation to generate information about the contents of the EWFs in the inventory. With respect to rehabilitation (*this is the term used in the EWD etc.)* strategies a guideline on a risk-based approach will be published in 2020.

WEFalck: many MSs found that they did not have sufficient information at hand to be able to decide whether the "seriousness" criterion would be met or not.

Euromines: Hungary has created a state-owned organization, with budget, for prioritized risk assessment and rehabilitation of the abandoned sites. The larger rehabilitation projects require large budgets that are difficult to raise.

WEFalck: Romania went through a similar exercise, but it is not apparent that anything further has been done since 2017.

MEERI: In Poland, the landowner can differ from the owner of the tailings, which also hampers rehabilitation.

Eco-Efficiency: The Greek inventory includes some sites that are officially owned by government ministries, local authorities or private individuals. This complicates efforts to rehabilitate/remediate. The problem of who must authorize the remediation/ rehabilitation (and/or pay for it) seems common to many Member States.

Ireland: Article 21 is where rehabilitation is referred to in EWD. The EWD does not require rehabilitation, but rather an exchange of information on rehabilitation information and methodologies. Ireland used the EU Guidance to rank abandoned sites and prioritise them for listing in the inventory. The "seriousness" criterion was to be chosen by MSs and reflected in the risk-based methodology that they chose to use. Reasons for not applying Art 20 – 21 are lack of budget and the fact that measures have to be implemented for ever. The costs to rehabilitate some of these sites are very large. Is there any EU funding available? Ireland works on abandoned sites on a reactive basis due to lack of staff to undertake a proactive approach. One site has required €50M of works to collect mine drainage from the site, treat it and contain the generated treatment residues.

DG ENV: What recommendations do you have to update the inventories on abandoned or closed EWF?

Ireland: If Member States wish to update their inventories, it might not be useful to repeat the previous exercise using the same EU Guidance. You will get the same list. It might be better to update based on known changes at the listed sites. E.g., authorities may be aware of sites that have been rehabilitated or where conditions have deteriorated.

DG ENV: Yes, remediation cost is an elephant in the room, but inaction also comes at the cost such as reduced public acceptance of new mining project. Some EU Regional Structural Funds are available for rehabilitation of publicly owned sites. Member States tend to prefer their use for new construction/infrastructure projects over and above rehabilitation of historic legacies.

Austria: The Waste Framework Act in Austria covers these sites in Austria. In most cases, the sites present a mixture of extractive and metallurgical wastes, for which different authorities are responsible. A fund has been raised, which is a work in progress. Austria finds the EU Guidance valuable, but Austrian work to evaluate, prioritise and list abandoned sites started in the 1990s and so Austria has the luxury of a large data set. Austria understands that the general requirements of Article 4 of the EWD apply to any site listed on the inventory and that this in turn requires action ("measures"). Funding is, however, the problem. Most sites no longer have a private owner, so they are under the responsibility of the State.

WEFalck: What would be a reasonable frequency for reviewing the inventories? Would three years be too short? How long does it take to raise funds? How long does it take for actions taken to have effects? What about climate change?

Euromines: How long does it take to develop such an inventory or assess all sites listed? Rehabilitation of sites can take anything from 3 to 25 years.

Finland: To gather questions to answers and discuss differences could take 2-3 months.

Austria: When there are new sites to add to the inventory, their initial investigation also takes time. A reasonable time frame is at least 5 years.

Ireland: Modelling future effects of climate change is extremely difficult. Anyway, you are most likely to go back again and again to your top priority sites.

4. Reporting and statistics

4.1 Reporting within the Member States

A short introduction was given by VITO.

→ Discussion:

Austria: The most important thing is for authorities competent for mining to work together with authorities competent for statistical reporting. In Austria, the authorities work together to ensure that the most reliable figures are reported. In Austria, there is no legal requirement for companies to provide such data. In the future, operators will be obliged to enter annual statistics into a digital database (unless the legislation does not pass).

MEERI: After a search conducted country by country, only brief general information on EWMPs was found. No detailed information on different categories of extractive waste is given. EUROSTAT data relates to waste from the mining sector in general, not only to the extraction of minerals.

Finland: In Finland, the National Institute of Environment is responsible for centralising the statistics and reporting to the EU. They send annual questionnaires to authorities competent for permitted EWFs. The Chemical Safety Institute also includes waste rock in their statistics, but not topsoil and often extractive waste is reported together with non-extractive waste. Finland is also running some digitalisation programmes.

IMA-Europe: The definition of “extractive waste” in the EWD is broader than the definition of “waste” in the statistics. This already produces substantial differences, because the statistics include large volumes of manufacturing wastes.

Ireland: The first thing you see on Eurostat website, is a statement that “major mineral waste” is excluded from the statistical reporting obligations of Member States. So, that immediately makes it difficult to access data on extractive wastes. There is no related statutory requirement. Therefore, companies are often not required to report extractive waste volumes.. The companies have lists of tonnages against waste codes as per the EU Waste Catalogue.

MEERI: “Major mineral waste” is usually excluded because it blinds the data from other waste streams. But, in Poland, the statistical office collects data from the “mining” sector every other year.

Croatia: Croatia collects waste statistics on an annual basis by waste code, but with no distinction of source sectors. Every second year, the data are aggregated in a report to Eurostat according to the statistics regulation. Quarries for architectural and building stones can hardly distinguish waste from product. Officially, very low quantities of waste are reported, so some estimation is usually required.

DG GROW, upcoming policy initiatives:

- EU Industry Strategy coming up beginning of March to be accompanied by a Circular Economy Action Plan 4 March.

- The publication date for the 2020 CRM list is not exactly known yet, but still is aiming for the first quarter of 2020.
- Principles for Sustainable Extractive Activities: reminder to please come back with any comments you may have by next week.

DG GROW and JRC:

- expect to produce fact-sheets that identify main environmental impacts and technologies to lessen them as well as guidance on what should be included in EIA studies.
- continue to improve PRODCOM statistics (i.e., approximately 100 new product codes).

4.2 Decentralisation, capacity, frequency and updates and contacts for reporting and feedback per MS

A short introduction was given by VITO and Euromines.

→ Discussion:

Austria: Local competent authorities have no budget for things beyond legal reporting requirements. Federal Ministries do not have dedicated budgets either, but they are doing what they can (to answer questionnaires from the Commission, for example). Nevertheless, if the task is too extensive, also the Federal Ministeris will not be able to provide all required information.

Ireland: Agrees with the Austrian comment.

Euromines: In the early years, the question was, whether the EWD had been implemented. Does the information gathered according to the EWD adequately fit the purpose to demonstrate progress in the industry? Adaptation is difficult to avoid, because it reflects strategic national decisions about how to implement the EWD, but even the relatively simple table in Annex III of the reporting COM DEC is interpreted differently by MSs. Can some things be harmonised?

Euromines: The industry has an interest in improved reporting by MSs and DG ENV.

MEERI: Statistics for sectors with less than three entities and operations with less than nine employees cannot be gathered or released by the Statistics offices.

Austria: The Commission could provide the MSs with a list of wastes that it considers to be within the scope of the EWD and which the authorities could rely on for legal certainty.

DG ENV: Current statistical regulations do not allow the distinction of “extractive waste”. Eurostat insists very much on continuity to be able to compare data over years and will not agree to modify indicators or codes to capture things that might turn out to be short-term phenomena. Absolute quantities of waste will not say much about the implementation of the EWD. They are more relevant to raw materials policy than to environmental law. DG ENV is interested in discussing potential impacts from handling the same materials (whether they be considered waste or not by individual competent authorities). At the same time, according to the current one-in-one-out policy of the Commission, we cannot increase the mandatory reporting burden on the sector. This study aims to at least provide a single snapshot of the sector. DG ENV would prefer to think and speak as closely as possible to the way the industry does and hopes that the VITO-consortium will recommend useful things that can be done in response to the picture that is being formed. The triannual reporting format is a legally binding implementing act, so the Commission cannot simply add questions. Additionally, any change must be notified 12 months in advance, which means that any change to the COM DEC could only yield new information after a period of five years. Only guidelines on how to fill in the questionnaire are possible. After submission of the final report the need to adjust the questionnaire and the way in which possible adjustements can be conducted can be discussed

Euromines: Would a five-year transition period be such a show-stopper given that the mining sector does not change so dramatically from year to year?

DG ENV: This can be considered pending the results and recommendations of the study, but it is not possible to have a new questionnaire already for the next reports, which will be due in 2021.

MEERI: Perhaps Circular Economy policy provides opportunities to gather data differently. For example, we have seen that some of the tailings produced in Europe come from re-processing of old tailings.

Euromines: This is not just about correct counting. We have also seen MSs requiring placing back of material into excavation voids in order to achieve Circular Economy goals.

WEFalck: What does Eurostat do, if its statistics are comparable over time, but are not tracking the desired trend? Perhaps it is worth collecting information on where current statistics are used and/or what information is needed for what purpose.

DG ENV: Developing a new reporting COM DEC is a possible follow-up action of this study. The Commission is open to hearing any related recommendations from the study group. Up to now, we are not collecting the data necessary to assess the implementation o fthe extractive waste directive.

Poland: It is questionable whether we can collect the required data on the mining sector with the current set of available waste codes.

Eco-Efficiency: Is there any MS that is collecting “real” data and how do they use it? E.g., for decision or policy making?

MEERI: Since 1989, environmental fees are paid for all releases to the environment, which therefore generates data in a financial form. It may not necessarily be connected yet to the EU waste codes.

Ireland: There are loads of data. One could drown in the data, but what is the objective? We do not want any more tailings failures. So, data on engineering and structural integrity of tailings facilities should be the priority. A second consideration might be indicators of any leakage of contaminants from tailings into the environment. The key question should be, what is the objective of any reporting?

Euromines: Otherwise, the study group is collating the set of 27 Country Fact Sheets, which will be released for comment one by one as they are completed. MSs should have a complete set well before the 14 May Workshop. DG ENV intends to publish them on the JRC Raw Material Information System (RMIS), so MSs need to give their approval for that.

DG ENV: Expects that the Fact Sheets will form part of the final study report, which is routinely published in the EU Book Store with an ISBN number. Current versions of the Fact Sheets contain data that cannot be published (e.g., personal contact details). Thus, the final report (ISBN publication) will need to comply with all data protection laws including those regulating confidential business information.

4.3 Member States waste codes

A short introduction was given by Eco-Effiency.

→ **Discussion:**

Croatia: Only collects extractive waste using codes beginning with 01 to the level of 6-digits. However, other wastes fitting with other waste codes can also be generated at the same sites. Croatia does not use additional 6-digit codes beyond those listed in the EU Waste Catalogue.

MEERI: Would it be helpful to collect data only using 2-digit or 4-digit codes?

Eco-Efficiency: Has seen examples of extractive waste being reported under waste codes not beginning with 01. Are MSs aware of such cases?

Poland: Some companies that engage in cutting of stone also report their waste under the 01 codes. So, even 01-coded waste is sometimes mixed with non-extractive waste.

Eco-Efficiency: Waste code 01 01 01 would appear to capture overburden, but some MSs do not seem to use it at all. Do any MSs use this code? [Apart from Croatia, people responsible for such reporting were not in attendance].

TBL: In Romania, some radioactive extractive waste has been reported using a code starting with “19”.

Croatia: Normally “01” codes are used for extractive waste and “19” is used for ‘secondary’ waste produced from a ‘waste treatment’ process. For example, sludge from mine water treatment is likely reported under “19”, rather than as “extractive waste”.

Eco-Efficiency: It seems that some MSs consider “19” waste as extractive waste and other MSs do not. Additionally, some MSs do not allow mixing of “01” and “19” wastes on site.

Ireland: The “01” chapter contains about 28 individual codes. So, reporters refer to the codes, but they do not distinguish extractive waste from non-extractive waste. There are no “extractive waste codes”, only “01” codes for waste arising from extraction, treatment, etc.

Euromines: We have seen cases where slag is being re-processed at the mine mill. So, that would suggest that “01” and “19” waste is being sent together to a tailings dam somewhere. From the perspective of Article 4 of the EWD, is this really an issue?

4.4 Definitions: waste facility “in operation”, “in transition”, “closed”

A short introduction was given by WEFalck

→ **Discussion:**

France: In France, closed and abandoned facilities are treated in the same way. Closed sites are certified as such, whereas abandoned sites are not (yet).

Ireland: Looking back to before any of the Directives existed (e.g., 18th or 19th Centuries). In Ireland at that time, "closed" meant closed in an orderly fashion. What was accepted by authorities as an orderly fashion has of course changed over time, but that does not detract from the fact that the sites were legally closed at that time – rather than abandoned. Article 20 of the EWD relates to both those facilities closed according to former rules ***and*** abandoned (in contravention of any rules). The scope of Article 20 should not be artificially reduced to facilities that have been closed according to the EWD definition of closure. Concretely, this means that it is entirely possible to have sites that were closed before 1 May 2008, even if they are not the subject of an EWD-style approval of such closure.

WEFalck: The question is, what do MSs include in the numbers that they report under Article 20? Do they include all sites including those previously closed ***and*** abandoned? Or only those that have been abandoned?

Ireland: Ireland has included historically closed sites together with abandoned mines in its Article 20 reporting. By contrast, a mine that began before 2008 and closed formally in 2012, was not included in the Article 20 reporting.

Austria: Austria used definitions of 'closed' and 'abandoned' as provided in the EU Guidelines prepared by Hungary and Ireland and included them in its Article 20 reporting accordingly.

Sweden: Article 20 of the EWD refers to "closed waste facilities including abandoned waste facilities".

5. Supporting questions / practices

5.1 Dam safety review

A short introduction was given by Euromines.

→ Discussion:

Austria: Austria does not have Category A EWFs, but any facility with dams must have similar reviews carried out for a renewal of permits (1-5 yrs).

DG ENV: The COM DEC on Article 17 inspections should be published in the coming weeks[1]. Some of the discussion around that COM DEC was related to how detailed an activity needs to be to qualify as an "inspection". The COM DEC now distinguishes between inspections with or without a site visit. This might not simplify MSs' reporting of numbers of inspections, but at least it brings in a reliable definition consistent with generic Commission guidance on environmental inspections.

5.2 Monitoring and instrumentation

A short introduction was given by Petros Maraboutis (Eco-Efficiency).

[1] Meanwhile, the document referred to has been published. It is given in Annex E.

→ Discussion:

Cyprus: Receives monitoring results from the one Category A facility once per year in March. They have monthly monitoring for their own use. Monitoring results are also requested during inspection.

Ireland: Licences require monitoring. If there's an issue, it will be required more frequently, but at least once per year in March. Non-compliance or negative trends need to be reported immediately as an "incident" and are followed-up by the EPA. In-house, they may need to monitor down to a daily basis. Any non-compliance found by an independent auditor must also be reported to the EPA. Thresholds are set, for example, on freeboard of dams that would raise an alarm for immediate action, if breached and such breaches would be reported as an incident.

Sweden: The competent authority for Article 17 inspections is at County level. The inspection reports are sent to the Counties and do not come to the national EPA. The EPA will see reference to inspections in the annual reports from the Counties. In some cases, inspections appear to be quarterly.

Cyprus: In Cyprus, a technical committee considers permit extension applications including consideration of inspection reports and issues arising. In case of serious concerns, the permit is not renewed until the issue is resolved.

Euromines: From the information gathered, it seems that the inspector itself enforces follow-up actions, so there should normally be less need for interaction between the inspector and the permitting authority.

6. Conclusions (EC-DG ENV.)

The dynamics of the workshop were positive with an atmosphere of constructive discussion, which is very much appreciated.

DG ENV has noted that the CEN Technical Reports and Standards probably deserve some more attention.

The Workshop has brought to light issues that have arisen in the bilateral discussions between the study group and MSs.

Hopefully, the Workshop has provided progress on answers to the questions raised and not raised too many new questions.

Annex A: Agenda

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
ENVIRONMENT
Directorate B – Circular Economy & Green Growth
ENV.B.3 - Waste Management & Secondary materials

Brussels,

MEMBER STATES EXPERTS AND RAW MATERIALS SUPPLY GROUP MEETING ON THE IMPLEMENTATION OF DIRECTIVE 2006/21/EC (EXTRACTIVE WASTE DIRECTIVE - EWD)

Meeting of 13 February 2020

09:30 - 17:00
VLEVA (Liaison Agency Flanders-Europe),

71 Kortenberglaan – 1000 Brussels, Belgium

09.00	*Coffee*
09.30	1. WELCOME & INTRODUCTION (EC-DG ENV., CHAIR)
09.45	2. IMPLEMENTATION OF THE EXTRACTIVE WASTE DIRECTIVE (I) • Definition of reactive waste (Eco-Efficiency) • Major accident prevention (Ireland) • Interpretation of CEN standards on sampling of extractive waste and implications for the characterisation of waste (Euromines) •
11.15	*Coffee*
11.30	2. IMPLEMENTATION OF THE EXTRACTIVE WASTE DIRECTIVE (II) • Inventory & rehabilitation of closed and abandoned EWFs (WEFalck) 3. REPORTING AND STATISTICS • Reporting within the Member States (VITO)
13.00-14.00	Lunch

14.00	3. REPORTING AND STATISTICS • Decentralisation (Euromines; VITO) • Frequency and updates (Euromines; VITO) • Capacity (Euromines; VITO) • Contacts for reporting & feedback per MS (Euromines; VITO) • Member States waste codes (Eco-Efficiency) • Definitions: waste facility “in operation”, “in transition”, “closed” (WEFalck) 4. SUPPORTING QUESTIONS/PRACTICES • Dam safety review (Euromines) • Monitoring and instrumentation (Eco-Efficiency)
16.30	5. CONCLUSIONS (EC-DG ENV.)
17.00	*End of the meeting*

Note: Working language of the workshop will be English.

Annex B: Presentations


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Mining – Environment – Waste
W E Falck
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IGSMiE
PAN
TECHNICAL WORKSHOP
STUDY SUPPORTING THE DEVELOPMENT OF GENERAL GUIDANCE
ON THE IMPLEMENTATION OF THE EXTRACTIVE WASTE DIRECTIVE
(ENV.B.3/ETU/2017/0039)
22/04/2020
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SUPPORT EWD – MEETING WITH EXPERTS

AGENDA

09.00	*Coffee*
09.30	1. INTRODUCTION
09.45	2. IMPLEMENTATION OF THE EXTRACTIVE WASTE DIRECTIVE • Definition of reactive waste • Major accident prevention • Interpretation of CEN standards on sampling of extractive waste and implications for the characterisation of waste • Inventory & rehabilitation of closed and abandoned EWFs
11.15	*Coffee*
11.30	3. REPORTING AND STATISTICS • Reporting within the Member States • Decentralisation
13.00-14.00	Lunch
14.00	3. REPORTING AND STATISTICS • Frequency and updates • Capacity • Contacts for reporting & feedback per MS • Member States waste codes • Definitions: waste facility "in operation", "in transition", "closed" 4. SUPPORTING QUESTIONS/PRACTICES • Dam safety review • Monitoring and instrumentation
16.30	5. CONCLUSIONS

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DEFINITION OF REACTIVE WASTE

Study supporting the development of general guidance on the implementation of the Extractive Waste Directive

ENV.B3/ETU/2017/0039

Technical Workshop
Brussels 13 February 2020

The term "Reactive Waste"

- **Directive 2006/21/EC (EWD)**: The term **"reactive waste" is not presented**, but the necessity to assess the expected physical and chemical characteristics of the waste to be deposited is introduced
- The study "**Classification of mining waste facilities**" developed by **DHI, SGI and AGH University in 2007** revealed the issue of "reactive waste"
- **Decision 2009/337/EC** on the definition of the criteria for the classification of waste facilities requires an evaluation of the potential hazards constituted by facilities containing **reactive waste**, regardless of the classification of the waste as hazardous or non-hazardous
- **CEN/TR 16376:2012** "Characterization of waste – Overall guidance for characterization of waste from extractive industries" **provide the terminology** of reactive waste as:

  thermodynamically unstable under present or expected future conditions and therefore may react and cause the release of significant amounts of contaminants or heat

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When is an extractive waste reactive?

According to CEN/TR 16376:2012 the evaluation of reactive waste is based on:

- Total chemical composition (e.g. sulphur content)
- An assessment of self-ignition properties
- the potential for A/NRD production

- Reactive Waste
  - Non-Hazardous
    - "Reactive" is not the same as "hazardous"
  - Hazardous
    - 01 03 04* Acid-generating tailings from processing of sulphide ore
    - HP 3 Flammable (self-ignition)
    - HP15: Waste capable of exhibiting a HP not directly displayed by the original waste

HP: Hazardous Properties from Regulation 1357/2014/EU

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Questions and request for advice

- Which are the main criteria used to classify reactive extractive waste as hazardous or non-hazardous?
- Do authorities require evaluation of the acid generation potential of extractive wastes reported undr codes "01 01 01" (waste from mineral metalliferous excavation) and "01 01 02" (waste from mineral non-metalliferous excavation)?
- Are the residues that are placed back into excavation voids for rehabilitation and construction purposes evaluated for their chemical stability and/or the potential to generate acid?

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MAJOR ACCIDENT PREVENTION

- *Q2.a Are competent authorities notified if their colleagues declare an EWF as a Seveso site within the meaning of Directive 2012/18/EU?*
- *Q2.b Where can a public list of Seveso sites on your Member State territory be accessed?*
- *Q2.c. On what grounds has your Member State declared a Category A EWF as falling within the scope of Directive 2012/18/EU?*
- *Q2.d Is Annex I of the EWD useful for checking of Extractive Waste Management Plans, major accident prevention policies, safety management systems and internal/external emergency plans at Category A EWFs?*

22/04/2020

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2. IMPLEMENTATION OF THE EXTRACTIVE WASTE DIRECTIVE

Interpretation of CEN standards

Q3- Questions on sampling and characterisation of extractive waste

Q3.a: Have Member States approved any new EWMPs since 2012?

Q3.b: If yes, did proponents make use of the CEN Standards when preparing their EWMPs in compliance with Commission Decision 2009/360/EC for waste characterisation?

Q3.c: Do gold mines in your Member State make use of CEN/TS 16229 when monitoring WAD Cyanides in compliance with Article 13 of the Directive?

EWD Implementation

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Extractive Waste Directive

Sampling & Analysis	CEN/TR 16365:2013 ~285€
WAD-CN Analysis	CEN/TS 16229:2011 ~62€
Waste Characterisation	CEN/TR 16376:2012 ~367€
AP/NP Static Testing	CEN/EN 15875:2011 ~191€
AP/NP Kinetic Testing	CEN/TR 16363:2012 ~235€

European Association of Mining Industries, Metal Ores & Industrial Minerals www.euromines.org

CEN/TR 16365:2013 Sampling of Extractive Waste

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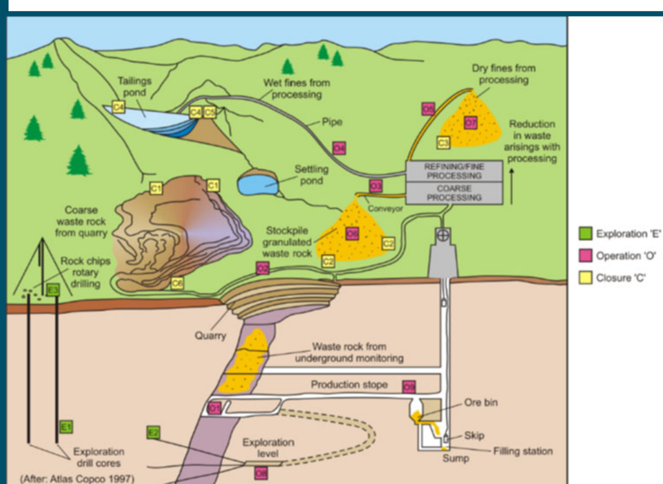

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CEN/TS 16229:2011 Analysis of WAD-Cyanide

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CEN/TR 16376:2012 characterization of extractive waste

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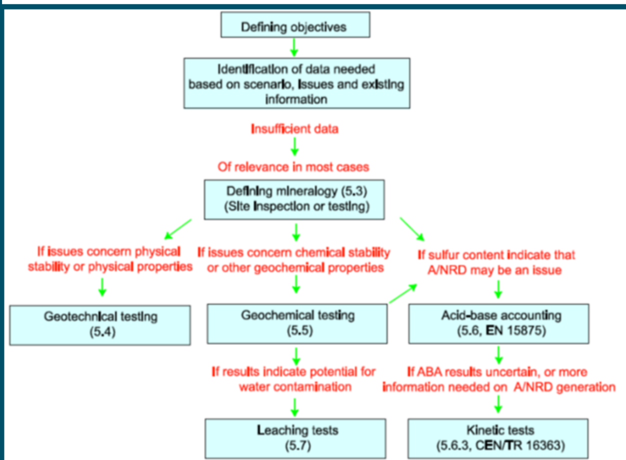

Figure 2 — Examples of sequences of testing in extractive waste characterization

EN 15875:2011

TR 16363:2012

EN 15875:2011
Static test for AP & NP

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CEN/TR 16363:2012
Kinetic testing for assessing AGP

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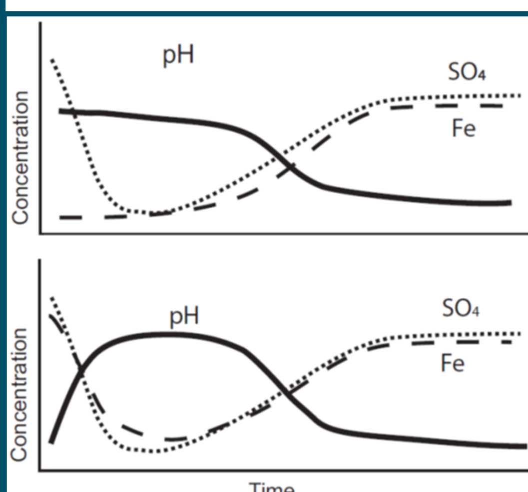

If Static Testing shows Acid Generation Potential,

,….or is inconclusive,

Can reaction rates result in realisation of Acid Generation Potential over time?

Interpreting Article 20 EWD

- **Criteria for inclusion into Article 20 sites inventories**

Article 20 stipulates that sites with (potentially) serious impact should be included into the inventory, but does not define ‚serious', leading to non-uniform reporting.

Discussion Point: ***How do MSs define what constitutes the 'seriousness' of an impact or threat ?***

- **Member States' interpretation of Article 20**

MSs used different sets of guidelines and criteria to identify sites for inclusion into the inventory, based on pre-existing legislation and inventories.

Discussion Point: ***How can a comparable status for all MS be achieved ?***

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Verification of Article 20 site inventories

- **Complex and unclear responsibilities**

In certain cases it has been difficult to obtain additional information from MSs due to complex and unclear (to the outside) reporting responsibilities that also change between periodic reports.

Discussion Point: ***How can the reporting responsibilities by clarified and contact points be identified to facilitate further updates of the list of Article 20 sites ?***

- **Role and function of the 'Guidance' document**

The role and function of the 'Guidance' document beyond the initial screening was questioned by some MSs. The original purpose of the 'Guidance' was to aid MS in screening for relevant sites by providing a logical framework and a set of criteria. This screening has largely been achieved by now.

Discussion Point: ***Is there a need and added-value for a benchmarking document on common criteria by which Article 20 sites are identified ?***

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Looking ahead

- **Interpretation of further implications of Articles 4, 20 and 21**

While Article 20 does not require MSs explicitly to rehabilitate sites listed in the inventory, such requirement may arise from Articles 4 and 21. A periodic revision of the inventory thus should report on progress in this respect.

Discussion Point: ***What would be an appropriate frequency, mechanism and scope for periodic reporting ?***

- **Adaptation of design assumptions**

Article 21 1 (b) requires the "... establishment of the most appropriate risk assessment procedures and remedial actions having regard to the variation of geological, hydrogeological and climatological characteristics across Europe." Given the fact that climatological characteristics are changing significantly in recent years, there may be a need to review the design assumptions used previously.

Discussion Point: ***How do MSs plan to ensure the safety of closed and abandoned EWFs vis-à-vis the need to adapt design bases ?***

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REPORTING WITHIN THE MEMBER STATES

Reports on extractive waste rely on Eurostat data defined as '*waste from mining and quarrying*' cover wastes from different types of minerals and different sectors.

Eurostat data is divided in hazardous and non-hazardous waste aggregating data from different sectors (e.g., primary and secondary raw materials are not reported separately).

Eurostat reports on '*waste from mining & quarrying*', '*hazardous waste*' and '*mineral & solidified waste*' most likely include a mix of extractive waste and other waste because of misaligned definitions.

This inventory confirms that the hypothesis that '*all hazardous waste from mining & quarrying should be extractive waste being managed in Category A EWFs*' does not hold.

REPORTING WITHIN THE MEMBER STATES

Misalignment between Eurostat data and definitions of the Directive

EWMPs contain predicted volumes, generated volumes may differ and change over time, waste characteristics may change over time.

Data about generated wastes in individual MS according to the List of Wastes are not readily available.

Variation in reported figures may be partly explained by looking per mine: whilst ore grade affects the quantities of tailings & waste rock generated, its link with topsoil and overburden is much less direct. Therefore, both ore grade and stripping ratio are probably required to understand the variation in Member States' reporting of Category A facilities.

As waste codes cover extraction of different types of minerals and sectors it is not possible to separate Eurostat data for individual types of minerals extraction.

REPORTING WITHIN THE MEMBER STATES

Sources of uncertainty for the European Commission

- Decentralization, competences and reporting lines: Data generated in accordance with the Directive is not necessarily all required in reports to a national body, or to the European Commission
- Categorization of wastes arising from the sector: EWMPs are required to use European List of Waste categories, which are not specific to individual extractive industries (Annex II of the Directive)
- Hazard Classification of extractive wastes: Extractive waste reported under different European LoW categories is irretrievably aggregated with similar waste from other sectors
- No valid basis for disaggregation of reported data: Legal requirements of the Directive and Eurostat do not generate centralized data on different categories of extractive waste arising

REPORTING WITHIN THE MEMBER STATES

Questions and request for advice

- When preparing tri-annual implementation reports, do you process statistical data to clearly split out the 'extractive waste' component or do you take a more pragmatic approach (e.g., by reporting the most appropriate readily available waste statistics)?
- Are there any UN or OECD statistics that you think are more appropriate than Eurostat statistics for reporting progress in implementation of the EWD?
- Would the statistics so far reported be expected to change dramatically if EWFs subject to reduced or waived requirements were included?
- Can Member State experts recommend any good administrative practices that have resulted in successful splitting out of '*extractive waste*' data for accurate reporting to the European Commission?

DECENTRALISATION

Authorities competent for the implementation of different aspects of the EWD are often not at central, federal or national level, but can be at regional or local level as well.

Due to the nature of permitting under the EWD, some of the desired information is held at a very local level or within permits themselves.

There is often no legal basis for data reporting to the regional or national level. In several member states, relevant legislation is held at regional or local level.

Legislation and competent authorities may be different for different sectors or different aspects of the Directive (e.g., active mines versus closed mines and legacy wastes, yearly and tri-annual reporting versus inspection of waste facilities).

DECENTRALISATION

Questions and request for advice

- Which authority does each expert at the workshop represent and what are the relevant competencies of that authority?
- Does the competent authority for co-ordinating the yearly and tri-annual reports to the European Commission have guaranteed access the information required to assemble the reports?
- Can Member State experts recommend any good administrative practices that have resulted in successful co-ordination of accurate reporting to the European Commission?

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FREQUENCY AND UPDATES

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operating Sites	Last exemptions				**1st permits**		**1st FGs**					
Abandoned Sites					**1st Inventory**							
Annual Reporting		COM DEC **1st Annual Report**	2nd Annual Report	3rd Annual Report	4th Annual Report	5th Annual Report	6th Annual Report	7th Annual Report	8th Annual Report	9th Annual Report	10th Annual Report	11th Annual Report
Tri-annual Reporting		COM DEC			**1st 3yr Report**			**2nd 3yr Report**			**3rd 3yr Report**	
Waste Characterisation		COM DECs			**CEN Standards**							
Exchange on BAT		**1st BAT Document**										2nd BAT Document
EWMPs					**1st EWMPs**					2nd EWMPs		EWMP Guidance
WAD Cyanide Limits	50ppm CN				**CEN Standard**	25ppm CN					10ppm CN	
Inspections												**Technical Guidelines**

vito

FREQUENCY AND UPDATES

Questions and request for advice

- Where there timing issues that contributed to incomplete or preliminary reporting in the first three tri-annual implementation reports?
- How long does it take for the competent authorities in your Member State to generate all the information asked for in Annex III to Commission Decision 2009/358/EC (the reporting questionnaire)?
- Has your competent authorities submitted complete & final answers to Part A of the questionnaire at least once?
- Have all permits granted before entry into force of the EWD now been replaced?
- To what extent do you expect the new European Commission technical guidelines for Article 17 inspections to assist in better reporting of inspections in your Member State?

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CAPACITY

In 2017, the EC stated that '*In some countries, a lack of financial and human resources poses an obstacle to implementation, as this prevents the authorities from preparing and implementing investment projects. Even when financing is available, local authorities sometimes lack the human resources and/or the know-how for organising public procurement and monitoring the quality of the service provided*'.

This inventory did not detect any lack of implementation or enforcement of reporting requirements laid out in the Directive.

The information requested of Member State authorities within Task 6 represented extra work for which competent authorities lacked legal basis and/or budgetary mandate suggesting lack of capacity within the MS to:

- To undertake any accompanying or enhancement measures;
- Promote awareness raising of the compliance of the sector.

vito

CAPACITY

Questions and request for advice

- Does your competent authority have budget available for answering the kinds of queries that this study had during the course of 2019?
- Can you describe examples of where your competent authority has been able to go beyond minimum legal obligations to provide the European Commission with more background to the legal reporting?
- In several cases, providing the requested information for this study would have required entering distributed paper-based information (e.g., in EWMPs) into a centralized database. Do you foresee your competent authority having budget and capacity to undertake such an exercise?

3. REPORTING AND STATISTICS

Contacts for reporting & feedback per MS

MEMBER STATES WASTE CODES
LoW VS WASTE CATEGORY BY NACE REV. 2 ACTIVITY

Study supporting the development of general guidance on the implementation of the Extractive Waste Directive

ENV.B3/ETU/2017/0039

Technical Workshop
Brussels 13 February 2020

Member States Waste Codes

Classification of waste according to LoW

Decision 2014/955/EU
List of Waste (LoW)

Chapter 1: wastes from exploration, mining, quarrying, and physical/chemical treatment of mineral

Six-digit code
Non-Hazardous
Hazardous with *

Real cases examples that shows the complexity of waste classification

- Poland: Introduce new waste codes at national level such as:
  - 01 03 81 Wastes from flotation enrichment of non-ferrous ores
  - 01 04 81 Waste from coal flotation enrichment
- Greece: Some operators register the soil from the rehabilitation of an extractive waste facility under a waste code not related to Chapter 1 of LoW. The issue that arises is that in some MSs the waste that is not assigned under Chapter 1 is not extractive waste and cannot be deposited into an EWF

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Waste Statistics and Extractive Waste

- According to Regulation (EC) No 849/2010 on **waste statistics** the extractive waste may register in the group **Waste of naturally occurring minerals.** This group includes also waste codes like:
  - 08 02 02 aqueous sludges containing ceramic materials
  - 19 08 02 waste from de-sanding
  - 19 13 01* solid wastes from soil remediation containing dangerous substances
- In Eurostat – Waste Statistics the data for waste generation is according to economic activities (NACE Rev. 2) "**Mining and quarrying**" (Section B)
- In Eurostat - Data Explorer the data for extractive waste generation are presented under the title "**Mineral and solidified Wastes**"

Waste generation from mining & quarrying

Waste of naturally occurring minerals

Mineral and solidified Wastes

Are all these titles extractive waste?

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Questions and request for advice

- What is your country approach in classifying extractive waste?
- Do you keep records for extractive waste using the waste codes 01.....?
- Do you report extractive waste using the extractive waste codes and to whom?
- In your MS are there any additional codes that are used to describe extractive waste that cannot be named under the existed waste codes of the List of Waste?
- Is it possible an extractive waste to be classified under a waste code not strictly including in the first chapter of the List of Waste?
- The National Statistics Office is receiving data directly from the extractive industries or this transition is an internal procedure?

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Operating – closed – abandoned EWFs

- **Article 18 vs. Article 20**

The requirements of the EWD are reduced for certain EWFs that were closed before 31.12.2010 and do not apply at all to EWFs closed by 01.05.2008. The natural or legal person responsible for such EWFs is not obliged by the EWD to hold a permit. Such facilities may need to be reported under Article 20, but not under Article 18. This may also have been a source of variation or incoherence.

Discussion Points:

Have Member States identified an 'operator' for every closed EWF? If not, why not?

Do Member States have cases where the competent authority is the 'operator'?

Do Member States require 'operators' of 'closed' EWFs to hold a valid permit meeting all requirements of the EWD? If not, why not?

- **Diverging interpretation of the terms 'closed' and 'abandoned'**

‚Closed' sites have been subject to a certain regulatory procedure, while ‚abandoned' site were given up by the operator without such procedure. However, MSs interpretations seem to differ, leading to diverging criteria for the inventories.

***Discussion Point:* MSs should clarify, how they have interpreted the terms 'closed' and 'abandoned' in the context of Article 20 EWD**

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Faktors hindering rehabilitation

- lack of definitions of what an abandoned mine site/EWF is
- mine closure practices and expectations related to rehabilitation outcomes have changed
- the lack of clearly defined or assumed responsibility
- uncertain or unclear site ownership
- unwillingness of future site owner to assume long-term responsibilities
- the absence of criteria and standards of rehabilitation
- competing regulations and regulatory objectives
- the lack of capacities in regulatory authorities
- the real and perceived cost of rehabilitation
- the lack of financial resources
- unrealistic demands on the outcome of rehabilitation projects
- legal actions by certain stakeholders
- collateral damage due to the actual rehabilitation project

Discussion point: Have MSs experienced any hindering factors to proceed with a rehabilitation perceived necessery and what was the strategy to alleviate them ?

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4: SUPPORTING QUESTIONS/PRACTICES

Dam Safety Review

Q11 – Questions on dam safety review

Q11.a: Is there any Member State having a Category A facility on its territory that does not follow a procedure for independent expert review like that described in MWEI BAT Conclusion 24(c)?

Q11.b: To what extent do you expect the new European Commission technical guidelines for Article 17 inspections to assist in better structuring Dam Safety Reviews in your Member State (e.g., definitions)?

LMC - Independent Third Party Tailings Review

Lundin Mining has established procedures for improvement of corporate accountability and adoption of best applicable practices and technologies to manage risk at their tailings management facilities. Includes:

- Tailings Management Technical Standard
- Independent Third Party Tailings Review Program

The Independent Third-Party Tailings Review program involves annual site inspections carried out by:

- TST (Tailings Stewardship Team) – Corporate team responsible for ensuring compliance with Lundin Mining's tailings management standard and associated procedures.
- Responsible Person and other key site personnel.
- Representative from the Engineer-of-Record
- The Third Party Independent Reviewers – since 2015 BGC Engineering Inc.

The field visits generally take from 2-4 days and consist of :

- Kick-off meeting to review data discuss known issues and previous findings and anything that has changed over the past year.
- Tour of facilities – physical inspection of all earthworks by all parties.
- Close-out meeting to discuss findings and assign and prioritize actions.

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LMC - Independent Third Party Tailings Review

Reporting & Follow Up:

- Key recommendations summary – to be distributed to all attendees at the close out meeting. A copy is also to be sent to the CEO.
- Report from Third Party Reviewer, with defined Recommendations, Best Practices and Observed Improvements identified, to be sent to site and the TST, no later than one month after each visit. For Recommendations expected completion dates are established.
- Quarterly action follow ups between the site RP and the TST.
- 4. Results of the Third Party Reviews, TST recommendations and progress updates to be sent to the Board appointed HSEC committee each quarter.

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The International Board of Experts and the Polish Geotchnical Expert

- **The IBE's meetings** - since 2007 the IBE's meetings have been held twice a year (ones a year from 1992 to 2006), during which the newest monitoring data, results of research and analysis and calculations are presented by:
  - Monitoring Department (KGHM)
  - Chief of Designer of TSF Zelazny Most (DHV Hydroprojekt)
  - Polish Geotechnical Expert
  - External contractors, both Polish and international
- **The PGE**, before each meeting issues for the IBE a detailed report that describes the current state of the TSF Zelazny Most according to the most recent :
  - data taken from control and measurement devices
  - geological and geotechnical investigations
  - numerical analysis
- **The IBE**, after each meeting issues a report, in which summarizes the current state of the TSF Zelazny Most and provides, KGHM and the designer of TSF, advise regarding, e.g. :
  - execution of geotechnical tests, e.g.: field and/or lab
  - performing numerical analysis, e.g.: slope stability, seismic impact, deformations, etc.
  - installation of measuring control devices, e.g. inclinometers, piezometers, GPS
  - construction of remedial measures for raising the safety of TSF, e.g.: loading berms, circumferential drainage embedded into tailings body and relief wells to reduce pore pressure in dam foundation, ect.

KGHM

Industry guidelines (GruvRIDAS)

Daily monitoring and surveillance
By operator

Inspections (2 to 4 times per year)
Carried out by in-house experts.
Include all relevant parts of the facility and an analysis of all monitoring data and observations.

In depth inspections (every 2nd/3rd year)
Carried out by Independent experts.
Include all relevant parts of the facility and an analysis of all monitoring data and observations. Documented report and action plan.

Comprehensive dam safety evaluation (every 10th/15th year)
The evaluation is a comprehensive and systematic evaluation of the safety of a dam facility, based on a total analysis of all parts of the facility, its design and operation and the entire technical and governance system from a safety perspective.
Carried out by a team of independent experts, national and/or international, with 10+ years of experience in their area of expertise.

SveMin

Industry practice and legislation

All operating mining companies have implemented the practice of bringing in Independent Review Boards on a regular basis.

Ordinance on Dam Safety (2014:214)
§5 Require a safety management system including:

- Documented organisation/responsibilities
- Identification of failure modes and potential consequences
- Plan for Operation, Surveillance and Maintenance (OSM-manual)
- Procedures for change management
- Emergency planning
- Procedures for evaluation and revision (of the management system)

§7 Requires a overall (technical and managerial) in depth evaluation of dam safety every 10 years
§8 Requires an annual dam safety report

SveMin

TSM Tailings Management Protocol

Tailings Management Indicators
Tailings management policy and commitment
Tailings management system
Assigned accountability and responsibility for tailings management
Annual tailings management review
Operation, maintenance and surveillance (OMS) manual

Rating system

AAA	•Excellence and Leadership
AA	•Integration into management decisions and business functions
A	•Systems/processes are developed and implemented
B	•Procedures exist but are not fully consistent or documented; systems/processes planned and being developed
C	•No systems in place; activities tend to be reactive; procedures may exist but they are not integrated into policies and management systems

KAIVOSTEOLLISUUS FINNMIN

TSM Annual Tailings Management Review

AAA	An external, independent audit or assessment to ensure: • that the annual corporate review of tailings management is reported to the accountable executive officer; and • that the review is in conformance with the guide
AA	An internal audit or assessment to ensure: • that the annual corporate review of tailings management is reported to the accountable executive officer; and • that the review is in conformance with the guide4
A	A formal annual corporate review of tailings management reported to the accountable executive officer
B	Periodic formal reviews of the tailings management system and performance at facility level in conformance with the guide4
C	Periodic, informal reviews of the tailings management system and performance at facility level

KAIVOSTEOLLISUUS FINNMIN

Reflected in EWD

euromines

BAT 24. In order to support the monitoring of the physical stabilit... waste deposition area (including the EWF), BAT is to use o... techniques, appropriately selected fromf the following list:

c	External audits	*Relevant for ponds, dams and* ... *excavation voids where extr*... *back*	
		Planning and desi... To plan ext... perfor... d... ...lar ...ert. The ...udits in Table	...impact ...ation (see ...BAT 5).
		...n, *management and* ... ...e external auditing, while applying ...ent systems (see BAT 1, BAT 11 and ...12).	

ECO EFFICIENCY
CONSULTING & ENGINEERING Ltd

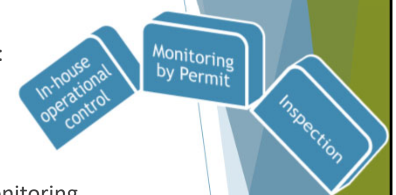
Monitoring & Instrumentation

Study supporting the development of general guidance on the implementation of the Extractive Waste Directive

ENV.B3/ETU/2017/0039

Technical Workshop
Brussels 13 February 2020

Monitoring & Instrumentation



- Industry calls for a distinction to made between:
  - Monitoring by permit (based on MWEI BREF)
  - In-house operetional control
  - Inspections
- Introduction of an appreciation of risk in the monitoring
- Approach for monitoring a Category A Facility differs from non Cat. A Facility
- MWEI BREF & Monitoring:
  - BATs 23-24. BAT is to monitor the physical stability of the extractive waste deposition area
  - BATs 40, 48 & 52. BAT is to monitor emissions to air, soil, surface water and groundwater by implementation of a monitoring plan that properly selects monitoring parameters and frequencies according to the site-specific conditions and adapts them based on monitoring findings over time.

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MWEI BREF & Monitoring

BATs 23-24. BAT is to monitor the physical stability of the extractive waste deposition area (including the EWF) as follows:

- Develop a physical stability monitoring plan and to plan conformance checks by operators, reviews, audits and safety evaluations;
- Carry out conformance checks and internal audits;
- Properly select monitoring parameters and frequencies according to the site-specific conditions and adapt them based on monitoring findings over time;
- Including – depending on risk – the following:
  - number and location of control stations;
  - scheduling (control periods and conformance checks by operators);
  - type and purpose of monitoring measure (visual conformance checks by operators, measurements and parameters);
  - appropriate instrumentation selection;
  - conformance check methods and evaluation;
  - identification of the person/function responsible for the monitoring and reporting;
  - data storage and reporting systems;
  - criteria to assess the monitoring plan;
  - schedule of the monitoring plan review;
  - a dam surveillance plan (for dams);
  - emergency planning, including the internal emergency plan specifically required for Category A EWFs.

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From previous implementation studies,…

- The BATs reported by the highest number of facilities include monitoring of stability and groundwater monitoring
- 200 explicit references to BAT relating to monitoring of stability in a limited number of Member States (CZ, FI, SK, PT, PL, HG, ES and UK)
  - E.g., monitoring seepage flow (tailings), monitoring position of the phreatic surface (tailings), monitoring pore pressure (tailings, dam, heap) and monitoring position, slope and movements (tailings and heaps)
- Stakeholders have called for a clear distinction between monitoring that is required as a condition of permits which may be carried out in detail and inspections which may review the monitoring carried out

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4: SUPPORTING QUESTIONS/PRACTICES

Monitoring and instrumentation

Q11 – Questions on monitoring and instrumentation

Q11.a: Do you have any examples of good monitoring and instrumentation practices that could be replicated in other Member States?

Q11.b: Would there be added value in having EU level guidance on monitoring & instrumentation, as a complement to the MWEI BAT and Commission Decision on Article 17 inspections?

Q11.c: Is there a need to clarify the meaning of "non-compliance" as stated in Annex I §1(3)(f) of the Directive? If yes, how should this be done?

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Annex C: Example of Irish External Emergency Planning

Public information leafleat, External emergency plan of the Aughinish Alumina LTD., bauxite residue disposal area Aughinish Island Asketon Co. Limerick

Note: This information is only relevant to persons in the Public Alert Area—see area shown in yellow in Plan below:

Information about Aughinish Alumina Ltd. BRDA (Bauxite Residue Disposal Area)

Aughinish Alumina Ltd. is an alumina refinery situated on Aughinish Island on the south side of the Shannon estuary near Foynes, 20 miles downstream from Limerick City.

The plant produces over 1.8 million tonnes of alumina (Al_2O_3) per annum by processing bauxite ore, a reddish brown earth, using the Bayer process. Alumina is a fine white granular powder which is exported to aluminium smelters for processing into aluminium metal.

The Bayer Method results in the production of bauxite residues which is deposited in the lined Bauxite Residue Disposal Area within the facility boundary. The process yields approximately 0.3 tonnes of waste for disposal for each tonne of bauxite processed. The BRDA (shown black in drawing) contains 2 separate areas. Phase 1 comprises 104 ha and is substantially filled. Phase 2 comprises 78 ha and is currently being filled. It is estimated that filling will continue to 2031 approx.

Waste Management (Management of Waste from the Extractive Industries) Regulations 2009 (SI 566 of 2009)

The Environmental Protection Agency (EPA) has classified the Bauxite Residue Disposal Area at Aughinish Alumina Ltd. as a Category A Waste Facility as defined in the Regulations and therefore requiring an External Emergency Plan.

Risk Assessment for BRDA

Golder Associates prepared a Risk Assessment and Break-out study of the BRDA in 2012, on behalf of Aughinish Alumina Ltd. This document is summarised as an Appendix to the External Emergency Plan.

AAL Emergency Response Procedure

Aughinish Alumina Ltd. Emergency Response Procedure considers 2 worst-case scenarios in which a breach or failure of BRDA containment may occur:

1) A release of alkaline waste water in the Perimeter Interceptor Channel over the top of the Outer Perimeter Embankment Wall of the Phase 1 BRDA
2) A release of red mud slurry into the Perimeter Interceptor Channel and over the top of the Outer Perimeter Embankment Wall of the Phase 1 BRDA

External Emergency Plan

Limerick County Council has prepared an External Emergency Plan which outlines the procedures to be observed by the Principal Response Agencies (LCcC, HSE, Gardai) in the event of an emergency at the BRDA at Aughinish.Alumina Ltd.

The initial External Emergency Plan was prepared following two periods of public consultation and was prepared in consultation with Gardai, HSE, NPWS, EPA and OPW. A review and table-top exercise of the External Emergency Plan took place in March 2019.

Effects of a Major Accident Off Site

Both the red mud slurry and associated run-off water are alkaline in nature (mud with a pH of 10.5-11 and water with a pH of <11.5). Direct contact with either of these substances can result in skin and eye irritation and possible worsening of any pre-existing skin disorders.

Zone for Public Alert

As part of the preparation of the External Emergency Plan, Limerick City & County Council reviewed the Specified Area for the facility which is defined as the area which is liable to be affected by a major accident at the facility. This area was defined in the Golder Risk Assessment and Break-out study as being contained within lands in AAL ownership.

Any person residing within 100m of the Robertstown River tidal area will also be notified in the unlikely event of an actual or threatened emergency. This notification will be via house visits and / or direct phonecall .

What You Should Do in an Emergency

1. **Avoid contact with watercourses in the area**
2. **Follow any instructions from the Principal Response Agencies (HSE, Gardai, Limerick City & County Council)**

Persons located within the Zone for Public Alert will be contacted by Limerick City & County Council to confirm the All Clear and will be given advice on any additional measures, if any, to be adopted following the incident.

Further Information

The current IE (Industrial Emissions) licence for Aughinish Alumina Ltd. Is P0035-06 and is available to view at www.epa.ie/licensing/ippc by completing a licence search.

Limerick City & County Council Contact Details:

Office Hours: 061 556000

Out of Office Hours: 061 417833

Comhairle Cathrach & Contae **Luimnigh**

Limerick City & County Council

Produced by
Planning & Environmental Services
Date: August 2019

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Comhairle Cathrach & Contae **Luimnigh**

Limerick City & County Council

PUBLIC INFORMATION LEAFLET

EXTERNAL EMERGENCY PLAN

AUGHINISH ALUMINA LTD.
BAUXITE RESIDUE DISPOSAL AREA
AUGHINISH ISLAND
ASKEATON
CO. LIMERICK

Produced by
Planning & Environmental Services
Date: August 2019

Annex D: Mandate to CEN for the development of standardised methods relating to the characterization of wastes from the extractive industries

EUROPEAN COMMITTEE FOR STANDARDISATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN/TC 292/WG 8 Wastes from the extractive industry

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doc.nr. CEN/TC 292/WG 8	**N 58**
date **2007-01-20**	total pages
item nr.	supersedes document
Committee	CEN/TC 292/WG 8 Wastes from the extractive industry

Mandate to CEN for the development of standardised methods relating to the characterization of wastes from the extractive industries

Note!
The document is for voting in CEN/BT (deadline 2007-01-2).

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
ENVIRONMENT
Directorate G - Sustainable Development and Integration
ENV.G.4 - Sustainable Production & Consumption

Brussels, 5th December 2006
M/395 EN

MANDATE TO CEN FOR THE DEVELOPMENT OF STANDARDISED METHODS RELATING TO THE CHARACTERISATION OF WASTES FROM THE EXTRACTIVE INDUSTRIES

I. MOTIVATION

Directive 2006/21/EC[1] lays down requirements for the safe management of waste from extractive industries ('extractive waste'). The Directive was formally adopted by the EP and Council on 15/3/2006 and entered into force on 1/5/2006.

Article 22 of the Directive sets out the implementing measures that will have to be adopted by the Commission within 2 years from the date of entry into force, i.e. by 1/5/2008, in accordance with the procedure referred to in Article 23(2), i.e. with the assistance of the Committee established by Article 18 of directive 75/442/EEC. These measures include (see details in Annex 2):

- ***completion of the technical requirements for waste characterisation contained in Annex II;***
- ***determination of any harmonised standards for sampling and analysis methods needed for the technical implementation of this Directive***
- ***the implementation of Article 13(5), including technical requirements relating to the definition of weak acid dissociable cyanide and its measurement method;***

A mandate to CEN is needed to specify the standardisation needs related to the implementing measures set out above. This will allow CEN to concentrate their work along these requirements and thus speed up the completion of the required standardised methods.

II. DESCRIPTION OF THE MANDATED WORK

This mandate covers waste from mineral extraction and processing, in accordance with Article 2 of Directive 2006/21/EC.

[1] Directive 2006/21/EC on the management of waste from extractive industries and amending directive 2004/35/EC, OJ L102, 11.4.2006

Responsible person: Fotios Papoulias (fotios.papoulias@ec.europa.eu)

The methods and standards to be developed should fit the needs across the entire range of extractive industries, as defined in Directive 2006/21/EC.

The guidelines and standards to be developed should incorporate, as far as possible and appropriate, existing and practicable standards and methods, applying within the EU and internationally.

Methodological approaches contained in the 'mining BREF' (Best Available Techniques Reference Document for the management of tailings and waste rock) shall be taken into account.

Furthermore, other relevant related work carried out in the context of the European Waste Catalogue[2], the Hazardous Waste directive[3], as well as the Landfill directive[4] shall also be taken into account.

The mandated tasks require in particular evaluating standardisation work relevant to the characterisation of extractive waste and developing deliverables as set out in Annex 1. The work shall focus on sampling, testing and analysis, with emphasis on acid generation behaviour; it shall also include methods and standards applicable to measurement of WAD cyanide.

As a general rule, the work will comprise an evaluation of any existing standards in the respective areas, assessment of their applicability for extractive waste, and identification of needs for modifications so that they can serve the requirements of the Directive. Modifications can be extensive (leading to the development of a new standard) or limited (leading to the amendment of an existing standard at its revision). The work will involve, as appropriate, desk surveys, preparation of draft texts, validation and publication.

The following CEN standards are in particular relevant:
- EN 12920 "Characterisation of waste – Methodology for the determination of leaching behaviour of waste under specified conditions.
- EN 14899 "Characterisation of waste – Sampling of waste materials – Framework for preparation of a sampling plan"

The Commission entrusts CEN to develop standards as described in Annex 1.

III. BODIES TO BE ASSOCIATED

The elaboration of the standards should be undertaken in co-operation with the broadest possible range of interested groups. Co-operation with organisations such as ANEC[5], ECOS[6], NORMAPME[7] and ETUI-REHS[8].should be ensured where relevant.

---

[2] Commission Decision 2000/535/EC as amended.
[3] Directive 91/689/EEC.
[4] Directive 1999/31/EC and Council Decision 2003/33/EC
5 European Association for the Co-ordination of Consumer Representation in Standardisation
[6] European Environmental Citizens Organisations for Standardisation
[7] European Office of Crafts, Trades and Small and Medium- Sized Enterprises for Standardisation

The standardisation work should take into account initiatives at international level where appropriate.

IV. EXECUTION OF THE MANDATE

The standards shall be developed in accordance with the requirements and timetable as stated in Annex 1. In carrying out those tasks CEN shall ensure effective liaison, exchange of information and collaboration with activities undertaken under Article 23(2) of Directive 2006/21/EC related to implementing measures on characterisation of waste and on inert waste.

CEN will submit progress reports to the Commission every nine months following acceptance of the mandate.

After publication, CEN shall make available to the Commission the standards in three linguistic versions (English, French and German) and other deliverables in the published language.

Standards to be developed under this mandate shall be published in the Official Journal of the European Communities.

The standstill period referred to in Article 7 of Directive 98/34/EC (OJ L 217, 5.8.1998, p. 18) shall commence when CEN accepts this standardisation mandate.

In the light of activities undertaken according to Art. 23 of Directive 2006/21/EC the Commission may issue a further mandate to CEN for standardisation work.

[8] European Trade Union Institute - Research, Education, Health and Safety

ANNEX 1

Tasks covered by the mandate

Topic	Output	Delivery date	Description/Remarks
1. Guidance for on characterisation of extractive waste	Technical report	Task a) Desk study and Draft rep1/07 Final rep 12/07 Task b) Desk study 6/07 Draft rep 10/07 Final rep 6/08	a) Evaluation of suitability of existing CEN standards (including EN12920). - Include physical/ geotechnical parameters (e.g. permeability, shear strength, ...). - Cover content (total and sulphidic sulphur, cyanides, major, minor and trace elements), basic characterization and compliance testing, analysis of eluates and leachates. b) Recommendation on general methodology, covering both physical/geotechnical and chemical/geochemical aspects. Information contained in the output (technical report) will be used for further relevant work on waste characterisation to be undertaken according to the provisions of Art. 23 of Directive 2006/21/EC.
2. Sampling	a) Revised EN 14899	Draft 1/07 prEN 6/07 EN 6/08	Identification of sampling needs for extractive waste (including pre-treatment of samples). Evaluation of applicability of EN14899 and development needs (e.g. sampling plan(s) specific to extractive wastes). Standards being developed under project *Horizontal* to be taken into account.
	b) Technical reports specific to sampling of extractive waste	Draft 6/07 prTR 12/07 Final 6/08	

3. Acid generation behaviour - Static and kinetic testing	a) EN on *static test*	prEN 9/07 Formal vote 12/08	One test or a set of tests for determination of net acid production potential in sulphidic waste
	b) Technical specification on *kinetic test*	prTS 6/07 Formal vote 6/08	Planning, execution and interpretation of tests in sulphidic waste. Kinetic testing for determination of reaction rates. References to existing international and European guidelines and standards. To be linked with the overall guidance report under 1b.
4. Methods for measuring WAD (easily liberatable) cyanide	Technical report – revised EN or new EN	Technical report 1/07 prEN 6/07 Formal vote 6/08	Evaluation of suitability of existing standards and methods developed in the EU and internationally for determination of cyanide in water, eluates and soil.

<u>***ANNEX 2***</u>

<u>Provisions of the Directive on the management of waste from extractive industries related to waste characterisation</u>

<u>*Art. 22 – Implementing measures*</u>

1. By [2 years after entry into force], the Commission shall adopt, in accordance with the procedure referred to in Article 23(2), the provisions necessary for the following, prioritising (e), (f) and (g):

(a) the harmonisation and regular transmission of the information referred to in Articles 7(5) and 12(6);

(b) the implementation of Article 13(5), including technical requirements relating to the definition of weak acid dissociable cyanide and its measurement method;

(c) technical guidelines for the establishment of the financial guarantee in accordance with the requirements of Article 14(2);

(d) technical guidelines for inspections in accordance with Article 17;

(e) completion of the technical requirements for waste characterisation contained in Annex II;

(f) interpretation of the definition contained in point 3 of Article 3;

(g) definition of the criteria for the classification of waste facilities in accordance with Annex III;

(h) determination of any harmonised standards for sampling and analysis methods needed for the technical implementation of this Directive

…

<u>*Annex II - Waste characterisation*</u>

The waste to be deposited in a facility shall be characterised in such a way as to guarantee the long-term physical and chemical stability of the structure of the facility and to prevent major accidents. The waste characterisation shall include, where appropriate and in accordance with the category of the waste facility, the following aspects:

*(1) description of expected physical and chemical characteristics of the waste to be deposited in the short and the long term**,** with particular reference to its stability under surface atmospheric/meteorological conditions, taking account of the type of mineral or minerals to be extracted and the nature of any overburden*

and/or gangue minerals that will be displaced in the course of the extractive operations;

(2) classification of the waste according to the relevant entry in Decision 2000/532/EC [9]*, with particular regard to its hazardous characteristics;*

(3) description of the chemical substances to be used during treatment of the mineral resource and their stability;

(4) description of the method of deposition;

(5) waste transport system to be employed.

<u>Art. 13 – Prevention of water status deterioration, air and soil pollution</u>

6. In the case of a pond involving the presence of cyanide, the operator shall ensure that the concentration of weak acid dissociable cyanide in the pond is reduced to the lowest possible level using best available techniques and, in any case, at waste facilities which have previously been granted a permit or have already been in operation on .... [*] that the concentration of weak acid dissociable cyanide at the point of discharge of the tailings from the processing plant into the pond does not exceed 50 ppm as from .... [*], 25 ppm as from .... [**], 10 ppm as from .... [***] and 10 ppm at waste facilities which are granted a permit after .... [*].

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9 Commission Decision 2000/532/EC of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste (OJ L 226, 6.9.2000, p. 3). Decision as last amended by Council Decision 2001/573/EC (OJ L 203, 28.7.2001, p. 18).

* Two years after the date of entry into force of this Directive.
** Seven years after the date of entry into force of this Directive.
*** Twelve years after the date of entry into force of this Directive.

Annex E: Commission implementing decision (eu) 2020/248 d.d. 21 february 2020, Laying down technical guidelines for inspections in accordance with article 17 of directive 2006/21/ec of the European Parliament and of the Council

DECISIONS

COMMISSION IMPLEMENTING DECISION (EU) 2020/248

of 21 February 2020

laying down technical guidelines for inspections in accordance with Article 17 of Directive 2006/21/EC of the European Parliament and of the Council

(notified under document C(2020) 889)

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC ([1]), and in particular Article 22(1)(c) thereof,

Whereas:

(1) Article 17 of Directive 2006/21/EC requires inspections of any waste facility covered by Article 7 in that Directive in order to ensure that it complies with the relevant conditions of the permit. In order for those inspections to be efficient and effective, competent authorities should be appropriately resourced, independent from the operators of the waste facilities concerned, vested with the necessary functions and powers and entitled to assistance from operators. Inspection activities should also involve co-operation and co-ordination between national authorities responsible for ensuring that waste facilities in their jurisdiction comply with the provisions set out in Directive 2006/21/EC.

(2) In order for the inspections to be efficient and proactive, it is appropriate that they are planned in advance by means of inspection plans reflecting the risks presented by the waste facilities concerned.

(3) As the waste facilities covered by Article 7 of Directive 2006/21/EC include waste facilities which ought to have a permit and, as Article 7 provides that no waste facility should operate without a permit, it is necessary for the inspection plans to take account of those waste facilities which ought to have a permit but do not hold one.

(4) Member States should retain a margin of discretion in the application of the inspection guidelines having regard to the different circumstances of each waste facility, to ensure that inspections are proportionate to the relevant environmental and safety risks presented by each waste facility.

(5) In order to address different situations of possible non-compliance with permits, provision should be made for both routine inspections and non-routine inspections to respond to serious complaints, accidents, incidents and occurrences of non-compliance. When carrying out the inspections, the inspectors should also take account of the findings of inspections carried out under other applicable EU legislation to the extent that those findings may also indicate possible problems with the permit requirements under Article 7 of Directive 2006/21/EC.

([1]) OJ L 102, 11.4.2006, p. 15.

(6) In order to ensure the effectiveness of the inspections, it is necessary that a certain proportion of inspection activities, and in particular site visits, are unannounced.

(7) In order to make it possible to draw conclusions from inspection activities, in particular site visits, and to provide an empirical basis for future inspections and other related measures, it is important that all inspection activities are properly documented, including through regular site visit reports.

(8) In order to effectively ensure compliance with permit conditions, it is important that inspections facilitate and enable any further measures to respond to detected non-compliance.

(9) Given that risks vary depending on the stage of existence of the concerned waste facilities, it is necessary that the technical guidelines contain detailed provisions concerning the different life phases of waste facilities covered by Article 7 of Directive 2006/21/EC.

(10) Given that Category A waste facilities pose potentially higher risks, it is necessary that the technical guidelines contain specific provisions in respect of such facilities.

(11) The measures provided for in this Decision are in accordance with the opinion of the Committee established in accordance with Article 23(2) of Directive 2006/21/EC,

HAS ADOPTED THIS DECISION:

Article 1

The technical guidelines for inspections of waste facilities in accordance with Article 17 of Directive 2006/21/EC set out in the Annex to this Decision are adopted.

Article 2

This Decision is addressed to the Member States.

Done at Brussels, 21 February 2020.

For the Commission

Virginijus SINKEVIČIUS

Member of the Commission

ANNEX

TECHNICAL GUIDELINES FOR INSPECTIONS OF WASTE FACILITIES

PART A

Objectives

These guidelines set out elements to be taken into consideration for inspections of waste facilities covered by Article 7 of Directive 2006/21/EC that are to be carried out by competent authorities in accordance with Article 17 of that Directive. Such inspections are aimed at ensuring that any waste facility has obtained the required permit and complies with the relevant permit conditions. The inspections relate to the different life-phases of the waste facilities.

These guidelines address the general framework for carrying out inspections (Part C), the focus of the inspections for each of the different life-phases of the waste facilities (Part D) and the specific elements relevant to inspection of Category A facilities (Part E).

PART B

Definition

For the purpose of these guidelines, 'inspection' means all activities undertaken by a competent authority or on its behalf in order to ensure compliance by waste facilities covered by Article 7 of Directive 2006/21/EC with the conditions of the permit that they have to obtain. These activities may include in particular:

— assessing relevant environmental and safety issues and the risks presented by the waste facilities;

— carrying out site visits to check premises, site conditions, relevant equipment, including whether it is adequately maintained, relevant documents and electronic data, internal measures and systems and operating processes;

— interviewing staff working at the waste facility;

— reinforcing operators' knowledge of the relevant legal requirements and the environmental impacts of the activities of the operators;

— taking samples;

— using earth observation techniques and other forms of remote surveillance, including those involving *in situ* sensors, where appropriate;

— verifying operators' self-monitoring;

— checking documents and electronic data, including operator's reports, other than by means of site visits;

— checking operators' internal measures and systems and operating processes other than by means of site visits;

— checking financial guarantees or equivalent;

— recording factual information on non-compliance;

— identifying the reasons for detected non-compliance and the possible types of impacts of such non-compliance on the environment and human health;

— describing detected non-compliance, in particular the circumstances (including the persons) which led to non-compliance, in order to identify, as far as possible, what actions are needed to ensure compliance and enable them, including by cooperating and sharing inspection findings with other relevant competent authorities.

Inspections, including site visits, may be routine, i.e. carried out as part of a regular set of activities, and non-routine, i.e. carried out in response to serious complaints or for the investigation of serious accidents, incidents and other occurrences of non-compliance.

PART C

Conduct of detailed checks, investigations and information gathering

1. *Competent authorities*

The following shall be taken into consideration:

(a) the availability, for the entire territory of the Member State and for the full range of waste facilities covered by Article 7 of Directive 2006/21/EC, of competent authorities in charge of inspections;

(b) the independence of the competent authorities and their capacity to fulfil all tasks necessary for carrying out the inspections;

(c) the powers of the competent authorities to carry out inspections, including their right to enter facilities and examine relevant material assets, documents and electronic data;

(d) the sufficiency of the resources, personnel and equipment available to the competent authorities in order to carry out inspections;

(e) the arrangements the competent authorities have in place for co-operation and co-ordination of their activities with other relevant authorities, in particular other authorities with responsibilities in relation to compliance with permits required under national or Union environmental legislation that is applicable or relevant to the facilities covered by Article 7 of Directive 2006/21/EC;

(f) the level of knowledge, experience and competence that inspectors need to have to carry out inspections, in particular as regards the design, construction, operation and closure of waste facilities;

(g) the organisation of training to update the knowledge that inspectors have;

(h) the necessary assistance that operators must provide to the competent authorities to enable them to carry out inspections, including site visits, the taking of samples and the gathering of information necessary for the performance of their duties pursuant to Article 17 of Directive 2006/21/EC.

When carrying out inspections, the competent authorities may be assisted by and may delegate inspection tasks to independent experts in accordance with national legislation, provided that the experts operate under the supervision of the competent authority. The competent authority shall determine the minimum qualifications of the experts and shall assess whether those qualifications are met. The competent authority shall also verify that the experts have no personal interest in the outcome of the inspection.

2. *Organisation of inspections*

2.1. Inspection plans

The following shall be taken into consideration:

(a) planning of inspections in advance by means of a plan or plans established at the appropriate administrative level based on a general assessment of the relevant environmental and safety issues and risks of the waste facilities and, where information is already available on compliance, an overall assessment of the state of compliance for the waste facilities operating within the plan area. Such plans can be integrated or combined with other inspection plans where considered appropriate;

(b) the periodic review and, where appropriate, the updating of the inspection plan or plans;

(c) the coverage in the inspection plan or plans of each waste facility under Article 7 of Directive 2006/21/EC;

(d) the inclusion in each inspection plan of the following:

   (i) a general assessment of relevant environmental and safety issues and risks;

   (ii) the geographical area covered by the inspection plan;

   (iii) a list of the waste facilities covered by the inspection plan which hold a permit;

   (iv) the means of ensuring identification of waste facilities covered by Article 7 of Directive 2006/21/EC which operate without a permit;

   (v) procedures for carrying out routine inspections;

   (vi) procedures for carrying out non-routine inspections;

   (vii) procedures for carrying out announced and unannounced site visits;

   (viii) where necessary, arrangements on the cooperation and co-ordination between different competent authorities in charge of inspections and between those authorities and other authorities with a role in the enforcement of permits required under national or Union environmental legislation that is applicable or relevant to the waste facilities covered by Article 7 of Directive 2006/21/EC;

   (ix) information on the human, financial and other resources needed by the competent authority for the implementation of the inspection plan.

2.2. Routine inspections

The following shall be taken into consideration:

(a) the carrying out of routine inspections at regular intervals based on an appropriate risk assessment of the waste facility concerned;

(b) an adequate frequency of site visits based on an appropriate risk assessment of the waste facility concerned, reflecting also the potentially higher risks of Category A facilities;

(c) the application of the following criteria for the risk assessment of the waste facilities:

   (i) the potential and actual impacts of the facilities concerned on human health and the environment, taking into account the levels and types of emissions, the sensitivity of the local environment and the risk of accidents as further specified in Best Available Technique (BAT 5) of the BAT Reference Document for the management of wastes from the extractive industries (MWEI BREF) ([1]);

   (ii) the previous compliance record;

   (iii) the participation of the operator of the waste facility in the Environmental Management System (EMS) as further specified in BAT 1 of the MWEI BREF;

(d) the noting by the inspector, where appropriate, of relevant findings of inspections carried out under other applicable Union legislation;

(e) the provision to the operator, when site visits are announced in advance, of the visit schedule and details of the information, and any other assistance, that the operator will be requested to provide;

(f) in the event of detection of non-compliance or a risk to compliance, the carrying out of an investigation and, as appropriate, the sharing of the results with other authorities, in particular with a view to:

   (i) providing a description of the non-compliance or compliance risk, clarifying its causes and impact on the environment and human health, and in particular clarifying the circumstances (including the persons) which led to non-compliance;

   (ii) providing a factual base to facilitate and enable appropriate responses to address the detected non-compliance and prevent future non-compliance, including, as appropriate, additional inspections, corrective measures by the operator, update of permit conditions, suspension of the permit or use of sanctions;

(g) in the event of the suspension of the operation of a waste facility because of non-compliance with permit conditions, the undertaking of further inspection activities with a view to attaining environmental and other results that the permit conditions were intended to secure.

2.3. Non-routine inspections

The following shall be taken into consideration:

(a) the carrying out of non-routine inspections, including site visits, as soon as possible after the competent authority receives serious complaints concerning non-compliance with the permit requirements or otherwise becomes aware of serious accidents, incidents or occurrences of non-compliance, irrespective of whether such events need to be notified according to Article 11(3) or Article 12(6) of Directive 2006/21/EC, in particular with a view to:

   (i) clarifying the causes of the event, its impacts on the environment and human health, and in particular clarifying the circumstances (including the persons) which led to non-compliance;

   (ii) providing a factual base to facilitate and enable appropriate responses to address the detected non-compliance and prevent future accidents, incidents or occurrences of non-compliance, including, as appropriate, additional inspections, corrective measures by the operator, update of permit conditions, suspension of the permit or use of sanctions;

(b) the noting by the inspector, where appropriate, of relevant findings of inspections carried out under other applicable Union legislation;

(c) the carrying out of non-routine inspections as soon as possible with respect to, and, where appropriate, before the reconsideration or update of a permit.

2.4. Unannounced site visits

The following shall be taken into consideration:

([1]) http://eippcb.jrc.ec.europa.eu/reference/BREF/jrc109657_mwei_bref_-_for_pubsy_online.pdf

(a) the undertaking of an appropriate number of unannounced site visits, in particular where relevant to the detection of problems or risk exposure or the need to respond to an urgent situation;

(b) as far as practicable, the addressing, in decisions on unannounced site visits, of health, environmental and safety concerns and of the possible need for the waste facility's operational staff to be on site.

3. *Documentation of inspections*

3.1. Documentation of inspection activities, including site visits

The following shall be taken into consideration:

(a) the appropriate documentation of all inspection activities;

(b) the preparation, after each site visit to a waste facility, of a site visit report that is recorded in writing and stored in identifiable form in a readily accessible and adequately maintained database;

(c) the inclusion in the site visit report of the purpose of the inspection, the data, information and findings gathered, an evaluation thereof and a conclusion on whether the waste facility complies with the relevant conditions of the permit and whether any further action should follow;

(d) the completion of the site visit report within two months after the site visit, unless more serious findings have been made during the site visit, in which case another deadline may be required;

(e) the provision to the operator, before or after the finalisation of the site visit report, of an opportunity to submit comments, where appropriate;

(f) the availability to the public of the results of the site visit and, as appropriate, of other inspection activities, in accordance with Directive 2003/4/EC of the European Parliament and of the Council ([2]).

PART D

Focus of inspections over the different life-phases of waste facilities

1. *Inspections of new waste facilities prior to the commencement of deposition operations*

The following shall be taken into consideration for the purposes of the inspection:

(a) the implementation of the measures taken in order to minimise environmental impact during operation and after closure, including, if required, handling of contaminated water and leachate;

(b) the compliance of the location, design and construction of the waste facility with the safety and environmental elements given in the permit;

(c) the content, availability and performance of the self-monitoring system for regular monitoring and operators self-inspections and of the planned reporting of the monitoring data to the competent authority;

(d) the implementation of the management, maintenance and surveillance measures planned to ensure the physical stability of the facility and to prevent pollution or contamination of soil, air, surface water or groundwater in the short and long-term perspectives as well as to minimise as far as possible damage to the landscape;

(e) the availability of sufficient human resources and the competence of the personnel in charge of the environmental management and safety of the waste facility;

(f) the adequacy of the plan for closure referred to in Article 5(3)(f) of Directive 2006/21/EC;

(g) the adequacy of the financial guarantee or equivalent with regard to its amount and form, where the competent authority requires a financial guarantee or equivalent; whether the classification of the waste facility as a Category A facility or not a Category A facility needs to be reviewed and verified;

(h) the compliance with any other permit conditions and any other relevant requirements set out in Directive 2006/21/EC.

([2]) Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC (OJ L 41, 14.2.2003, p. 26).

2. *Inspections of waste facilities in operation*

The following shall be taken into consideration for the purposes of the inspection:

(a) adverse effects of the waste facility on the environment and human health and measures taken in order to minimise environmental impact; in particular, suitability of the construction, management and maintenance of the waste facility to ensure its physical stability and to prevent pollution or contamination of soil, air, surface water or groundwater in the short and long-term perspectives as well as to minimise as far as possible damage to landscape and how these effects correspond to the permit conditions and the information in the environmental impact assessment if such an assessment is required;

(b) the compliance of the quantities, characteristics and classification of the waste deposited in the waste facility with the elements given in the permit;

(c) the compliance of the estimated leachate generation, including the contaminant content of the leachate, of the deposited waste, and of the water balance of the waste facility with the elements given in the permit;

(d) structural and operational changes of the waste facility: checking of (1) the water management, (2) the quality of geotechnical construction activities (e.g. raised dam/embankment construction), (3) the management of geotechnical safety systems (e.g. surface coverings, stability and safety monitoring), (4) quantities and characteristics of the waste deposited in comparison to projections in the waste management plan, (5) leachate generation including contaminant content of the leachate in comparison to projections in the waste management plan, (6) the water balance of the waste facility in comparison to projections in the waste management plan, and (7) techniques used for, and the adequacy of, the environmental and safety management and the environmental monitoring;

(e) the adoption of measures recommended or imposed after previous inspections;

(f) the environmental and safety audit reports and statements if required in the permit;

(g) results, completeness, management and performance of the self-monitoring programme for regular monitoring and of the reporting of all monitoring data (if applicable) to the competent authority;

(h) visual abnormalities of the site;

(i) the representativeness of the sampling and characterization of extractive waste;

(j) roles, responsibilities and competence of personnel in charge of the environmental and safety management of the waste facility as well as availability of sufficient human resources and training provided to staff;

(k) procedures for notifying the competent authority of any events likely to affect the stability of the waste facility, and any significant adverse environmental effects revealed by the relevant control and monitoring procedures;

(l) the adequacy of the plan for closure referred to in Article 5(3)(f) of Directive 2006/21/EC and compliance with any progressive closure measures specified in the plan;

(m) the adequacy of the amount and form of the financial guarantee or equivalent in respect of the calculated costs for the obligations of the operator under the permit, including closure and after-closure arrangements and rehabilitation of the land affected, where the competent authority requires a financial guarantee or equivalent;

(n) the classification of the waste facility as a Category A facility or not a Category A facility;

(o) the compliance with any other permit conditions and any other relevant requirements set out in Directive 2006/21/EC.

3. *Final on-site inspection of waste facilities in accordance with Article 12(3) of Directive 2006/21/EC*

The following shall be taken into consideration for the purposes of the inspection:

(a) adverse effects on the environment and human health from the waste facility and the measures taken in order to minimise such impact after closure, including, if required, the handling of contaminated water and leachate;

(b) the implementation of the plan for closure referred to in Article 5(3)(f) of Directive 2006/21/EC;

(c) the rehabilitation of the land affected by the waste facility;

(d) the adequacy of the plan and arrangements for the maintenance, monitoring, control and corrective measures in the after-closure phase of the waste facility, including the functioning and the adequacy of the monitoring, surveillance and control equipment;

(e) *the adequacy of the amount and form of the financial guarantee or equivalent* in respect of the calculated costs for the obligations of the operator under the permit, including completion of closure and after-closure arrangements and remaining rehabilitation of the land affected, where the competent authority requires a financial guarantee or equivalent;

(f) the classification of the waste facility as a Category A facility or not a Category A facility;

(g) the compliance with any other permit conditions and with any other relevant requirements set out in Directive 2006/21/EC.

4. *Inspections of waste facilities after the closure, with regard to facilities closed after 1 May 2008*

The following shall be taken into consideration for the purposes of the inspection:

(a) adverse effects on the environment and human health from the waste facility and the measures taken in order to minimise such impact after closure, including, if required, the handling of contaminated water and leachate;

(b) the correspondence between, on the one hand, the adverse effects referred to in point (a) and, on the other hand, the permit conditions and the information in the environmental impact assessment, if required;

(c) the compliance of the leachate generation, including the contaminant content of the leachate, of the deposited waste, and of the water balance of the waste facility and, if required, the handling of contaminated water and leachate with the elements given in the permit;

(d) the implementation of the plan for closure referred to in Article 5(3)(f) of Directive 2006/21/EC;

(e) the adequacy of the plan for closure referred to in Article 5(3)(f) of Directive 2006/21/EC, in particular as regards the need for additional closure and rehabilitation measures based on environmental risk and impact evaluation;

(f) the rehabilitation of the land affected by the waste facility; the adequacy of the plan and arrangements for the maintenance, monitoring, control and corrective measures in the after-closure phase of the waste facility, including functioning and the adequacy of the monitoring, surveillance and control equipment, and of the reporting of all monitoring data to the competent authority;

(g) procedure for notifying the competent authority of any events or developments likely to affect the stability of the waste facility, and of any significant adverse environmental effects revealed by the relevant control and monitoring procedures;

(h) the adequacy of the amount and form of the financial guarantee or equivalent with in respect of the calculated costs for the obligations under the permit, including completion of after-closure arrangements, corrective measures and rehabilitation of the land affected, where the competent authority requires a financial guarantee or equivalent;

(i) the classification of the waste facility as a Category A facility or not a Category A facility;

(j) the compliance with any other permit conditions, and any other relevant requirements set out in Directive 2006/21/EC.

PART E

Additional elements for inspections of Category A waste facilities

1. *Inspection of dams of Category A waste facilities containing tailings*

In addition to the relevant elements listed in Part D, the following shall be taken into consideration by the inspector where the inspection concerns dams of Category A waste facilities containing tailings:

(a) type and condition of erosion protection;

(b) adequacy of the hydrological design, such as water balance, available free-board (vertical distance (height) between the normal maximum operating level of a pond and the crest of the dam);

(c) composition, status and structural integrity of the beach, such as presence of depressions, tailings density, dust control;

(d) changes of the dam's crest and slope comparing the current state versus the design state;

(e) functioning and condition of the drainage system and its state and geotechnical structures (such as geomembranes, dams) and equipment (such as dam structure monitoring);

(f) leakage and seepage areas, and amount of material leaked;

(g) any detected damages;

(h) trees and vegetation on the dam.

2. *Inspection of discharge arrangements of Category A waste facilities containing tailings*

In addition to the relevant elements listed in Part D, the following shall be taken into consideration by the inspector where the inspection concerns discharge arrangements of Category A waste facilities containing tailings and the functioning of such discharge arrangements:

(a) adequacy of access to discharge lines and discharge points;

(b) damages of construction and control equipment;

(c) leakage through and around the discharge arrangements;

(d) erosion of downstream outlet;

(e) vegetation in or close to the discharge arrangements;

(f) discharge regulation equipment;

(g) emergency discharge arrangements;

(h) back-up power supply;

(i) rate of increase of discharges to the tailings pond and related rate of increase of the pond level (measured in meters/year);

(j) tailings placement system;

(k) water management system.

3. *Inspections of Category A waste facilities containing waste rocks*

In addition to the relevant elements listed in Part D, the following shall be taken into consideration by the inspector where the inspection concerns Category A waste facilities that contain waste rocks:

(a) weathering of the rocks;

(b) seepage water quality and quantity;

(c) whether the measures taken to minimise the environmental impacts of waste rock facilities are adequate;

(d) correctness and effectiveness of recultivation activities based on relevant legal obligations.

Distribution: Restricted

Date :	20/11/2020	Ref.	RMA/1810454/IVK-BL-JB-PC/20201120
From :	Project coordinator	Annexe(s):	
To :	EU Project Officer		
Copy (CC) :	Consortium		

Study supporting the development of general guidance on the implementation of the Extractive Waste Directive (EWD) – Minutes of the final workshop (webinars)

Service contract no. ENV.B3/ETU/2017/0039
When:

- **Webinar 1: 8 June 2020, 14:00 to 16:29**
- **Webinar 2: 10 June 2020, 14:00 to 16:39**
- **Webinar 3: 11 June 2020, 14:00 to 16:00**

Location: Online meeting (ZOOM platform)

LIST OF ACRONYMS

AEG	Alberta Energy Regulator (Canada)
AMSA	Austrian Mining and Steel Association
BoQ	Bills of Quntities
BGR	Bundesanstalt für Bodenforschung
CE	Circular Economy
CONFEDEM	Spanish national confederation of entrepreneurs in mining and metallurgy
DG ENV	Directorate-General for Environment
DG GROW	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
EC	European Commission
EIA	Environmental impact assessment
ENEA (It)	National agency for new technologies, energy and sustainable economic development
EOPC	Employers Organization of Polish Copper
EW	Extractive Waste
EWD	Extractive Waste Directive
EWF	Extractive waste Facility
EWMP	Extractive waste management plans
FG	Financial guarantee
FIDIC	International Federation of Consulting Engineers ("Fédération Internationale Des Ingénieurs-Conseils")
GME	Greek Mining Enterprises association
GTK	Geological Survey of Finland
IMA-Europe	Industrial Minerals Association Europe
JRC	Joint Research Centre
LBEG	Landesamt für Bergbau, Energie und Geologie
Ł-IMN	Lukasiewicz-Institute of Non-Ferrous Metals
MS	Member State
RMIS	Raw Material Information System
TBL	Total Business Land
TMD	Turkish Miners Association
UEPG	European Aggregates Association
UNECE	United Nations Economic Commission for Europe
VKS	Association of the Potash and Salt Industry eV

1. Webinar I: Production and waste reporting (08/06/2020)

1.1 Attendees

- EC:
  - EC - DG Env
  - EC – DG Grow
  - EC-ISPRA
  - EC – JRC

- Consortium
  - VITO
  - Eco-Efficiency
  - Euromines
  - MEERI
  - TBL
  - WEFalck

- Associations
  - AEG
  - AMSA
  - CATAPA
  - CONFEDEM
  - EOPC
  - Eurogypsum:
  - Finish mining association
  - GME
  - IMA-Europe:
  - SveMin
  - TMD
  - UEPG

- Consultants
  - C&E
  - Ictus

- Geological Surveys
  - Finland
  - Slovenia
  - Spain (IGME)
  - Sweden

- Industry
  - First Quantum Minerals
  - Hellas Gold SA
  - Imerys
  - Nordkalk
  - Sibelco
  - Tolsa
  - Vapenka Vitosov s.r.o.

  - VRB

- Member States (MS)
  - Bulgaria
  - Croatia
  - Cyprus
  - Czech Republic:
  - Estonia
  - Finland
  - France
  - Germany
  - Greece
  - Hungary
  - Ireland
  - Italy
  - Latvia
  - Poland
  - Portugal
  - Spain
  - Sweden

- Universities – Research institutes
  - ENEA (ItT)
  - Hochschule Magdenburg
  - Ł-IMN

1.2 Agenda

The agenda of Webinar 1 is given in Annex I.

1.3 Welcome & objectives of the project (EC-DG Env.)

VITO welcomed remote guests and introduced the project officer from the European Commission.

The project officer from the European Commission welcomed the participants and gave a brief introduction on the Commission's efforts to foster the implementation of the key principles of the Extractive Waste Directive (EWD), which was adopted in 2006 and came into force in 2008. Two tri-annual Member States reporting periods were analysed in 2015 and published in an Implementation Report in September 2016. The main conclusions of the Implementation Report were that the Member States (MS) had taken the initial steps and adopted the measures needed to implement the EWD. However, the report identified several issues that had still to be addressed. In particular, the report pointed out that the figures on the amounts of waste and waste facilities appeared not plausible. The reported waste data did not appear to match the number of mining facilities known to be presentin many Member States. Member States with a quite strong mining sector reported rather small amounts of waste and/or waste facilities and vice versa. Subsequently, the European Commission (EC) already announced first steps, including the adoption of the technical guidelines on the inspections of extractive waste facilities (EWFs). In March 2017 the EC organized two workshops, one with Member States and one with stakeholders to identify elements and issues where legal or technical clarifications would support a more uniform implementation of the EWD. Both workshops materialised, inter alia, the technical workshop in February 2020. Another outcome of the workshop in March 2017 was the elaboration of guidelines on setting financial guarantees for the closure of EWF, a topic that would be touched upon in the second webinar this week. The 2016 Implementation

Report announced the plan to resume the preparation and adoption of the technical guidelines for EWF inspections. Furthermore, the Implementation Report announced that the Commission would develop *general guidelines* on the implementation of the key principles contained in the EWD. The call for tender for the current project requested the development of "General Guidelines" for the implementation of the EWD that needed to be distinguished from "Commission Guidelines", which provided interpretative guidelines for legislation and requires adoption by the College of Commissioners. The main objective of the project, therefore, was to initiate a dialogue with authorities and stakeholders on key concepts of the EWD in the context of a wider picture of implementation for the entire sector. The focus on waste turned out to be a bit too narrow when we wanted to have a better understanding on what Member States regard as being waste and what flows were not considered as being waste. So, the project looks at all material flows from an extractive site and to finds out how and why they are classified in a given manner. This automatically has led to a discussion on the key concepts of the EWD, which is the first step towards a more uniform interpretation of the EWD.

The project officer from the European Commission briefly introduced the members of the VITO consortium, who have done a great deal of work over the last two years to gather information.

Due to the Corona outbreak the earlier announced final workshop which would have presented all results of the project had to be adjusted. Not only the format but also the content was changed. This week's webinars will bring all stakeholders (71 participants today) up to date on the progress of the project. Perhaps delegates will have some answers or further questions. The webinars allow us to consider your views when finalizing the full reporting for the project. From the DG Environment point of view, it will also allow the Commission to consider possible follow-up actions.

DG ENV suggested that rather than introducing all 71 delegates, at least the consortium members could introduce themselves under the leadership of VITO.

1.4. Key issues concerning waste,waste treatment and waste codes – Euromines (Euromines)

Euromines summarised the key issues that the project has uncovered from the country reports and the various discussions with the Member States. What is presented is of course not applicable to each and every Member State but represents an overall summary. The slides are given in Annex II.

The first issue to raise is that despite definitions being clear, there seems to be a problem with those being properly reflected in statistical reporting. For example, statistics are not collected for all the categories of waste mentioned in the EWD. More specifically, the European list of waste does not distinguish inert waste from non-inert waste or reactive waste from non-reactive waste.

Secondly, implementation of the EWD definitions is not an issue either (most Member States have copy/pasted the definitions directly from the EWD into their legislation), but often the vernacular or professional language used within the Member State / sector does not line up very well with the legal terms and interpretation.

Thirdly, it appears that characterisation of the expected wastes is an important aspect of implementing the Directive, both for understanding how to adequately manage the risks posed by reactive waste once it is generated, but also how to manage any by-products, for instance in excavation voids. This is an area were policies and management practices have changed and not everything is completely in harmony.

A fourth issue is how the definition of extractive waste depends on the linked definition of “treatment” of a mineral resource. Legally speaking, metallurgical waste should not be reported under extractive waste codes, but it appears that this separation might not always be successfully practiced all the way along the reporting lines. For example, in certain instances (e.g., some gold mines) extractive and metallurgical wastes may be managed together and may therefore not be reported separately in the MS statistics. Within this respect some clarification may be required when it comes to the amounts being reported.

The legal definitions and the industrial practices in some areas are not always a perfect match. The boundary between extractive waste and metallurgical waste sometimes is a bit of a grey area and sometimes it does not make a lot of practical sense. How is this being reflected in the national statistical reporting? How do the figures arrive from the companies? Have they differentiated the numbers?

The sixth aspect is that sometimes the progress keeps shifting faster than the statistical reporting. Unique to the extractive sector is the regular changing of a materials’ status due to 1) business and price cycles, 2) technological conditions, and 3) the changing of the setting of environmental and social policies (e.g., waste becoming a by-product and a by-product becoming waste). Hereby the following question arises “When does waste cease to be a waste and when does it actually (or should) fall out of waste reporting”? This issue deserves some more reflection.

Finally, we have some questions concerning the waste codes. Some of the waste codes that are currently being used for the reporting cause some confusion because of the imprecisions of some of the codes. For all the above reasons, it cannot be assumed that all the (hazardous) waste reported as arising in the sector is “extractive waste” and/or should be managed in (Category A) extractive waste facilities. Other waste is included in the statistics, which is managed elsewhere.

Euromines presented several short-term and longer-term options for improving the current waste reporting for discussion, including through some digitalisation of the information generated by implementation of the EWD. This brings us to the option already proposed by the European Commission to modify the current reporting format to resemble more a collection of Country Fact Sheets. Finally, very much a longer-term option, would be to seek changes to the Eurostat indicators to better match the needs of the Commission in evaluating the implementation of the EWD.

→ Discussion

DG Env, referred to previous discussions in 2017 about the development of an electronic reporting system. Since the Commission has concluded in the 2016 implementation report that the information being currently collected is not suitable to assess implementation of the EWD, it would make sense to first consider which information is required, and to then progress to a more digital way of reporting it.

DG Env argued that metallurgical processes are excluded from the definition of waste treatment of the EWD while the directive sets detailed requirements for the cyanide leaching step of gold ore processing. He asked whether participants consider cyanide leaching as a hydrometallurgical step. He asked whether, therefore, the exclusion would be restricted to pyrometallurgy rather than all metallurgy.

Euromines, proposed that a difference should not be made between hydro- and pyro-metallurgical processes, but rather a clear distinction made between metallurgical processes and "treatment of a mineral resource".

On the digitalisation of the reporting, Euromines agreed with DG Env and suggested that a digital format might allow for greater precision so that better quality information can be collected. Euromines asked for further answers from the participants.

Hellas Gold, asked whether mine water sludge, for which it considered there was not an appropriate European waste code, can be disposed of in an EWF or whether it must be taken offsite to a hazardous waste landfill. **Euromines** responded that the question would need to be studied in detail, also with reference to the views of the national authorities.

BGR, asked about how the potential value of old tailings might be assessed. Euromines responded that this was beyond the scope of the project.

SveMin, agreed that an important distinction should be made between extractive waste and non-extractive waste and that this might need to be decided for each operation individually. In most cases, it should not be an issue.

JRC, pointed out the existing definition of "treatment of a mineral resource" in the EWD. From that definition it seems clear that waste from the cyanide-leach process is included in the definition of "extractive waste".

Swedish EPA, completed this by saying that indeed leaching is included in the definition and that metallurgy is excluded. It suggested that the hydrometallurgical steps of heap-leaching operations are considered by some to be in scope, but perhaps there is some lack of clarity about what constitutes a metallurgical process.

Eco-Efficiency, proposed that the difference between beneficiation and metallurgy is clear for the industry based on science, so together with authorities the distinction between both can be agreed for each site. If there are any problems arising, they could be where a legal document might contradict the science.

Euromines agreed with the JRC that cyanide-leaching is a "beneficiation" process and not a hydrometallurgical process.

DG Env, asked to move on to the proposed short-term and long-term options for improvement.

BGR, raised the EU's INSPIRE code. When combining different sources of data, the devil is in the detail. With regards to the presented options, before establishing a common Country Fact Sheet based reporting, it would be interesting to think about the different reporting indicators to include in them. In addition to cycles referred to by Euromines, materials change (weather) over time *in-situ* and larger non-cyclical trends in materials demand also influence the status (or value) of former wastes. There are therefore many uncertainties and so developing an INSPIRE-compatible digital reporting would take a lot of time.

Swedish EPA, asked about the alternative means of reality-checking that Euromines referred to. It was not clear whether the method referred to in the background document would successfully consider the first criterion for Category A facilities (possibility of a major accident from incorrect operation).

Euromines, responded that the bottom-up approach taken for existing metal mines guides one to a number of questions as to why certain mines do not have Category A facilities. One reason may be that some assumptions are incorrect, but equally the question about incorrect operation could be raised.

Turkish Mining Association, asked whether the proposal only applied to metal mines, because in some of them (and also at many industrial minerals mines) lower-grade material is stored for future sale and may not finally become waste. A good example is Chromium content, for which prices and therefore saleable grades vary frequently. Large volumes of overburden, containing minerals associated with the orebody being exploited, are also handled at mines. In some cases, previously high quantities of reported waste in some Member States could have included this overburden. *[ndlr This was reported to be the case in Bulgaria & Romania for example].*

→ Relevant chats

1) **Hellas Gold**, Regarding the extractive waste codes, Euromines said in slide 7 that waste from metallurgical process should not be reported as extractive waste. My question is whether we can consider the soil that is contaminated from extractive wastes (i.e. tailings) if it can be disposed in an extractive waste management facility? Similar to that, the mine water sludge is it considered as extractive waste?

2) **Eco-Efficiency)**, "Answer to Hellas Gold 's question": If I understand well your question, the land (soil) has been affected only from the deposition of extractive waste and not from the existence of other waste. The contaminated soil from extractive waste is not mentioned in the European List of Waste and it is not clear how this issue is managed in each member state. Taking into consideration that it is soil/excavated material contaminated/ affected by the deposition of old tailings (extractive waste) why not let it be deposited in the extractive waste Category A facility with the other extractive waste that is managed?

3) **BGR,** mentioned the dynamics of the concept - valuable good vs waste. Can you elaborate how you see the various minerals properties (recent and formed over time in historical mining heaps) are reflected?

4) **SveMin,** Hydro- and pyro is in most cases a practical distinction. But to be 100% clear, what is extractive waste will have to be decided/defined for each alternative process. In my opinion in most cases (including gold leaching) it is not an issue.

5) **Eco-Efficiency,** Hydro or pyro metallurgy is scientificly clear and it is separated from the beneficiation process. The problem is what legally is given in some legal documents.

6) **Euromines,** I think it must be questioned whether cyanide-leaching is "hydrometallurgy". I guess most in the industry would consider it a beneficiation step prior to any "metallurgy".
7) **WEFalck,** There is a fundamental problem with the concept of "waste", particularly in the context of the circular economy paradigm.

1.4 Waste from extractive industry reporting – case of Poland (MEERI)

MEERI presented a detailed case study for Poland. The slides are given in Annex II. In Poland, mining companies report to at least three different organization including the statistics offices, the Voivodship offices, mining authority offices and geological surveys. Unless confidentiality limits must be applied, all the data is public somewhere, but it is not an easy exercise to gather it all together mine by mine. Sustainability reports of companies are another source of data, but not all the smaller companies produce one.

From such public sources, it is not always easy to attribute waste quantities to a particular mine, or even to the mining of a particular commodity. Neither is it possible to split out waste from primary production and waste from re-processing of waste. This can lead to waste from "treatment of a mineral resource" being reported despite the absence of a mine (extraction activity).

National statistics from the statistical office aggregate waste data for the NACE Section B set of activities, which covers more than just extractive waste. In Poland, fees are paid to a National Fund per unit of waste discarded and this fiscal data can be gathered at regional scale (voivodships).
MEERI referred to specific examples of how the definitions are applied in Poland, which leads to results that may at first be surprising: e.g., the lignite mines do not report extractive waste, but do report waste from aggregates production. Other aggregates quarries sell all materials and report zero waste.

In conclusion, there is a difference between "extractive waste", "waste from mining" and "waste from the mining sector".

→ Discussion

Turkish Miners Association, asked if the Polish approach of excluding materials that are not waste can be generalized for implementation of the EWD across the Union. **MEERI** explained that the Polish approach is common across Europe. **Euromines** confirmed that the Polish approach follows EU legislation and rulings of the European Court of Justice.

Eco-efficiency, asked MEERI if the code 010101 is sometimes used in Poland for process waste, because normally all process waste should have its own code. **MEERI** responded that waste from re-processing of older wastes is correctly reported under 0101, which includes waste from treatment of such material. An alternative code might be found under 0104, but for the moment it seems to be reported under 0101.

→ Relevant chats

1) **Eco-Efficiency:** So, for Poland there is no way Eurostat can give figures for extractive waste?
2) **Turkish Mining Association:** Can similar waste exclusions applicable to Poland's case (i.e., overburden in open pit coal mines, ……) be considered in EU-wide implementation of the Directive?

1.5 Licensing and supervision (Ictus Consulting)

Ictus Consulting presented a Licensing and Supervision platform that his company was preparing for the Finnish agencies. This project was launched by the Finnish Prime Minister in 2016 and includes many stakeholders and very different subject areas.

Work began in 2018 and it aims to provide a client-oriented one-stop-shop that provides services across administrative levels in any activities that requires licensing and supervision. Hereby, it is important to ensure fast, efficient and high-quality licensing and supervision so that all aspects of environmental safety and economical topics are secured and posted. It is therefore very much about unifying and rethinking processes within and between organisations and legislations. To reach the project goals, an iterative approach is needed.

The information needs are very agency-specific and there are large gaps in digital services at the local scale. The individual agencies lack visibility on the overall business and licence needs of the customers. Therefore, the customers need to act as a link between different authorities. The service platform provides a unifying layer that collects and relays information to different organisations and combines the status information from various processes back into a summary review based on the customer needs. The initial focus has been licensing of other sectors, but also supervision of mining operations. The digital platform supports scheduling of inspections and efficient alerting in case of an accident. There are many stakeholders to work with and the project is cross-functional across the Finnish government.

The platform is currently being piloted at Kitilla Gold mine. Value has already been identified. Later this year, the platform will be expanded to other sectors and to mine licensing. Ictus Consulting then gave a live demonstration of the tool as it is today. It compiles centralized lists of all the licences required for a single project.

→ Discussion:

Eco-efficiency, also asked who in Finland will be authorized to validate the data that is entered into the system. Ictus Consulting explained that the project is working on the processes to manage this in accordance with the legislation, which is very strict about individual agencies' responsibilities for the data. At the same time, individual companies will retain responsibility for entering other information. Mechanisms of moderation and oversight are also being discussed.

Euromines, asked if the Finns need to do some digitalization of information. Ictus Consulting explained that, yes, in parallel there are several projects to convert older paper or pdf information into a structured digital form. It may be necessary to specify a pragmatic starting date to avoid having to enter a lot of older information.

→ Relevant chats

1) **EPA Ireland,** Ireland has developed an online and interactive licensing, supervision and enforcement system along the lines of Finland.

1.6 Discussion on a European approach

DG Env asked Ictus Consulting how far the Finnish system might reach. For example, will it also take in waste data from the licensing process and then pass it on to Eurostat?
Subsequently he asked all Member States the extent to which they are implementing similar digital systems for their permitting processes? Would there be any sense in developing such things jointly?

Ictus responded the project's vision is ambitious and extensive. The intention is to add functionality over time. For example, there is potential to use Artificial Intelligence to help agencies with the licensing processes. The overall focus is to be customer-centric, shortening licensing times for customers. Additionally, the entire platform is being made to be open source, which means it is amenable to working jointly rather than re-invent wheels across Europe.

EPA Ireland reported that it runs a similar on-line system. It interacts with the companies, they provide the data that is required in their licenses, (Irish licenses are integrated so they meet the requirements of other Directives as well), the EPA scrutinizes the information and companies are legally obliged to flag any non-conformities to the authorities. The system can be expanded with additional functionalities, so in principle it could also extend to reporting to Europe and that is still being developed.

1.7 Reflections and conclusion (EC-DG Env.)

EC-DG Env summarized the agenda of the day and suggested moving to digital systems in future would probably be in everyone's interests. Main message is that the digital format is not put on top of the development. Nevertheless, he was interested that the Finnish project mentioned an iterative process as matching up available information and information needs would be important; and referred to similar work being undertaken by colleagues within the Commission, including the work connected with INSPIRE. The code list needs also to be considered while working on the databases. INSPIRE-compliance may be challenging, but even long-term initiatives must have a starting point. Any such work could not be unilaterally decided by the European Commission but would need to be agreed with the Member States. It is timely to think about better, more meaningful reporting more broadly and EC-DG Env expressed a willingness to make more internal enquiries within the Commission if Member States so wish. EC-DG Env concluded it was a very useful webinar for identifying potential ways forward in the near future.

2. Webinar II: Financial guarantees and extractive waste management plans (11/06/2020)

2.1 Attendees

- EC:
  - EC - DG Env
  - EC – DG Grow
  - EC-ISPRA
  - EC – JRC

- Consortium
  - VITO
  - Eco-Efficiency
  - Euromines
  - MEERI
  - TBL
  - WEFalck

- Associations
  - AEG
  - AMSA
  - CONFEDEM
  - EOPC
  - Eurogypsum:
  - Finish mining association
  - IMA-Europe:
  - SveMin
  - TMD
  - UEPG

- Consultants
  - C&E
  - IAF Radioökologie

- Geological Surveys
  - Finland
  - Slovenia
  - Spain (IGME)
  - Sweden

- Industry
  - Carmeuse
  - First Quantum Minerals
  - Hellas Gold SA
  - Imerys
  - Nordkalk
  - Sibelco
  - Vapenka Vitosov s.r.o.

- Member States (MS)
  - Bulgaria
  - Croatia
  - Cyprus
  - Czech Republic:
  - Estonia
  - Finland
  - France
  - Germany
  - Greece
  - Hungary
  - Ireland
  - Latvia
  - Spain
  - Sweden

- Universities – Research institutes
  - ENEA (ItT)
  - Hochschule Magdenburg

- Organisations / Affiliations?
  - LBEG
  - VKS

2.2 Agenda

The agenda of Webinar II is given in Annex I.

2.3 Welcome & objectives of the project (EC-DG Env.)

VITO welcomed participants and gave the floor to EC-DG Env who welcomed all participants to the second webinar dealing with financial guarantees and extractive waste management plans, noting that most participants had already attended the webinar on Monday. He invited any newcomers to refer to the background document. Although VITO had issued the invitations to this webinar, EC-DG Env explained that the day's topics would be presented by two separate sets of consultants working under separate contracts to the European Commission, under the leadership of C&E GmbH and Eco-Efficiency respectively.

The separate study run by C&E was focused on guidance for financial guarantees and closures of entire mines (not only the extractive waste facilities).

2.4 Waste Facilities Category A – Financial Guarantees (C&E)

C&E presented results of their study entitled "Study on the elaboration of guidance on best practices for calculation and periodic adjustment of the financial guarantee for extractive waste facilities". The slides are given in Annex III. The first part of the presentation deals with financial guarantees for Category A EWFs. The second part of the presentation is about closure planning and is scheduled before the presentation of Eco-Efficiency.

Firstly C&E described the term "extractive waste (EW)" as waste originating from extractive operations and processing of mine resources, including topsoil, overburden, waste rock and particularly tailing material remaining after processing. This material represents one of the largest

waste streams in the European Union and is an environmental liability. Such liabilities are covered / have to be covered by financial guarantees and are therefore internalised. The mining lifecycle must be considered since the approach is to accumulate as much funds as needed during the operation of the mine and if necessary to be spent on financial guarantees at the end. Financial guarantees represent a source of funding for these liabilities located at a financial institution (e.g. a bank). Provisions can be bank guarantees, letters of credit, surety bonds and performance bonds.
According to Petra Schneider, mine closure encompasses rehabilitation at the end of a mine's life and approval of that closure by the competent authority.

Horizontal EU legislation exists, including the EWD, the MWEI BREF, the Seveso III directive, the Environmental Liability Directive etc. The requirements of all these directives and guidance need to be considered during development of the mine closure plan. Of course, there are also strong linkages with waste legislation.

There are three main criteria for classification of Category A EWFs as per the Commission Decision (EWD, Annex III). The EWD requires that a financial guarantee be established by the operator, prior to the commencement of such facilities to protect society from closure liabilities and ensure that the closure plan is implemented.

Available financial guarantees can be divided into three different categories, ranging from guarantees 1) within the company structure, to 2) third (commercial) parties, through to 3) the placement of a guarantee with a competent authority or trust fund. A defined and approved closure plan forms the basis for calculating the financial guarantee. To arrive to such a closure plan a stepwise approach is necessary, including the definition of the after use for both the waste facility itself as well as for the land surrounding the EWF. Furthermore, an environmental risk assessment is needed comprising the characterization of the waste and continuous monitoring during the mining operations to establish the environmental baseline. These data together with the description of the environmental objectives after closure will result in a closure plan to achieve the desired land-use. Generally speaking, the main closure objectives are physical stability and prevention of release of contaminants in the short and long term. These objectives are usually fixed in the permits and applicable standards for implementation of the closure plan.

Measures to implement the closure must be site-specific and follow best available techniques. They may need to be implemented at differing timescales. The size of the financial guarantee therefore relies on estimates of future costs.

In terms of liability generally, C&E drew a difference between foreseen liabilities (e.g. development, closure, restoration, remediation, decommissioning and aftercare of installations) and unforeseen liabilities arising from incidents / accidents. The first are the subject of the EWD financial guarantee and the second are the subject of the Environmental Liability Directive. Foreseen closure liabilities can be expected to change through the life of the mine, so the amount of the financial guarantee may need to be updated at different times. In general, calculations should be based on the maximum potential liability as determined by the location specific risk assessment.

Closure plans not only include the activities to close the site itself but the fulfilment of Article 7 requirements of the EWD also require rehabilitation/restoration activities (the so-called after-care plan).

Regarding the cost of closure, the following cost types must be considered 1) investment and maintenance costs, 2) design, engineering and supervision costs and 3) administrative costs, including permits, fees and taxes. Post closure costs comprise 1) after-care and monitoring costs and 2) inspection costs.

Financial guarantees must be complemented by permitting, inspection, enforcement and education processes to be effectively implemented. According to the assessment of existing closure plans there is still room for improvement in terms of enforcement associated with the scope of established financial guarantees. The permitting process is necessary for clarifying the criteria for mine closure, impelling planning for closure cost, successful implementation and finally to get approval of the competent authority for the successful closure.

In concluding, C&E asked 1) if competent authorities required support in this area? 2) whether they had a preferred type of financial guarantee? and 3) how to maintain the value of the financial guarantee in time of decreasing interest rates?

→ Discussion

Irish EPA, asked whether C&E consider the Member State's access to the financial guarantee in the case of default/abandonment by the company? Sometimes, it has happened that others get access to the funds before the competent authority is able to. C&E had not explicitly addressed this topic yet and noted it for inclusion.

Euromines, raised that there are equally cases where once permit conditions are fulfilled, companies are not able to recover the funds that were placed in guarantee, which is not correct either. Once the closure is terminated, the financial guarantee must be refunded to the company. **C&E** will also make a note on this.

WE Falck, asked how it can be possible that a company cannot access the money? If it cannot do so, the funding would not appear to fit the definition or requirements of a financial guarantee. A guarantee is only a guarantee if the company receives the money back only after it has completed the works. Will you be touching on the way how to calculate the amount in euros or another currency? **C&E** acknowledged that if access is not secured, the funds are not "guaranteed". Regarding the currency aspect, C&E responded that this aspect was considered in the study. To get an idea of the cost range that might arise from the closure activities C&E assessed thirty different closure plans. The cost range is very site specific depending on the typology of the waste and the types of activities that are needed to be implemented to reach the closure goals and the after-care use.

DG Environment, clarified that the EWD article related to financial guarantees does not necessarily apply to non-Category A facilities. Member States appear to interpret the Article as meaning that Financial Guarantees must not be established for non-Category A EWFs. Hereby the following questions can be asked:

1) Did the closure plans assessed by C&E include non-Category A facilities?
2) According to which criteria did the authorities from MS decide to reduce or even waive the obligation for FG requirements for non-Category A EWFs?

C&E, answered that the criteria for classification of Category A facilities do not only depend on the intrinsic properties of the waste, but also the geotechnical/physical stability of the EWF as a whole. These can, in theory, be an issue also for large EWFs at aggregates quarries. To gain a full understanding, the study looked also at closure plans for non-Category A facilities.

Spain, provided the feed back that she would collect the answers to DG Environment's questions in the coming days.

Hungary, indicated that he is not aware of any problems with the management of the financial guarantees, because there is a strict regulation in place in Hungary and strict management by a central office of mining & geology.

Sweden, requested that the specific question be posed more clearly in writing so that an answer could be prepared. **DG ENV** indicates he plans to have a meeting with experts from the MS in fall of 2020 where the results of the report on the financial guarantees may be discussed. There will be no exchange on this question for the moment since that question will be discussed during the meeting.

AEG, wondered if C&E had taken into consideration concerning the funds of financial guarantees that it can take some time to access these financial funds. The longer it takes to get access to funds, the more expensive unplanned closures can become. **C&E** replied that C&E had touched on this subject a little bit but she would be happy to receive some more input and feedback on this aspect during the webinar. **AEG** indicated that in Canada there are 2 types of security for financial guarantees, “cash and letters of credit” because of the rapid access to these funds. Challenges are with the insurance mechanisms where you must make a claim against 3rd parties who save these provided provisions. AEG has experienced delays and funding shortfalls with insurance-type instruments for financial guarantee. The regulator or competent authorities must find creative solutions. Within this respect also monitoring the financial health of the guarantor becomes an issue as well. If they go out of business guarantees you received become worthless.

Irish EPA: With respect to the 3 main questions indicated by **C&E**, he expressed that there was no need for support, preferred cash secured funds or letters of credit from healthy institutions. Ireland had not experienced any of these issues with decreasing interest rates, but regular re-evaluations are undertaken to make sure that the guarantee matches remaining closure liabilities.

→ Relevant chats

1) **SveMin**,: On **WEFalck’**s comment, closure is not always only at the end of operation. On the opposite, partial closure work during operation is preferred, and should lead to release of funds.
2) **WEFalck**, Indeed. But a guarantee is only a guarantee, if the funds can only be accessed by the company (or its creditors/executors) once they have completed the works.
3) **Euromines**: Yes, but it has to be still there once the closure is terminated and has to be refunded then.
4) **Ministry of the Environment, Finland,**: In Finland the financial guarantees are also taken into account for non-hazardous, non-inert waste (facilities) in the environmental permits.
5) **Euromines**,:
    a. Article 2(3) of the EWD states that "Inert waste and unpolluted soil shall not be subject to Article 14 (on FGs) unless deposited in a Category A waste facility."
    b. "Member States may reduce or waive the requirements of Article 14 for non-hazardous non-inert waste, unless deposited in a Category A waste facility."
    c. Article 14 then states that "The calculation of the guarantee shall be made on the basis of [inter alia] the likely environmental impact of the waste facility taking into account in particular the category of the waste facility".

2.5 Waste Facilities Category A – Closure Planning (C&E)

C&E defined closure as either progressive site rehabilitation or site rehabilitation at the end of a mine's life including shutdown, decommissioning, remediation/rehabilitation and post-closure activities, approved by a closure certificate issued from the competent authority. A closure plan serves as the basis for the regulatory body's determination of the amount for the financial guarantees. The financial guarantees must cover closure and post-closure activities (see § 2.4).

In the context of overall closure planning, C&E highlighted the workflows or activities related to extractive wastes. Across aggregates, energy minerals, metallic minerals and industrial minerals sectors there are some general characteristics, but also large differences (e.g. large areas of land for lignite mining or large waste heaps associated with salt mining). There is no generic split between surface (open cast), underground mining or through drilling along mineral or product category lines.

Generally, closure must take place in accordance with BAT (Best Available Techniques) to achieve high level of protection of all environmental media under economically and technically viable conditions. Regarding mine closure, differences are made between progressive closure, final closure and premature closure.

In all cases, closure planning and design needs to be considered already during the design and permitting phase of a mining operation. C&E foresees stakeholder engagement as well as planning and implementation of "social transition". Post-closure activities were described as monitoring, maintenance and management. Closure planning and design is affected by considerations of the after-closure land-use: "what should be there after closure". Closure plans should be updated regularly and particularly the related cost estimates.

Some related terms usually require careful definition, like "decommissioning", "decontamination", "demolition", "deconstruction", "rehabilitation", "restoration" and "relinquishment" (cf. slide 30).

A general mine closure plan may comprise several pillars including a decommissioning plan, a final mine rehabilitation plan, a social plan and a maintenance and monitoring plan. As for any engineering or civil works project, planning should lead to technical designs, bills of quantities, cost and resource estimates, implementation, progress review, documentation, approval and finally relinquishment.

C&E ran through some examples of the different activities that might feature in a mine closure plan. Closure planning can be challenging because of the variation of activities that will be required at different sites to achieve similarly acceptable outcomes. So, they need to be site-specific.

(Re-)flooding of mine works, groundwater protection and water treatment are typically key issues to be considered in mine closure planning.

In terms of closure costing, C&E summarised several different relevant cost categories including monitoring and maintenance costs. After-care costs might include costs for dealing with sinkholes, subsidence and other ground movements, pumping of mine water or even gas emissions.

Finally, C&E presented some guiding questions to the participants dealing with 1) the use of Bills of Quantities (BoQ), 2) the application of the FIDIC rules for tendering and 3) the existence of methodologies for managing risks that result from post-closure liabilities (e.g.liabilities that arise after competent authority approval of closure).

→ Discussion

Turkish Mining Association, asked about 1) the size of the financial guarantees already established relative to total mining investment and 2) about liabilities arising after approval of closure. It is hard to find the competent authority to approve closure. How closed is closed? (and how clean is clean?) are controversial questions. If closure is approved and something comes up, who will be liable for it. Is there a statistics database indicating the financial guarantees requested in the beginning of each mining operation (see also question in chat)? C&E answered that C&E did not find any such official statistics. It is already difficult to find data on real final closure costs. If somebody is aware of such a database, please let us know.

Irish EPA, emphasised the difference between foreseen and unforeseen liabilities. Unforeseen liabilities after closure are covered by insurance based on a worst case scenario. Financial guarantees cover foreseen closure costs. Once the closure plan has been fulfilled satisfactorily, a separate financial provision (or set-up) can be set aside to cover any post-closure maintenance & monitoring costs. Irish EPA relinquishes any remaining financial guarantees back to the company, but on condition that a separate financial provision is secured for a minimum of 30 years' worth of after-closure costs. Liabilities for unforeseen events remain with the licensee (the legal entity holding the permit for the closed facility).

Confedem, asked if there exists any general rule to estimate the amount of liability to be covered by insurance companies and to calculate insurance premiums? **C&E** replied that C&E is working on this aspect and have taken it into consideration. To their knowledge insurance companies do have such rules, but they hadn't looked into these in detail.

Euromines, commented that the discussion revealed a need to clarify even further the different liabilities (foreseen & unforeseen) that can arise at different times (before or after closure) and the different financial arrangements and legislative instruments that address each of them. C&E indicated that they are aware that this issue must be elaborated more in detail in the report.

DG Environment, invited Member States to comment on the use of Bill of Quanitites (BoQs). Czech Republic and Greece had no comment. **Irish EPA's** feed back was that it has a high level of guidance on the use of BoQs.

→ Relevant chats

1) **Turkish Mining Association**: Is there any statistical data base available for financial guarantees versus initial mine investments calculated, say for metal mines? Just for a general info….
2) **WE Falck**:
    a. Incidentally, the IAEA prefers "remediation", see their safety glossary for the logic.
    b. Profit is not a cost in the table of cost elements.
    c. Foreseen after-closure liabilities are usually dealt with in the long-term stewardship arrangements.
3) **CONFEDEM**: is there any general rule to estimate the amount to guarantee by the insurance companies?
4) **Irish EPA**:
    a. In Ireland insurance is accepted for unforeseen events or accidents and not for foreseen events like closure. The plausible worst-case scenario (e.g. a tailings dam

break out) that might happen is taken and then we get the company to cost it. Then the insurance company is tasked with covering the cost of the eventuality.

b. Agree with Johannes. We get foreseen costs calculated and covered before, during operations, during closure and after closure. The risks generally diminish and the insurance should come well down by the time after closure comes along. Providing for unforeseen/accidents is completely separate to providing for closure and after closure costs

c. EPA Ireland : EPA Ireland uses Bills of Quantities. we have some high level guidance on this also.

2.6. Guidance on Extractive Waste Management Plans (EWMP) (Eco-Efficiency)

Eco-Efficiency reported on the results of a 3 years study completed in 2019 that resulted in guidance on the preparation of extractive waste management plans (see slides, Annex III). At first, he gave an overview of the contents of an EWMP followed by the results of the study.

According to the study performed and the assessment of various EWMPs, 1) the majority of the EWMPs are structured according to Article 5.3, but the level of detail varies considerably country per country and installation per installation, 2) the targets of EWD are fulfilled, however all details are not always presented in the EWMPs but are addressed in other related documents like the environmental impact assessment (EIA). The overall EWMPs only contain a summary of the management of the waste, 3) the amounts of extractive waste are not always presented in the available EWMPs or only an indication is given. 50% of the EWMPs only mention the total extracted amount, 4) the BAT for the management of waste are followed, 5) the risk management is only linked to Category A EWF and 6) the long-term stability as formulated in the EWD has not been reflected in the available EWMPs. A lot of information is given of the ongoing process and the closure, but information on the after-closure activities is lacking.

Different approaches have been noticed between MS. Some operators only address extractive waste in the EWMPs, while others develop a wider perspective addressing other material streams as well, how these waste streams are treated and what kind of waste will be deposited. Finally, some remarks on the value of EWMPs were given.

To steer the discussion the following statements were put forward to be commented on by the participants:
1) If there is no extractive waste, there is no need for an EWMP (e.g. if material is used internally or as by-product or if it is used for any other purpose).
2) Since in many countries EIA is linked to EWMP there is no need for an EWMP if there is no obligation to perform an EIA.
3) Regarding the approval of the EWMP the question is whether the full spectrum of the management of the extractive materials must be included and not only extractive waste? Or in other words do metallurgical waste, fly ash etc must be considered as well in the EWMP?

→ Discussion

Turkish Mining Association asked about the placement of extractive waste back into extraction voids (e.g., paste fill, backfill). Are the voids considered EWFs? Is it clear in the EWD? Even if mixed with cement or other binders/fillers? According to **DG Env** there is no need to permit the void as an EWF if extractive waste is placed back in extraction voids for certain purposes. *[Article 3 of the EWD explicitly excludes such voids from the scope of the definition of EWF].* **DG Env** referred to disagreement amongst the European Commission and Member States about the status of the material placed into such voids and the extent to which the provisions of different EU legislation apply to it. In either case, there should be no great difference in the level of environmental protection required because, for example, the Water Framework Directive is also relevant. **Turkish Mining Association,** is this statement also applicable to tailing material that is placed back in the underground voids mixed with cement to provide structural stability? According to **DG Env**, tailings placed back fall under the same regime. The question is "What does it mean 'applicable legislation'" because the EWD has certain provisions on for instance tailings placed back? For example, does it refer to the WFD and the other water legislation? The water legislation applies in any case whether you put the material back as waste or as a construction material. Leaching to the groundwater must be avoided. There is no difference in the level of environmental protection whether you call it a waste or not.

Svemin, asked whether the study looked at Member State procedures for approval and 5-year re-approval of the EWMPs. **Eco-Efficiency** replied positively and explained that, for example, in some cases the detailed information sat in Environmental Impact Statements and the EWMPs referenced it. This can raise some practical difficulties when needing to update the EWMP after 5 years without necessarily having to perform another Environmental Impact Assessment.

2.7 Reflections and conclusions (DG Env.)

DG Env thanked the speakers and encouraged participants to continue the discussion that was sparked around financial guarantees outside of the webinar. Furthermore, he reminded the participants that the C&E study had a broader scope extending to closure of entire mines. It is the European Commission's intention that participants treat the released draft guidelines as a stakeholder consultation and to send any comments and feedback to the C&E over the Spring and Summer.

Similarly, for the EWMPs, DG Environment requested that Member States provide Eco-Efficiency with feedback on the recurring questions around scope and review of the EWMPs.

Such expert discussions should not be limited to discussion of the minimum requirements in the EU legislation but must be broadened out to things beyond the legal requirements than can be generally recommended in expert guidance.

3. Webinar III: SUSTAINABLE AND TRANSPARANT MANAGEMENT OF EXTRACTIVE WASTE

3.1 Attendees

- EC:
  - EC - DG Env
  - EC – DG Grow
  - EC-ISPRA
  - EC – JRC
  - UNECE

- Consortium
  - VITO
  - Eco-Efficiency
  - Euromines
  - MEERI
  - TBL
  - WEFalck

- Associations
  - AEG
  - AMSA
  - CONFEDEM
  - GME
  - SveMin
  - TMD
  - UEPG

- Consultants
  - C&E

- Geological Surveys
  - Finland
  - Slovenia
  - Spain (IGME)

- Industry
  - Carmeuse
  - First Quantum Minerals
  - Hellas Gold SA
  - Imerys

- Member States (MS)
  - Croatia
  - Czech Republic:
  - Finland
  - France
  - Germany
  - Greece

    - Hungary
    - Ireland
    - Latvia
    - Poland
    - Spain
    - Sweden

- Universities – Research institutes
    - ENEA (ItT)
    - Hochschule Magdenburg

- Organisations / Affiliations?
    - LBEG

3.2 Agenda

The agenda of Webinar III is given in Annex I.

3.3 Welcome & objectives of the project (EC-DG Env.)

EC-DG Env. introduced the two topics for the day. The 1st one is Circular Economy (CE) which has been a high priority of the Juncker and von der Leyen Commissions. CE is a useful topic outside the study coordinated by VITO, but very important for the sector to position itself in the CE context. The 2nd subject to discuss are the findings of the 2016 EWD implementation report that concludes among other things that the questionnaire is not very helpful to assess the implementation of the EWD. This implies that it is time to rethink this questionnaire and identify the relevant questions that should be asked. The latter should go hand in hand with the development of an electronic reporting tool. Participants of the webinar are invited to discuss suggestions made by the consultants.

3.4 Addressing Circular Economy in extractive waste management (Eco-Efficiency)

Eco-Efficiency proposed to look at the EWD and EWMPs from the perspective of Circular Economy. The EWD was adopted before the official Circular Economy policies of the Commission, however the same basic elements of the thinking can already be recognised in the text of the EWD (cf. Article 5.2a & 5.2b). Because of the specific characteristics of each individual mining operation, not all the aspects of Circular Economy are necessarily applicable to all operations all of the time (see slides Annex III).

Firstly, CE policy is written from the perspective of final products, not mining products. Even so, the CE approach to production processes can be translated to some extent to mining processes. A well-developed EWMP considering the CE paradigm should be based on 1) optimising the ore extraction by strengthening the role of the exploration and design phase, 2) preventing waste generation within the possible extent by for instance applying new technologies, 3) minimisation of the environmental impact of waste by optimising deposition and/ or treatment and 4) strengthening of the recycling. Of course, this is not “easy”, also because of the different locations and economic circumstances of the different mines.

For example, several techniques at the different phases of the mine life can be used to optimise production and minimise waste, but successful marketing of by-products, for example, may be achievable in some specific locations and not in others. Apart from logistical and economic considerations, also the attitude of competent authorities can influence the ease of by-product marketing or material re-use. Throughout Europe, there are controversial discussions about which wastes should be accepted for re-entry into the economy. For example, some rules in certain Member States may require *a priori* the discardardance of hazardous materials as waste. In other cases, some Member States appear to enforce classifying material as “waste” even when it is not discarded in order to apply the environmental controls generally applied to wastes.

In general, mining companies already experience strong economic incentives to maximise saleable production and minimise the waste generated, and sometimes this is limited by transportation costs and the capacity of the market to absorb more supply.

3.5 Addressing Circular Economy in extractive waste management and reporting (MEERI)

MEERI explained how Circular Economy constituted an important part of the European Union’s Green Deal proposal. Circular Economy is about keeping materials in the EU economy for as long as possible. Metals in-particular are well suited to this goal. In promoting Circular Economy policies, the United Nations International Resources Panel speaks about “de-coupling” economic growth from the impacts of resource use. Realising the vision of Circular Economy appears to require much more comparable information about materials stocks and flows than is currently available.

The European Commission Joint Research Centre has suggested that valuable materials in historic extractive waste could be “vast”. Finding data to demonstrate this (for example, using Sankey diagrams) is not easy. The EU has sponsored several research projects to improve the practice of Materials Flow Analysis.

MEERI presented a case study of a lead/zinc mine in Poland that will close in 2020 due to depletion of the ore body. Therefore, the company is looking at continuing production from re-processing of its historic tailings, in collaboration with local smelters and recyclers.

So, whilst waste management is not mentioned directly in the European Green Deal, reference is made to ensuring supply of critical raw materials from both primary and secondary production to the European economy and the Polish lead/zinc mine seems a good example of doing that.

3.6 Discussion

Eco-Efficiency asked participants if, for example, safety and stability aspects are sufficiently considered by those competent authorities promoting further reduction, re-use or recycling of extractive waste. Eco-Efficiency also asked about opportunities to include more information in EWMPs to inform governments and citizens about the extent to which Circular Economy is being implemented in the extractive industries.

Turkish Mining Association, raised the point that a common problem in the mining sector was the lack of consideration by regulators of possible re-use of so-called extractive waste. They very often require that the materials be declared as waste and managed as such. Whereas, the industry does not think about these materials in the same way. It is always looking for opportunities to use the materials generated and often such materials are the only ones available to them for construction etc. So-called extractive waste is very different to municipal or industrial waste. It is often re-recovered, re-utilised. It might be helpful if regulators themselves could apply the Circular Economy paradigm to the sector and, for example, allow more temporary storage of materials as potential resources or by-products for sale in the future. Recovery of further resources is more difficult when materials are “locked away” in very long-term permanent EWFs. Can the CE concept in the guidelines be included in the Waste Framework Directive? **DG Environment** responded that the definition of waste is rather simple and is always linked to the obligation to dispose something. If nobody is willing to buy certain material then it is probably not a product and the material will be classified as waste. The guidelines have no way of manoeuvring to put legal obligations below policy initiatives. As long as CE does not trigger legislation it will never override legislation. The EU law has been established with time limits on material storage with the intention of enforcing a requirement to properly dispose of materials that really are waste. At the same time, the law does not require that waste status be permanent. It is possible that material classified as waste evolve in both directions and may later loses its status as waste. **DG ENV** asked why the industry would be so concerned about a material being temporarily classed as waste? Is it because of the fees that are paid for generation of waste in some Member States, that would perhaps not be refunded? **Turkish Mining Association** responded that it is not just about waste fees. Declaring something as 'waste' triggers many other regulatory requirements, which are then very difficult to unwind to allow re-use and takes too much time and effort to convert the label from waste to non-waste or by-product or commodity. **DG ENV** is not aware of such a provision in EU legislation. That's another common element experienced in discussions with the sector. There are additional provisions developed on national level by the MS on waste that are complementary to what is agreed at EU level. **DG ENV** understands that these national provisions are perceived as inhibitory for the company process. The solution however is not to water down the waste definition at the EU level to circumvent national provisions. These could be quickly readjusted. It is an issue that we cannot solve at EU level when MS have specific provisions on waste.

CONFEDEM, proposed that there should be some definition or clear guidelines what is "really" waste because the time-periods that are applied to define a material as waste are unrealistically short when applied to mining products rather than final products or industrial waste. Sale of a whole stockpile of mining product can take decades in some cases.

JRC, asked if the study found examples of applying end-of-waste criteria to extractive wastes, with reference to Article 6 of the amended WFD – Waste Framework Directive (see also chat session). **Eco-efficiency** did not find an applicable set of EU end-of-waste criteria. This being the case, it is currently necessary to apply the general definition of "by-product" provided in the Waste Framework Directive, and these are perhaps more open to interpretation by competent authorities in different Member States. No Member States on the call declared the existence of national end-of-waste criteria**. WEFalck** replied that we are digging ourselves into a problem by calling things waste. The concept was developed decades ago to ensure disposal of materials in a proper way. Obviously, it is not appropriate anymore in the context of CE. **WEFalck** suggested to rethink the whole concept of waste or frame it in a different way. The overall discussion on product, by-product, waste is a temporary classification for a particular purpose that can change rapidly. **DG ENV** agreed with Eberhard that the concept of waste will disappear when we are in a perfect CE.

DG Environment, DG Environment clarified that the WFD is *lex generalis* and the EWD is *lex specialis.* Therefore, the WFD applies to extractive waste to the extent that the EWD does not apply. In turn, this means that if "by-product" or "recycling" is not defined in the EWD, then it is correct that the corresponding definitions in the WFD (if they exist) apply by default.

Euromines, confirmed that rather than waste fees, the issue with temporary waste status is that mining companies are required to make big decisions that have very long-term consequences, and this highlights the tension that exists between achieving long-term chemical and physical stability of waste disposal solutions *versus* preserving a certain accessibility to potential resources for future generations. The time-limits after which waste status is created seem impractically short for the extractive industries.

Euromines, commented that one of the problems that the extractive industry is facing with respect to the reworking of old tailings is access to these tailings. Data on the tailings' composition, assessment of the economic viability can be done if the Member States would grant access to current mining companies and to historic mining waste.

→ Relevant Chats

1) **JRC**: Thx, minor comment, in the Sankey, the term dump was used. I believe it would be better to refer to Extractive Waste Facility(ies) (dump may refer to illegal waste deposition)
2) **WEFalck**: The problem is that ‚waste' is considered an absolute category, while it should be relative and temporary category ...
3) **Euromines**: EWF or Dump. This is just the difference between regulatory language and mining industry language. Very few workers on site would recognise the term EWF.
4) **CONFEDEM**: something should be said from the European Commission's side about timing... for instance, salt mountains coming from potash mining is not at all waste, but they need several decades to be sold.
5) **WEFalck**: I think we should move away from ‚'Waste' Directives and move to ‚'Materials' Directives ...
6) **Eco-Efficiency**: The question is since the EWD does not present the term by-product how the operator will document that the waste from the beneficiation plant is a by-product. This is the reason why we present the criteria of the Waste Framework Directive.
7) Discussion on end-of waste criteria:
    a. **JRC**: Eco-Efficiency did you come across end-of-waste examples? I mean national definitions of end-of-waste criteria at national level for extractive waste?
    b. **Eco-Efficiency:** For the by-products the criteria are (a) Further use of the substance or object is certain, (b)The substance or object can be used directly without any further processing other than normal industrial practice, (c) The substance or object is produced as an integral part of a production process and (d) Further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use.
    c. **MEERI**: We have not at national level end of waste criteria and administration time for recycling waste (permission) takes a very long time.
    d. **JRC**: Article 6, The European Commission shall monitor the development of national end-of-waste criteria in Member States. I understand from the answers that most probably no MS developed its own end-of-waste criteria for the extractive waste stream.
    e. **Eco-Efficiency**: I haven't met National Criteria at the moment. Is there any MS that has that?
    f. **CONFEDEM**: not at all in Spain, as far as I know.
    g. **MEERI**: Just for clarification in Poland end of waste criteria is for waste (may include extractive waste), but not particularly for extractive waste.
8) **Irish EPA**: Access to closed or operating extractive waste sites to examine their feasibility for re-use is an emerging issue in Ireland

3.7 Proposal for a new draft questionnaire for future reporting (Annex V)

Euromines explained that part of the exercise conducted during the project is to look at the different countries and produce country fact sheets that have been sent to most of the MS for review and to look at the future reporting under the EWD. Because of the contacts with the MS (i.e. country visit, telco's and/or mails) about the current questionnaire, as well as the analysis of current questionnaire responses, some changes to the questionnaire have been proposed since the current questionnaire appeared ambiguous and was creating confusion.

Euromines displayed the draft proposal for a new questionnaire to solve several issues, but also to include new information related to the various supporting legislation and guidance that has been adopted since the EWD entered into force. The result is a shortened and more streamlined questionnaire that would hopefully be clearer for Member States, avoid unnecessary filling-in and therefore lead to more consistent and comparable responses.

Finally, Euromines invited the MS to send Euromines their comments, suggestions and / or questions regarding the reworked questionnaire by mid-July.

→ Discussion

Finland, questioned the legal basis for the question regarding changes to national legislation. Such questions should only be relevant when an EU Directive is first transposed. For example, implementation of the EWD can be spread across several different national legal instruments. Furthermore, how this work linked to the broader Environmental Governance Assessment Framework? **Euromines** responded that the principle thought behind the revision of the questionnaire is the need for more specification. Because of on the one hand the development of additional guidances and on the other hand developments in the sector, in the economy and in the concepts of circular economy some MS have adapted their national legislation. It is within this respect we proposed to update the existing questionnaire.

Euromines referred to the chat from Finland (see below) which is referring to the Environmental Government Assessment Framework which indeed is something that DG Env has been working on for a number of years and that involved many meetings with the MS. Euromines asked DG ENV if he can give some more information on that initiative and how the VITO project links with it.

DG Env., confirmed that work on the Environmental Governance Assessment Framework was considering a shift towards Member States reporting to their own citizens rather than to the European Commission directly, but in a harmonized way so that the Commission could then (automatically) compile the information it needs from such national disclosures.

HoweverDG ENV was not able to confirm if the results of such efforts would be sufficient for evaluation of implementation of Directives by the European Commission.

That being the case, the Commission could still adopt a delegated implementing act with the agreement of the Member States.

→ Relevant Chats

1) **Finland**: I have heard that in the EU is going on a wider reform which is related to the reporting of directives. One attempt of this reform is to unify the reporting of different directives. Also in my knowledge is that in the reform the objective is among others to edit reporting so that the

questions in which the execution of directives is clarified in the national legislation will be given up. I want to point out here, that the implementation of directives in the national legislation will be reported separately to the EU at the stage when the directive is made part of national legislation. I have understood that another objective of the reform is to give up the questions which require a verbal answer. So, the answers to the questions can be obtained from database (for example digital form) as far as possible using public sources of information...maybe in the future. Are you aware of this?

2) **Irish EPA**: Can the draft questionnaire be separated from the background document so that comments can be inserted into it? And please confirm the deadline for comments. Time is tight and I will have to circulate to others (e.g. Department officials), thank you. My initial comment would be that I welcome any attempt to improve the text as some of the questions have been difficult to answer. However, I would hope that the questionnaire would be transformed into a webform/electronic/web portal format so that the data could be more easily inputted.
3) **Euromines**: Yes, we can certainly recommend that.
4) **Euromines**: Is it the Commission's position that current practices in line with EU law are not sustainable?

3.8 Reflections and conclusions (DG Env.)

Coming back to the context for the study, DG ENV explained that the 2016 implementation report announced some follow-up actions including adoption of the technical guidelines for inspections and general guidance to the EWD. The second of these has been supported by two studies – the one led by C&E on mine closure and this one led by VITO. As originally intended, the VITO study has now, in its final stages, shared with the participants the preliminary results.

Rather than relying only on a long final document, the consultative webinars have been useful from a communication perspective. Whilst a face-to-face meeting is always preferable, we have made the best of the difficult situation.

It is clear from the background document and the discussion that there historically has been a mismatch of activities covered by the various waste statistics and this project allows us to conclude that perhaps there are not so many inconsistencies as were apparent at first.

Another goal of the project is to explore better ways of reporting. Again, the study has confirmed that reporting that only focusses on materials defined as waste restricts the available information based on decisions that are already taken at national or sub-national level. Whereas, reporting that has a broader focus allows a better understanding of those decisions that have been taken. The country factsheets therefore draw a wider picture including data on the extractive waste management and on waste management plans.

The questions under the mandate of the EWD can be translated into a reporting format (e.g. questionnaire) and MS are obliged to answer them. If we want to have these questions in a wider context, quality control questions can be added to the questionnaire but only if there is a mandate. Under the Waste Framework Directive there is such a mandate for the recycling targets. Another option is to use the raw material information system (RMIS) to obtain a better picture of the extractive sector in the different MS.

Three DGs from the European Commission are working on the extractive industries, DG Environment, DG Grow and the JRC and they exchange well amongst themselves.

DG Environment has understood that the EWD could be revised to improve or include for the first-time certain definitions. Further discussion of options for revising the EWD should be based on the final report of the study.

With regards to CE the European Commission is very active from a sustainability and raw-material supply perspective. There is still a lot that could be done to foster domestic production and to ensure that it is sustainable. The next big project, coordinated by Eco-Efficiency, is the project on the identification of best practices in risk assessment in the extractive sector, covering the mine as a whole and balanced management of all risks including, but not limited to, risks to the environment[1]. A call for expressions of interest to join an advisory group for that has been issued recently[2]. That project would run until the end of 2022. DG ENV invited all participants to consider applying. The expert group is likely to be limited to about 50. The process will resemble to some extent the BREF process, except that interactions with the expert group will be more continuous.

VITO then confirmed that the minutes will be distributed to all participants, including the presentations given.

[1] https://ec.europa.eu/environment/waste/mining/risk_management.htm

[2] Information on the project and on the call for "applications for the selection of members of the expert group on risk management in the extractive sector (Technical Advisory Group, TAG-RM; continuosly open call) is available at https://ec.europa.eu/environment/waste/mining/risk_management.htm

Annex I: Agenda of the individual webinars

Webinar I: Production and waste reporting (08/06/2020)

1.	Welcome and tour de table **(European Commission)**	14^{00} - 14^{10}
2.	Practical guidelines **(VITO)**	14^{10} - 14^{20}
3.	Key issues around waste and waste treatment and waste codes **(Euromines)**	
	a. Presentation	14^{20} - 14^{30}
	b. Discussion	14^{30} - 15^{00}
Break		*15^{00} - 15^{15}*
4.	Introductory remarks on Digital platforms	
	a. Waste from extractive industry reporting – case of Poland **(MEERI)**	15^{15} - 15^{35}
	b. Licensing and supervision **(Ictus)**	15^{35} - 15^{50}
	c. Q & A	15^{50} - 16^{10}
5.	Discussion on a European approach **(All)**	16^{10} - 16^{30}
6.	Reflections and conclusion **(European Commission)**	16^{30} - 16^{45}

Webinar II: Financial guarantees and extractive waste management plans (11/06/2020)

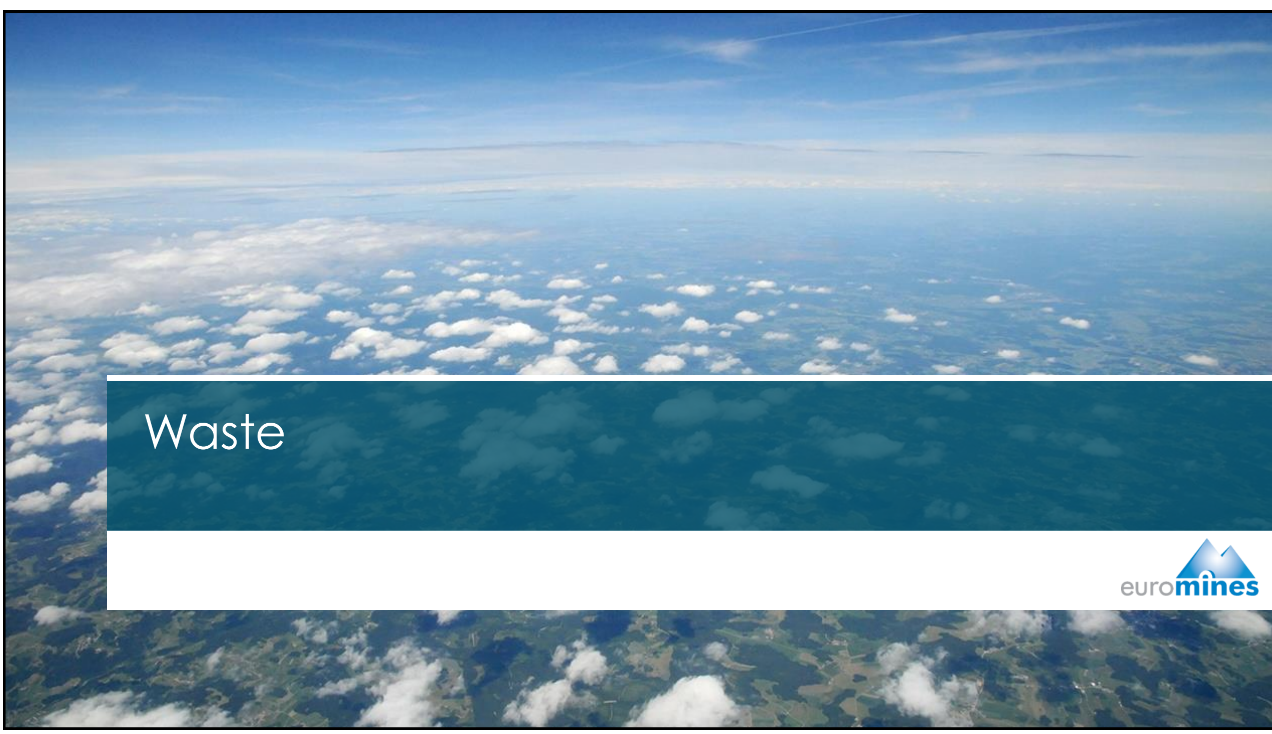
1.	Welcome and tour de table **(European Commission)**	14^{00} - 14^{10}
2.	Practical guidelines **(VITO)**	14^{10} - 14^{20}
3.	Waste Facilities Category A – Financial Guarantees **(C & E)**	
	a. Q & A	14^{20} - 14^{35}
	b. Discussion	14^{35} - 15^{05}
Break		*15^{05} – 15^{15}*
4.	Waste Facilities Category A – Financial Guarantees **(C & E)**	
	a. Presentation on closure planning	15^{15} – 15^{40}
	b. Discussion	15^{40} – 16^{10}
5.	Guidance on Extractive Waste Management Plans – (**Eco-Effiiency)**	
	a. Presentation on EWMP	16^{10} – 16^{25}
	b. Discussion	16^{25} – 16^{35}
6.	Reflections and conclusion **(European Commission)**	16^{35} - 16^{45}

Webinar III: Sustainable and transparant management of extractive waste (12/06/2020)

1. Welcome and tour de table (**European Commission)**	14^{00} - 14^{10}
2. Practical guidelines **(VITO)**	14^{10} - 14^{20}
3. Addressing Circular Economy in extractive waste management and reporting	
a. Addressing Circular Economy in extractive waste management – **(Eco-Efficiency)**	14^{20} - 14^{40}
b. Case of Polish company (**MEERI)**	14^{40} - 15^{00}
c. Q & A	15^{00} - 15^{15}
d. Discussion	15^{15} - 15^{45}
4. Draft Questionnaire – (**Euromines)**	15^{45} - 16^{00}
5. Reflections and conclusion (**European Commission)**	16^{00} - 16^{15}

Annex II: Presentations Webinar I (08/06/2020)


euromines
Study supporting the Extractive Waste Directive
Webinar I: PRODUCTION AND WASTE REPORTING
Key issues around waste and waste treatment and waste codes
8 June 2020


Waste
euromines

Definition of extractive waste

First aspect

Inconsistency between Directive and Statistics

- the European List of Waste does not distinguish inert waste from non-inert waste or reactive waste from non-reactive waste

Interpretation of Definitions

Second aspect

Legal interpretation of definitions

- Interviews with the Member States as part of this study did not reveal differences in the interpretation of definitions
- However, in day-to-day language being used in all contexts adds complications and should not be taken as a Member State's legal interpretation of the legally defined terms
  - E.g., "backfill", "residual waste", "by-product", "residues", "tailings"

Interpretation of related concepts: Characterisation

Third aspect

The two-fold tool to practical implementation

In practice, characterisation (e.g., according to CEN standards) informs on:

- adequate management of risks posed by reactive wastes, and/or
- compliance with rules for permitted use of the materials as by-products in excavation voids.

Definition of mineral resource treatment

Fourth aspect

Clarification of scope

≡ Waste from metallurgical processes should not be reported as extractive waste

Differences in data reflect different practices

Fifth aspect

Legal definitions and industrial practice

≡ The boundary between extractive waste and metallurgical waste may sometimes fall within a grey zone and cease to be meaningful

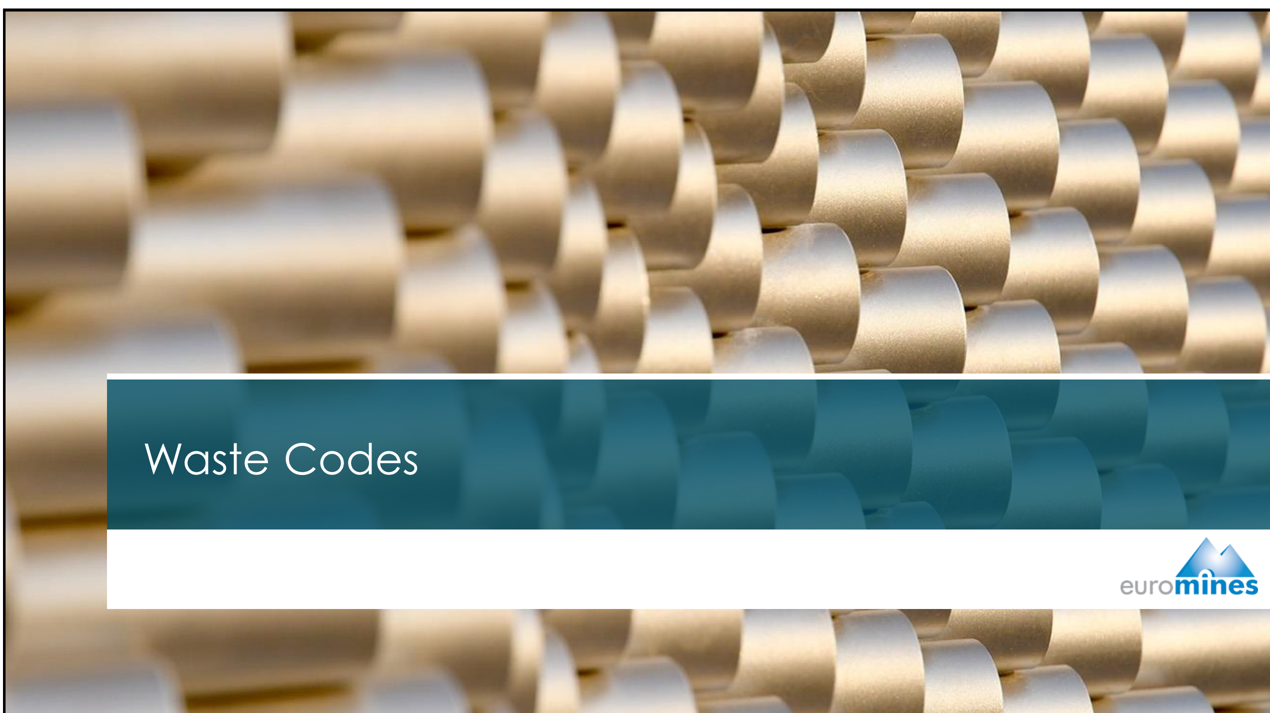
Differences in national reporting!!

Differences in data reflect changing management goals as time progresses

Sixth aspect

Progress keeps shifting faster than the statistical reporting

- Many 'wastes' generated in mines and quarries can readily become 'products' as commercial and technological conditions change and environmental and social policies set new goals



Disadvantages of some waste codes

Seventh aspect

Imprecision of codes or reporting

- It cannot be assumed that all hazardous waste reported as arising from the sector should be managed in Category A Extractive Waste Facilities: some of it is not extractive waste but might be treated in hazardous waste landfills.

Short-term and longer-term options

- An alternative means of reality-checking the number of Category A EWFs identified by the MS would be needed
- EU Guidance on which waste codes to include in EWD reporting & how to fill the reporting format throughout the reporting structure from company to MS to EU stats?
- Decide objective and tools for EU-wide monitoring of the EWD going forward
  - EU-funded collaborative project to digitalise existing records and store centrally within each Member State?
  - Change the reporting format of the EWD to Country Fact Sheets?
  - Seek long-term changes to the Eurostat waste codes to suit the EWD ?

Some country specific examples

- 15:15 Session on Digital platforms
  - a. Presentation by **MEERI, Poland**
  - b. Presentation by **Ictus, Finland**
  - c. Question & Answerd. Discussion on a European approach

Waste from extractive industry reporting – case of Poland

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MEERI

Extractive waste – reporting in Poland

Information about extractive waste management are reported to:

- Central Statistical Office
- Marshal Office – regional
- Mining authorities - local
- State Geological Institute (resources, spatial)

Poland implements Waste Management Plan at national and regional levels - few information on waste from extractive industry can be found

Mines and mining entities in Poland – data collections

According to Higher Mining Office – 31.12.2019

http://www.wug.gov.pl/bhp/nadzorowane_zaklady

- Undergrund mines – total 43 of which 36 coal, 3 copper, 1 zinc, 1 salt, 1 gypsum, 1 salt brine
- Open pit - total 7416 of which 10 brown coal
- Borehole mining – total 95, of which 8 oil and gas, 2 gas, 2 salt, 2 sulphur, 3 methane, 77 thermal water and brine
- Other mining entities – total 24
- Other mining entities for geological works – total 186

Data from individual mines could be available on sustainability or CSR reports (large companies)

Data collection and verification about waste generated by each mines could be very difficult

Code of waste - versus individual raw materials

1. Commission Decision 2000/532/EC (11) establishes the European List of Waste, revised it by Commission Decision 2014/955/EU (12) align it with developments in chemicals legislation
2. Some Member States use additional national sub-lists (8- digit codes) – in Poland there is additional number to code of waste including number 80 on the 5 or 6th digit number i.e. 100980 - condemned cast iron products or on 3rd and 4th digit 1080 - wastes from ferroalloys production, and follow 108001 – slags from the production of ferrosilicon, etc.
3. Waste codes cover extraction of different types of minerals (construction, energy, industrial, metallic) by processing - it is difficult to separate data for individual raw materials, i.e. copper or zinc.
4. List of Waste does not distinguish inert waste from non-inert waste or reactive waste from non-reactive waste,
5. The waste code does not separate waste from primary and secondary resources - it is difficult to compare volume of waste with the volume of extraction,
6. Due to possible application of different type of waste, especially topsoil, for internal use and reclamation data about waste are not registered.

Central Statistical Office

Scope of data collection about waste: by waste types in accordance with the waste code and by sections of the Polish classification of activities

Główny Urząd Statystyczny


GUS GŁÓWNY URZĄD STATYSTYCZNY, al. Niepodległości 208, 00-925 Warszawa www.stat.gov.pl

Nazwa i adres jednostki sprawozdawczej	OS-6 Sprawozdanie o odpadach (z wyłączeniem odpadów komunalnych)	Portal sprawozdawczy GUS portal.stat.gov.pl Urząd Statystyczny 40-158 Katowice ul. Owocowa 3
Numer identyfikacyjny – REGON	za rok 2018	Termin przekazania: do 29 stycznia 2019 r.

Obowiązek przekazywania danych wynika z art. 30 ust. 1 pkt 3 ustawy z dnia 29 czerwca 1995 r. o statystyce publicznej (Dz. U. z 2018 r. poz. 997, z późn. zm.).

(e-mail sekretariatu jednostki sporządzającej sprawozdanie – WYPEŁNIAĆ WIELKIMI LITERAMI)

Lokalizacja zakładu (należy podać miejsce wytwarzania odpadów a nie siedziby zakładu, w przypadku tylko składowania odpadów miejsce składowania odpadów)

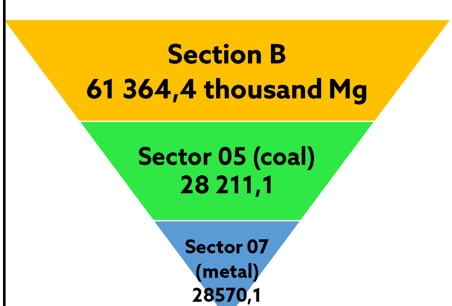
Lokalizacja zakładu	Symbole wpisywane w US
Województwo:	
Powiat:	
Gmina:	
Miejscowość:	
Polska Klasyfikacja Działalności – PKD 2007:	

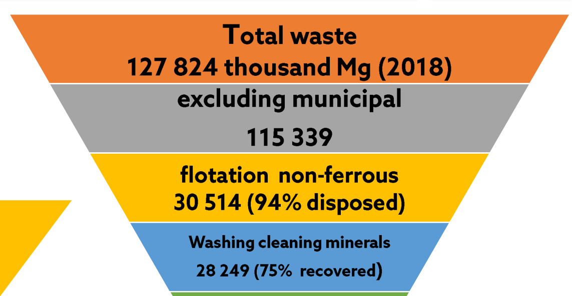
Dział 1. Rodzaje i ilość odpadów w tysiącach ton *(z jednym znakiem po przecinku)*

Rodzaje odpadów (patrz „Objaśnienia")	Kody odpadów (patrz „Objaśnienia")	Odpady wytworzone w ciągu roku														Odpady dotychczas składowane (nagromadzone) w obiektach własnych (stan na koniec roku)
		Ogółem (rubryki 3+7+11+15)	poddane odzyskowi we własnym zakresie				unieszkodliwione we własnym zakresie				przekazane innym odbiorcom				magazynowane czasowo	
			razem (rubryki 4+5+6)	kompostowane	wypełnianie wyrobisk własnych i innych	w inny sposób	razem (rubryki 8+9+10)	termicznie	składowane w obiektach własnych	w inny sposób	razem	do procesów odzysku	do procesów unieszkodliwiania: razem	w tym składowane w obiektach		
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
01 OGÓŁEM (wiersze od 2 do 30)																
02																

Extractive waste – one of the largest waste stream in Poland

1 760 milion Mg waste accumulated





Section B - One NACE code is assigned to each unit recorded in statistical business registers, according to its principal economic activity. The principal activity is the activity which contributes most to the value added of the unit.

Environmental fee – additional source of data

National Fund for Environmental Protection and Water Management

- The National Fund of Environmental Protection and Water Management (NFEP&WM) with regional funds (in 16 voivodships) established in 1989 as the pillar of the Polish system of financing environmental protection, mainly, with the income from the fees and fines for the use of the environment, service and concession fees, fees following from the Environmetal Protection Law:
  - fees for using the environment,
  - fines for exceeding the allowable emission limit
- The content of the reports on use of the environment determined by the Polish regulation in the areas of:
  - emission of gases or dust into air
  - consumption of water
  - emission of wastewater into water or soil,
  - storage of waste – data were reported

The main goal of waste data collection resulted from fees and fines for the use of environment

Data available from 16 Marshal's Offices

Annual reports – Reports on wastes prepared by 16 Marshal's Offices

Databases: collect information on waste generated, on management of different types of waste specifying methods of recovery and disposal, on permits for collection, transport, recovery or disposal of waste and waste management plans and reporting.

DZIENNIK USTAW
RZECZYPOSPOLITEJ POLSKIEJ

Warszawa, dnia 30 kwietnia 2019 r.

Poz. 819

ROZPORZĄDZENIE MINISTRA ŚRODOWISKA[1]

z dnia 25 kwietnia 2019 r.

w sprawie wzorów dokumentów stosowanych na potrzeby ewidencji odpadów

Dziennik Ustaw Nr 249 — 16950 — Poz. 1674

1674

ROZPORZĄDZENIE MINISTRA ŚRODOWISKA[1)]

z dnia 8 grudnia 2010 r.

w sprawie zakresu informacji oraz wzorów formularzy służących do sporządzania i przekazywania zbiorczych zestawień danych o odpadach

Dział 2. Zbiorcze zestawienie danych o rodzajach i ilościach wytworzonych odpadów[12)]

Lp.	Kod odpadów[13)]	Rodzaj odpadów[13)]	Masa wytworzonych odpadów [Mg][14)]	
			masa odpadów	sucha masa odpadów

Dział 9. Zbiorcze zestawienie danych o obiektach unieszkodliwiania odpadów wydobywczych[30)]

	Ogólne informacje				
1	Adres obiektu unieszkodliwiania odpadów wydobywczych				
	Nazwa obiektu unieszkodliwiania odpadów wydobywczych				
	Województwo	Gmina	Miejscowość	Telefon służbowy	Faks służbowy[3)]
	Ulica		Nr domu	Nr lokalu	Kod pocztowy
2	Adres posiadacza prowadzącego obiekt				
	Nazwa zarządzającego obiektem unieszkodliwiania odpadów wydobywczych				

Available data – on the example of hard coal

- Mining (about 20%) and processing waste - deposit on dump close to the mine or central one. Significant part of waste was used for filling natural or anthropogenic depressions, and treated as land reclamation. Some of them are used as aggregates and material for construction and building industry.
- Waste from extractive industry (010102) was also generated NOT from mining operations but from processing of waste – i.e. Haldex company 460 473 Mg, Barosz - Gwimet Sp. Z o.o. - 9 438 Mg, BM Recykling Sp. z o.o. - 49 308 Mg
- 010102 covers both coal and other non-metal waste i.e. industrial minerals – not data per raw materials

No detailed information about waste generation per mine but per company

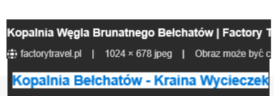
No	Waste generation in 2017		Recovery in installations and devices	Recovery outside installations and devices	Disposal of waste in installations and equipment	Waste transfer to persons or organizational units, not entrepreneurs, for their own needs
	Waste holder	Waste generated [Mg]	Waste recovered [Mg]	Waste recovered [Mg]	Waste recovered [Mg]	Waste recovered [Mg]
01 Wastes from mineral excavation						
01 01 02 Wastes from mineral non-metalliferous excavation						
1.	ZAKŁAD GÓRNICZY ZAGŁĘBIE Sp. Z o.o.	2 371		2 371		
2.	POLSKA GRUPA GÓRNICZA Sp. Z o.o.	133 234	28 008	16 507		
3.	Katowicki Holding Węglowy S.A.	6 949				
4.	Jastrzębska Spółka Węglowa S.A.	120 428		98 654	20 327	
5.	PRZEDSIĘBIORSTWO GÓRNICZE "SILESIA" Sp. z o.o.	7 757	7 757			
01 04 12 Washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11						
1.	POLSKA GRUPA GÓRNICZA Sp. z o.o.	7 984 688	1 580 765	845 490		
2.	Katowicki Holding Węglowy S.A.	6 949	940	2 769		
3.	Jastrzębska Spółka Węglowa S.A.	10 199 544	347 629	5 356 879	3 773 820	
4.	Lubelski Węgiel "BOGDANKA" S.A.	5 693 662			3 010 924	24 457
01 04 81 Waste from coal flotation enrichment						
1.	POLSKA GRUPA GÓRNICZA Sp. Z o.o.	302 875	2 186	78 539		
2.	Jastrzębska Spółka Węglowa S.A.	784 680	66 461	387 870	242 209	
01 04 99 Waste not otherwise specified						
1.	POLSKA GRUPA GÓRNICZA Sp. Z o.o.	1				

Available data – example of brown coal in Poland

Almost no waste from extractive industry during brown coal mining in Poland

1. Overburden is not classified as waste if stored in the mining area and managed according to Geological and Mining Law,
2. Intergrowth/interlayer in deposit is treated as overburden,
3. Soil and rock mass moved within excavation is not classified as waste from extractive industry if proper document (concession or local plan for mining area or mining plan) defined conditions for its management,
4. Associated minerals (by-product) sold or to be sold in the future, i.e. gravel and sand are not classified as waste,
5. Reported extractive waste by brown coal producer come from i.e. Aggregate Production Plant

Source



Available data - waste from industrial minerals in Poland

Some open pit industrial minerals producers do not report extractive waste – minerals are processed within excavation, in that case only contaminated soil and rock mass could be reported as waste

Source: Strzeblowskie

<u>Examples of such industrial minerals producers:</u>

1. **BENTONITE - PGP „Bazalt" S.A. in Krzeniów**
   - bentonite „co-/byproduct is used for the production of sorbents, reclamation of mining and technological heaps
2. **FELDSPARS - Strzeblowskie Kopalnie Surowców Mineralnych Sp.z.o.o**
   - produce rock with very fine grain size <700 mm are used
3. **DOLOMITES**
   - Żelatowa S.A. Chrzanów – all extracted materials are remanufactured and sold
   - Jaroszowiec CEMEX – processing in excavation and used for reclamation
   - Ząbkowice DOLOMIT S.A. - all materials are used
4. **KAOLIN - Grudzień-Las**
   - kaolin produced from modling sands, exploited deposit and processing plant in excavation

Source: Kaolin Grudzeń Las

Product and packaging waste and waste management (BDO)

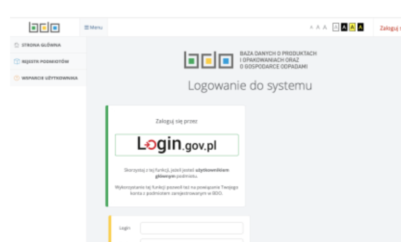
BAZA DANYCH O PRODUKTACH I OPAKOWANIACH ORAZ O GOSPODARCE ODPADAMI

Annual reports – Reports on wastes prepared by individual companies for Marshal's offices

The BDO system - central online database introduced in 2020 to increase transparency in waste management and recycling

The BDO system enables comprehensive collection and management of waste management data that relates to:

- waste generated from packaging and packaged products introduced into the territory of the country, lubricating oils, tires, vehicles, waste electrical and electronic equipment, batteries, achieved levels of waste recovery and recycling;
- types and amounts of waste generated;
- landfills;
- types of waste management installations.



The database, after starting electronic registration, as well as registers and reporting modules, will allow the collection and management of all waste information

Summary of Polish waste data management

State-of-art.:

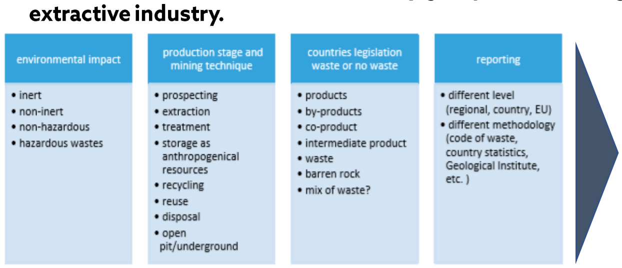
1. **Different sources of data on waste and scope of reporting**
2. **For Poland only general data without division to waste codes are available from Central Statistical Office**
3. **More detailed data reported only by the Marshal's Offices for individual companies without data aggregation for regions (voivodships)**
4. **Verification of detailed data could be done also at mining officces and National Fund resulted from introducing fees for using the environment**
5. **Implementation of the BDO system – a step towards the collection and management of all waste information in one place**

Additional actions needed:

1. **Analysis about legal assessment when „waste/run of mine/co-by-product" not reported as a waste**
2. **Unification of presented data to get consistency in all databases (Eurostat, National Statistical Office, regional offices)**
3. **Mechanism of introducing additional waste codes on the country level to avoid reducing waste levels in other categories**
4. **The change of waste codes to separate data for individual raw materials (coal and industrial minerals)**
5. **More detailed data about extraction waste given by companies - also for deposits and mine (1 company often more then 1 deposit and 1 mine)**
6. **Additional information in waste generation statistics - from primary or secondary source**
7. **Technical rules that determine the criteria of losing the status of waste have not been established so far.**

Conclusions

- **Different types, amounts and properties of waste produced at extraction sites depending on the resource being mined, process technology used and local geology,**
- **Different types of waste generated during each stage of mining project lifecycle,**
- **Different standards for the reporting of extractive waste depending on countries legislation (statistic offices, regional and EU database),**
- **Several unofficial systems for mining waste exist. Each system has its own unique classification, harmonisation, collecting and reporting tools - the input datasets in existing systems are scarce, dispersed and non-comparable (Orama project).**
- **Lack of data on the amount of mining waste information collected in the scope of the Directive 2006/21/EC (Prosume Project),**
- **Code of waste do not allow to identify group (metal, energy, industrial) of waste from extractive industry.**



Waste is considered to be a waste when they are moved out of the quarry ?

Figure: Overview of waste categorisation as a function of environmental impact, production stage & mining technique

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MEERI

Thank you

European Union

#CEstakeholderEU

European Circular Economy Stakeholder Platform

A joint initiative by the European Commission and the European Economic and Social Committee


Licensing and Supervision
8.6.2020
Ictus Consulting Oy
HALLITUKSEN KÄRKIHANKE
LICENSING AND SUPERVISION


One client – many actors
The aim is to have client-oriented packages providing services across administrative levels and official boundaries
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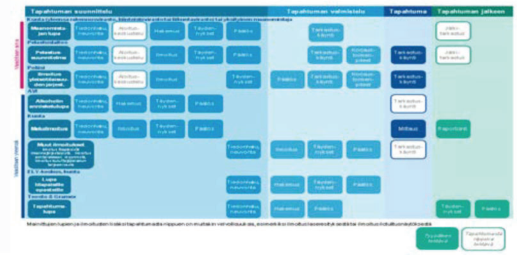
Present challenges

There are substantial differences between agencies in the adoption of digital services

Processes are agency-specific



There is little coordination between administrative levels

Focus in the development work is on agencies' needs

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Providing services across administrative levels and organisational boundaries

Smooth service chains that are independent of organisations and that make no distinction between clients

Digital services based on one-stop-shop model and all-channel support services

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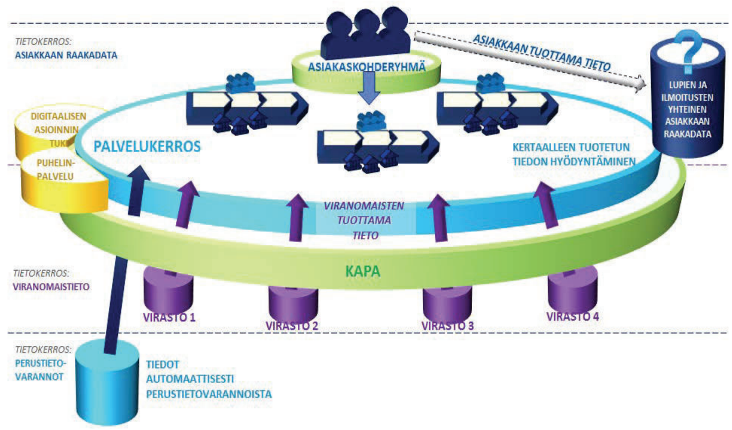
INFORMATION at the centre

- Real-time information follows the client
- Harnessing information, analytics and artificial intelligence
- Automation will also be used in monitoring and reporting



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Shared solutions and national service architecture

Service layer with shared functionalities

Relying on the solutions used in the national service architecture

Using existing solutions

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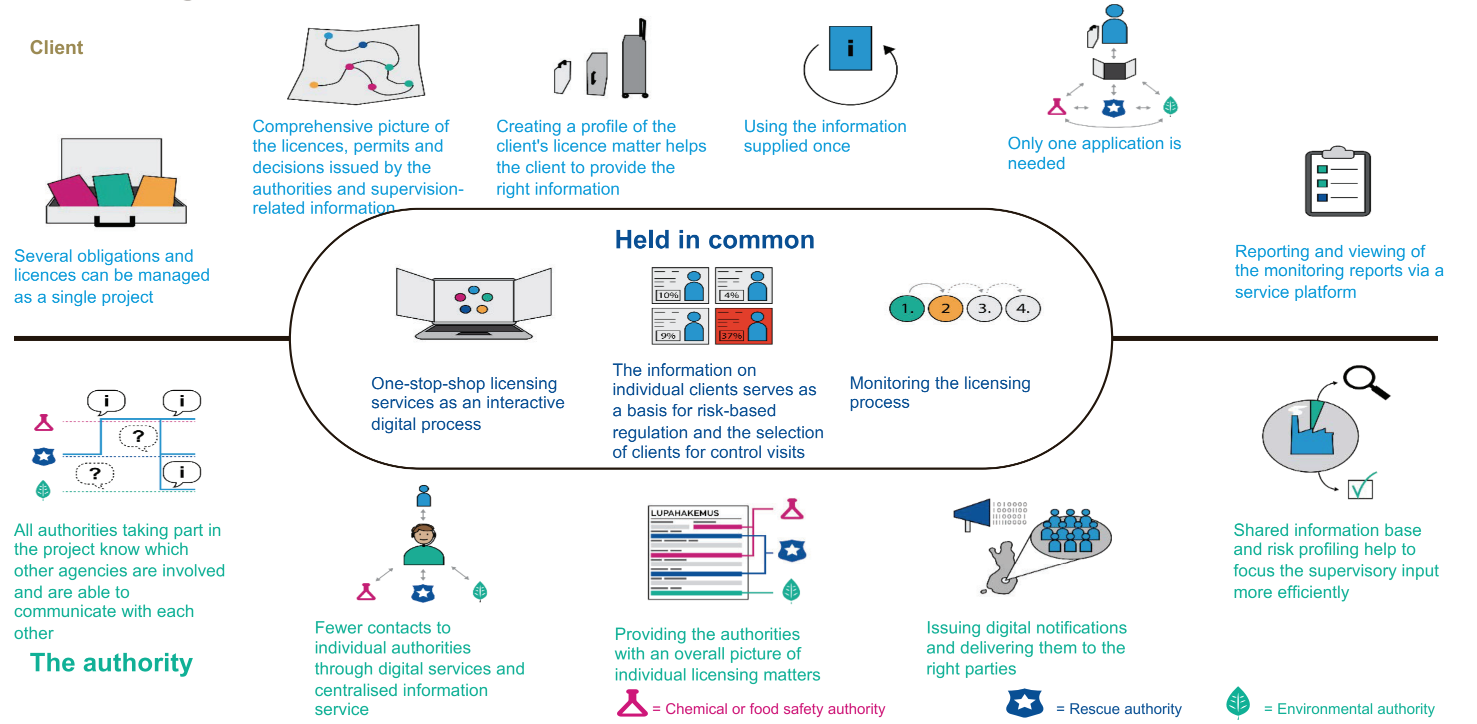
The aim is to have a digitalised client-oriented service package based on the one-stop-shop principle



Implementing the digital service counter

Current operating model	Opportunities opened up by the service layer	Client in the targeted operating model
The authorities have extensive advisory services Clients feel that the service channels (such as telephone service) are slow and inflexible	**Real-time advice, guided and profiling-based services**	Clients are provided with digital services at the right time and in the right place Guided by the system, clients are able to operate more independently
Actor-specific operating models – no unified operating models, process or practices Monitoring the licensing matters is difficult	**Clear, built-in process model**	Progressing on a client-oriented service path Clients can monitor the licensing process
A project of a client often involves several licensing processes involving more than one authority Dealing separately with each authority	**Licences as a single project**	One-stop-shop model: clients can manage several licensing matters as a single project

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LICENSING AND SUPERVISION

Implementing the digital service counter

Current operating model	Opportunities opened up by the service layer	Envisaged operating model
Services are based on email and forms	**Shared digital workspace**	All licensing matters are managed in a single location The clients and the authorities work together using up-to-date digital workspaces
Authorities have difficulty obtaining a comprehensive picture of clients' permit and licensing projects	**Extensive information base for shared use and exchange of information between the authorities**	The authorities share an extensive information base The overall picture and the information are in real time and can be viewed by all parties
Clients must repeatedly submit the same information to different authorities The client's previous visits do not result in history information	**Profiles and history**	The information supplied by the client once is shared by different authorities History information is extensively used

Implementing the digital service counter

Current operating model	Opportunities opened up by the service layer	Envisaged operating model
Supervision by the authorities is based on the resources available to them	**Reporting, analytics and risk profiling**	The authorities can focus resources on supervising known high-risk targets
The authorities make only limited use of the information possessed by citizens in supervisory work	**Crowdsourcing and mass data**	The authorities use information obtained from citizens Citizens may take part in the supervisory process

LICENSING AND SUPERVISION

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Annex III: Presentations Webinar II (11/06/2020)

Study on the elaboration of guidance on Best Practices for calculation and periodic adjustment of the financial guarantee for extractive waste facilities

Contract no. 07.0201/2018/793585/ETU/ENV.B.3

CHAPTER 3 WEBINAR II, WASTE FACILITIES CATEGORY A

C&E Consulting und Engineering GmbH
Jagdschänkenstr. 52, 09117 Chemnitz, Germany
www.cue-chemnitz.de

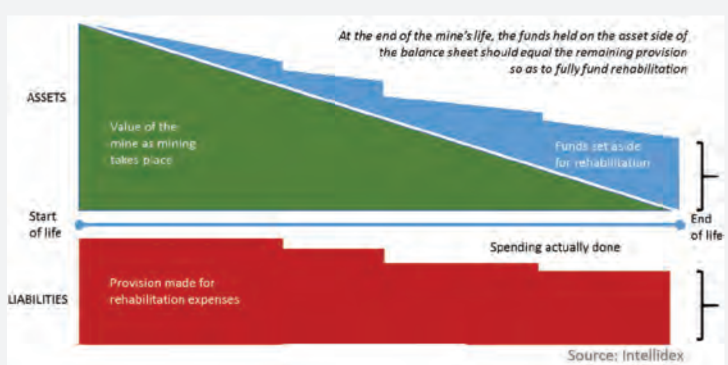
Content

Waste Facilities Category A – Financial Guarantees

Introduction

- Waste from extractive operations is waste from extraction and processing of mineral resources, such as topsoil, overburden and waste rock, as well as tailings remaining after minerals have been largely extracted from the ore
- one of the largest waste streams in the EU, that is an environmental liability causing closure costs that lead to financial obligations
- according to the Extractive Waste Directive 2006/21/EC, those cost shall be covered through financial guarantees (internalization strategy for environmental cost)

Source: Eco Efficiency Consulting and Engineering Ltd., 2019



Source: Tambo& Theobald, 2018

Introduction

- **Financial provision:** establishment of a source of funding for liabilities under environmental law or an environmental permit, license or other authorisation. Also called **'financial guarantee'** and 'financial security'.
- **Financial institution guarantee** is a guarantee provided by a financial institution (e.g. a bank or surety) to pay if an operator defaults on its obligations. This includes 'bank guarantees', 'letters of credit', 'surety bonds' and 'performance bonds'.
- **Performance bond** is an indemnity agreement for a specified amount issued by an approved bank, other financial institution or surety. The provider of the bond agrees to pay the relevant regulator up to the amount of the bond, as specified in the bond, if the operator defaults on its environmental obligations.

- **Mine Closure entails the process of rehabilitation at the end of a mine's life leading to the issue of a closure certificate by the competent authority.**
- Rehabilitation plan or Mine closure plan is describing and detailing the concrete actions that are required to adequately mitigate environmental impacts and achieve rehabilitation outcomes.

Horizontal EU environmental legislation and the Extractive Waste Directive 2006/21/EC

Horizontal EU environmental legislation:

- Directive 2006/21/EC on the management of waste from the extractive industries (the **Extractive Waste Directive EWD**),
- **Best Available Techniques reference document** Management of Waste from Extractive Industries in accordance with Directive 2006/21/EC (MWEI BREF),
- the **Seveso III Directive** which includes in its scope operational tailings disposal facilities, including tailing ponds or dams, containing dangerous substances,
- 2009/335/EC: Commission **Decision** of 20 April 2009 **on technical guidelines for the establishment of the financial guarantee** in accordance with Directive 2006/21/EC of the European Parliament and of the Council concerning the management of waste from extractive industries (notified under document number C(2009) 2798); and
- **Guidance document on non-energy mineral extraction activities** in Natura 2000 protected areas.

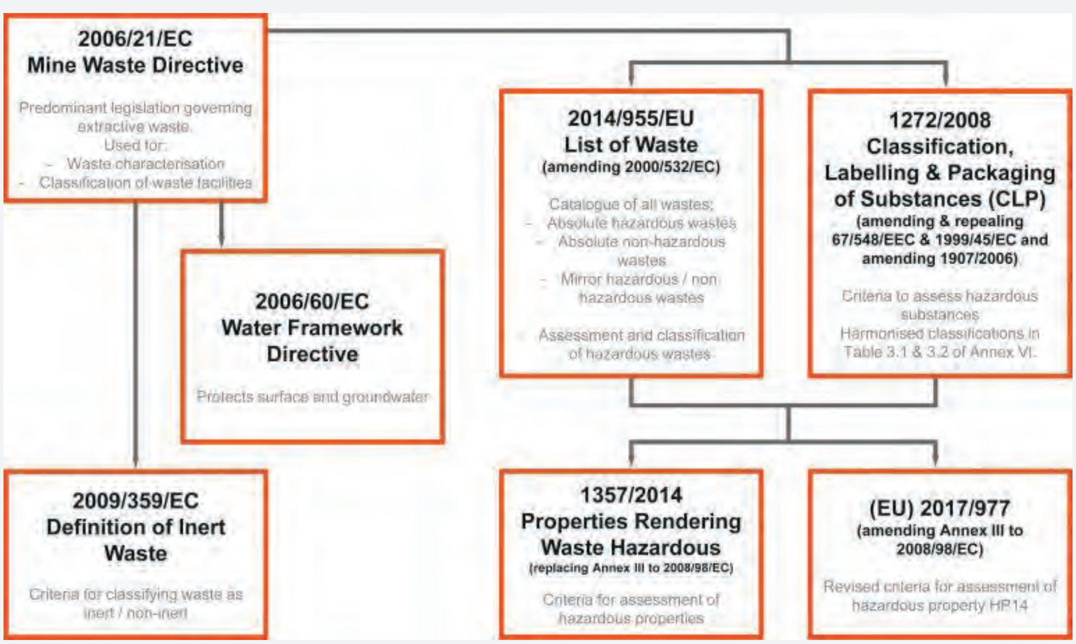
Further, there is a relation to the **Environmental Liability Directive 2004/35/CE** and apply the provisions of the Public Procurement Directive 2014/24/EU for public works contracts.

Environmental acquis and the Extractive Waste Directive 2006/21/EC

Further, following parts of the environmental acquis and the respective primary and secondary legislation apply:

- Treaty on the Functioning of the European Union (TFEU)
- EU´s Raw Materials Strategy framework, in connection with the classification according to the NACE Rev. 2 and the PRODCOM
- eight conventions (Aarhus, Espoo, Lugano, on the Protection and use of Transboundary Watercourses and International Lakes, on the Transboundary Effects of Industrial Accidents, the OSPAR, UNCLOS and London Conventions)
- internal market Directives (Services, Concessions, Public Procurement, Utilities Procurement, Accounting, Transparency, and Professional Qualifications Directives)
- European Framework Directive on Safety and Health at Work (particularly the Occupational Health and Safety Framework Directive 89/391/EEC) and the Carcinogens Directive
- environmental Directives (EIA, Birds, Habitats, Extractive Waste, Environmental Liability, Seveso III, and the Water Framework Directive).

Environmental acquis and the Extractive Waste Directive 2006/21/EC



Source: Cox et. al. 2018

Characterization of Category A Waste Facilities

C&E

According to Directive 2006/21/EC, the provision of Financial Guarantees has to be foreseen for category A facilities. According to Annex III of 2006/21/EC, waste disposal facilities are assigned to category A if:

- the risk assessment, taking into account factors such as current or future size, location and environmental impact of the waste disposal facility, shows that a failure or improper operation could lead to a serious accident, or
- the plant contains waste that is classified as dangerous according to Directive 91/689/EEC above a certain threshold, or
- the system contains substances or preparations which are classified as dangerous according to the guidelines 67/548/EEC or 1999/45/EC from a certain threshold value.

Purpose of Financial Guarantees (FG)

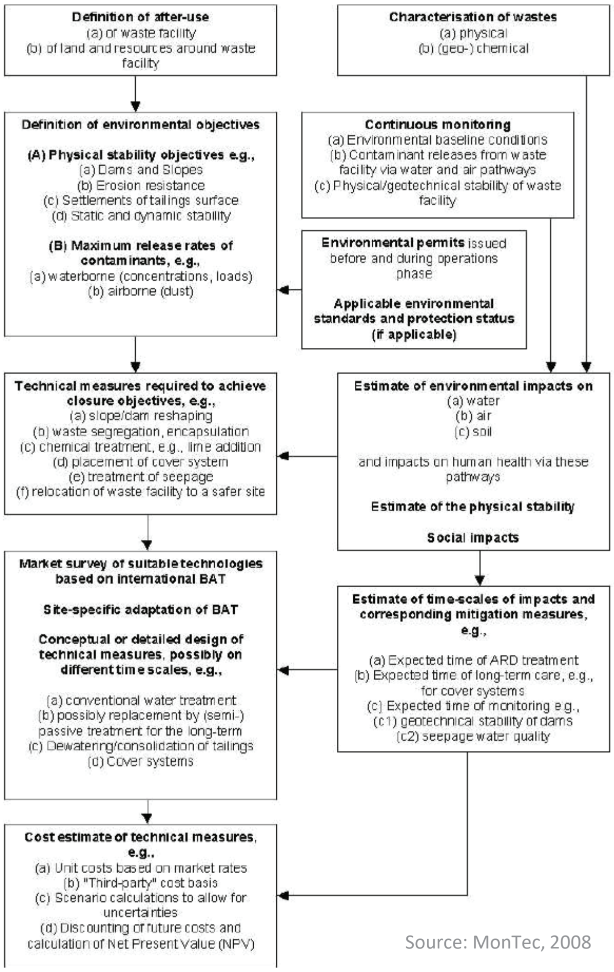
C&E

EWD provides measures, procedures and guidance to prevent or reduce adverse effects on the environment and any resultant risks on human health from the management of extractive waste.

EWD requires the competent authority to ensure a financial guarantee provided by the operator, prior to the commencement of any operations involving the accumulation or deposit of extractive waste in a waste facility.

- FG is an instrument issued by a bonding company, an insurance company, a bank, or other financial institution, which agrees to hold itself liable for the activities of a third party
- are designed to protect the society from closure liabilities
- is a guarantee that the closure plan will be implemented. It is for expected costs only.

FG is a promise to take responsibility for another company's financial obligation if that company cannot meet its obligation and refers to the establishment of a source of funding for liabilities under environmental law or an environmental permit, license or other authorization.



Source: MonTec, 2008

Principles of Financial Guarantees

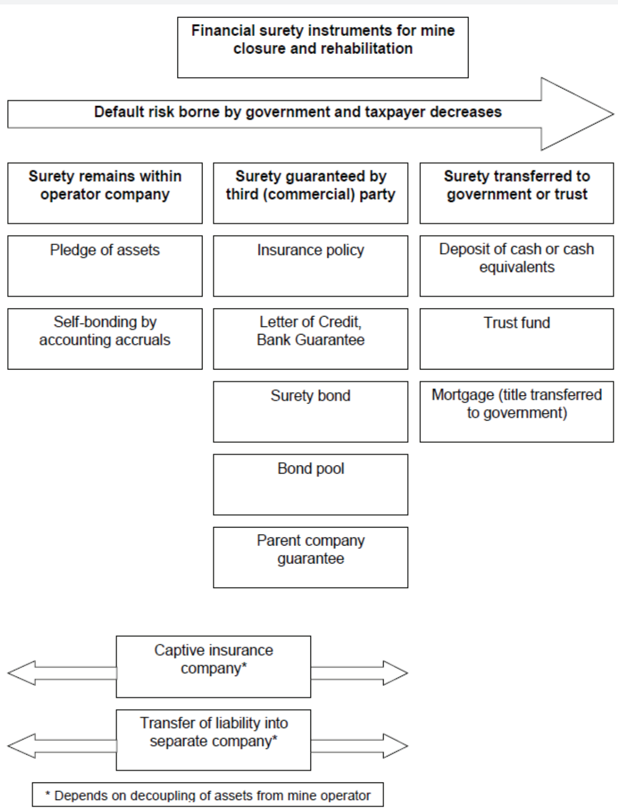
C&E

Financial instruments can be divided in three main categories depending on the degree to which FG is decoupled from the mine operator's assets (MonTec, 2008):

- FG remains within the operator company,
- FG is guaranteed by a third (commercial) party,
- FG is transferred to the government or a trust fund

Mine Reclamation Financial Provision Instruments

C&E



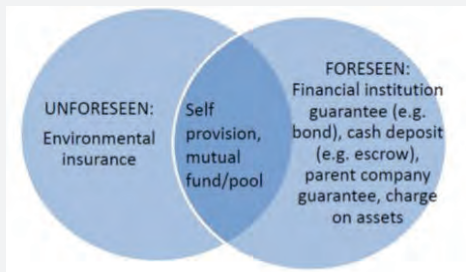
Source: MonTec, 2008

Principles of Financial Guarantees

The range of liability scenarios include (Bradley et al. 2017):

- ***Foreseen liabilities:*** liabilities that are known to arise. They include development, closure, restoration, remediation, decommissioning and aftercare of installations, etc.
  → belong to the jurisdiction of Extractive Waste Directive 2006/21/EC

- ***Unforeseen liabilities:*** environmental liabilities arising from incidents /accidents.
  → belong to the jurisdiction of Environmental Liability Directive 2004/35/EC



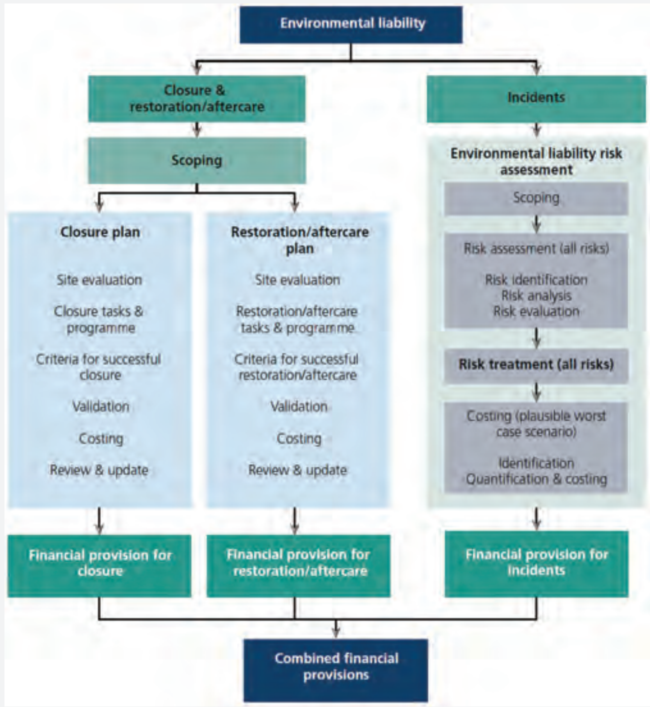
Source: Bradley et al. 2017

Principles of Financial Guarantees

For foreseen liabilities following issues apply (Bradley et al. 2017):

- calculation should typically be based on the maximum potential liability as determined by a risk assessment, and should apply any legally required formulas or default amounts.
- calculation should allow for the scenario where a third party needs to complete the works, to provide for cases where the liability is abandoned.
- where the liability is going to change throughout the life of the operation, calculations should take account of the cost profile of the operation.
- for operations where the liability is unlikely to change significantly (e.g. a maximum amount of waste that is permitted to be held at a waste transfer facility), calculations should be based on that maximum amount.
- contingency may be necessary to provide for the uncertainty in costing complex and remote events, e.g. mobilization issues or design changes, and for inflation.

Principles of Financial Guarantees



calculation of the volume of the financial provisions is based on the prognosis of closure and restoration costs after termination of the mining activities

The more independent the financial guarantee is, the less it is affected in case of a bankruptcy

need for combined closure and restoration plans

Source: Environmental Protection Agency of Ireland, 2014

Structure of Costing

The structure of costing of closure activities comprises following basic cost types:

Closure cost:

- Investment and maintenance cost
- Design, engineering and supervision cost
- Administrative cost (permits, fees and taxes)

Post closure cost:

- Aftercare and monitoring cost
- Inspection cost

FG must be complemented by permitting, inspection, enforcement and education process to be effectively implemented.

Permitting process is necessary for clarifying the criteria for mine closure, impelling planning for closure cost and successful implementation.

Review and Release of the Financial Guarantee

According to EWD, the FG size has to be **adjusted periodically** in accordance with any rehabilitation work as described in the waste management plan.

- Furthermore, the waste management plan must be **reviewed every 5 years**, or more frequently in case of substantial changes of the operations.
- Modifications in the technical or exploration works design shall be accompanied by the appropriate updating of the closure plan design.
- release of the FG shall depend on the period of liability for the mine waste facility described in the Mine Closure and Rehabilitation Plan

For the closure and after-closure phase, the EWD requires MS to ensure that the operator requests an authorization to start the closure procedure, based on the latest periodic review of the waste management plan.

Thank you for your attention!

Part I: Waste Facilities Category A – Financial Guarantees.

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Some questions for discussion

Do you need support for the enforcement of the EWD? If yes, what kind of support?

What type of financial provision is preferably used in your country?

How to keep the value of the FG in times of decreasing interest rates?

Waste Facilities Category A – Closure Planning

Introduction to Closure Planning

Mine Closure entails the process of site rehabilitation at the end of a mine's life approved through a closure certificate by the competent authority.

- steps taken for rehabilitation measures taken for a mine or parts thereof commencing from cessation of mining or processing operations

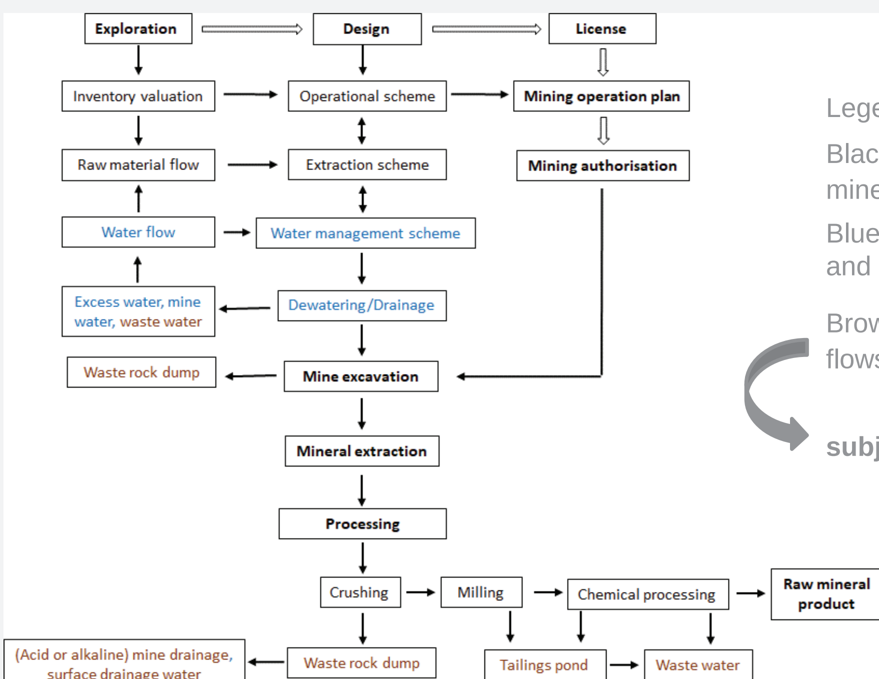
Mine closure process

- Shutdown – production stoppage, early retirement of employees, minimum labor force needed for shutdown.
- Decommissioning – equipment, buildings, disposing waste
- Remediation/ rehabilitation
- Post closure – monitoring, long term after care and maintenance

A closure plan serves as base for regulatory body's determination of the FG amount. The FG must cover closure and post-closure activities.

Introduction to Closure Planning

Exemplified scheme of mine design and mining process



Legend:

Black words: activities related to mine preparation and operation

Blue words: water-related flows and activities,

Brown words: to waste-related flows or activities

subjects of closure planning

Figure source: Schneider & Wolkersdorfer, 2020, in press

Mining Typology

Aggregates

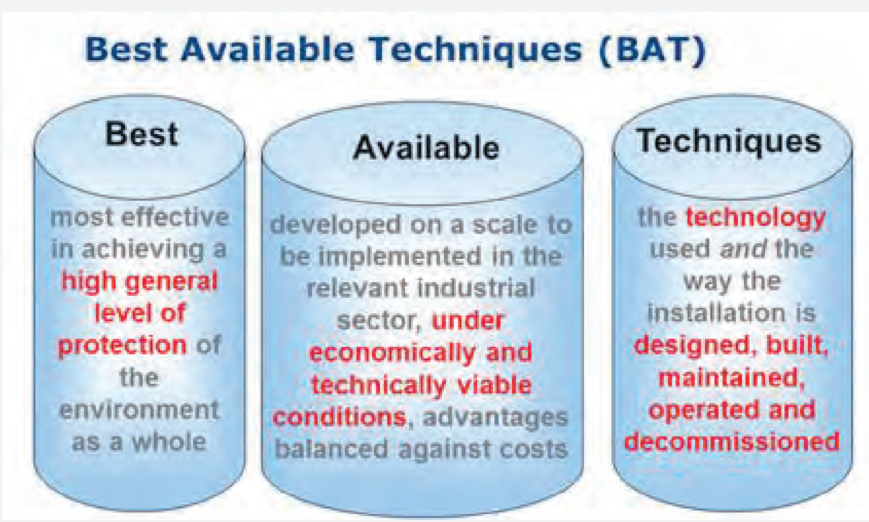
Energy Minerals

The different mining types of the resources are characterised by certain particularities that must be taken into account in the closure plan.

Ores

Industrial Minerals

Closure must take place acc. to BAT



Source: https://www.era-comm.eu/

Closure Planning

Progressive mine closure (concurrent rehabilitation) plan includes various land use activities to be done continiously and sequentially during the entire period of mining operations, while

Final mine closure activities would start towards the end of mine life, and may continue even after the recources are exhausted and/or mining is discontinued till the mining area is rehabilitated

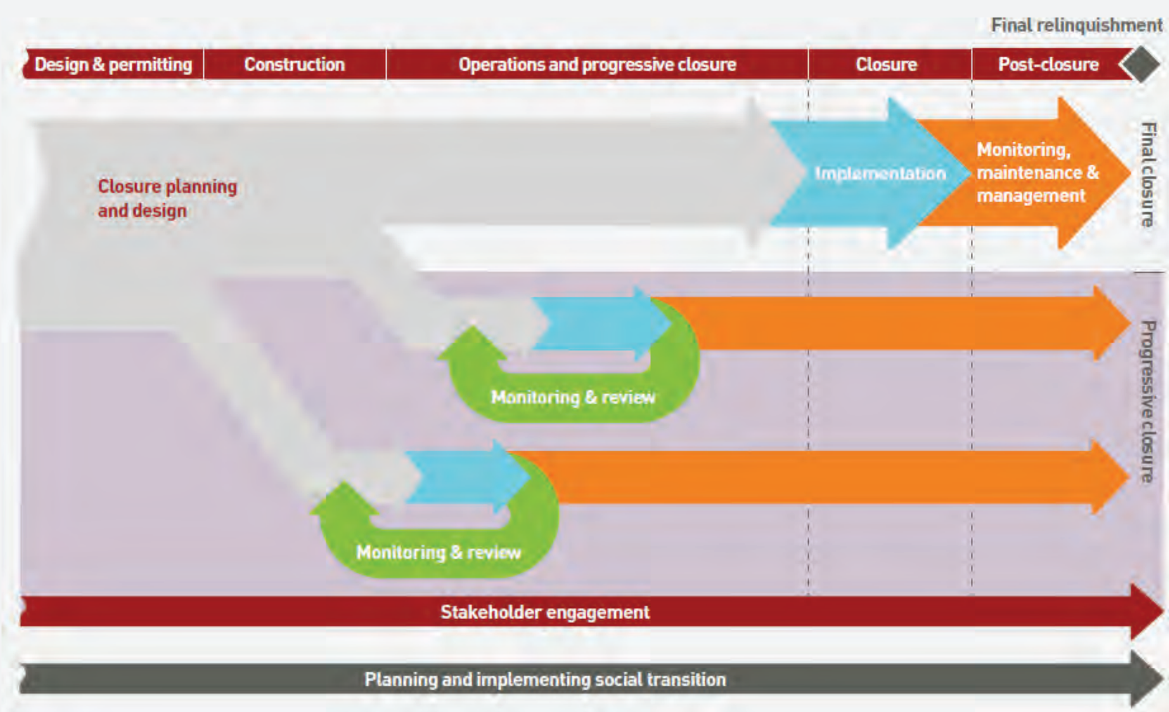




Premature mine closure is a form of mine closure that occurs when closure is unexpectedly necessitated before the anticipated time of closure as outlined in a long-term mine plan.

Reasons for this form of closure can include unforeseen technical difficulties in mining, sharp decreases in ore prices, etc.

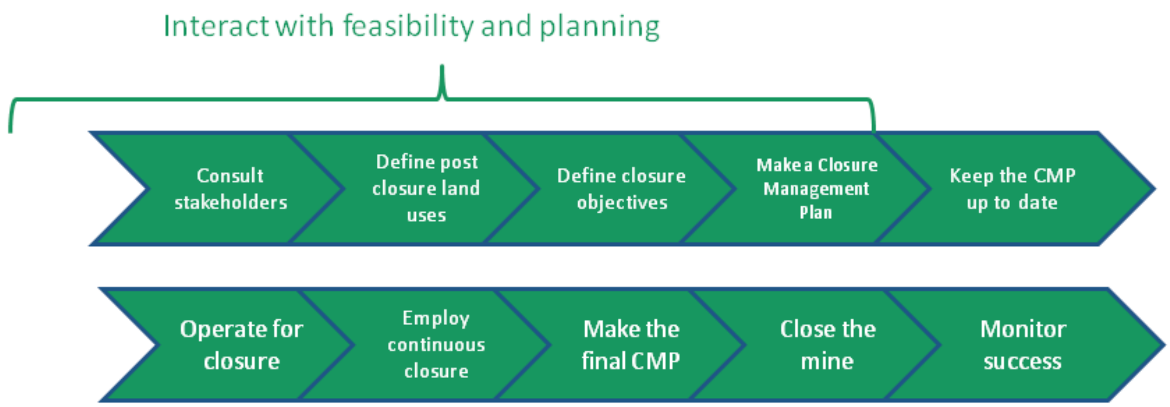
Closure Planning



Source: ICMM Integrated mine closure: good practice guide, 2019

Closure Planning

Source: www.paulhogarth.com/about-us/clients/client-list.html



Source: Geological Survey of Finland

Closure Planning

Decommissioning: process of taking infrastructure out of active service, from the end of its utility for site activities until the removal of all unwanted infrastructure and services.

Decontamination: removal of contaminants from buildings or other infrastructure, for instance asbestos abatement, pipeline cleaning and general cleaning/washing.

Demolition/deconstruction: process of physically taking apart infrastructure, may involve disassembly of some or all of the structures, or destruction of infrastructure with heavy equipment or explosives.

Rehabilitation: return of land to a stable productive and self-sustaining condition, after taking into account beneficial uses of the site and surrounding land. Reinstatement of degrees of ecosystems and function where restoration is not the objective.

Restoration: is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.

Relinquishment: end of site ownership by the mining company and of their responsibility for the site, with transition of ownership and residual liability to the jurisdictional authority or a third party. Completed closure was approved by the competent authorities.

General Mine Closure Planning Process

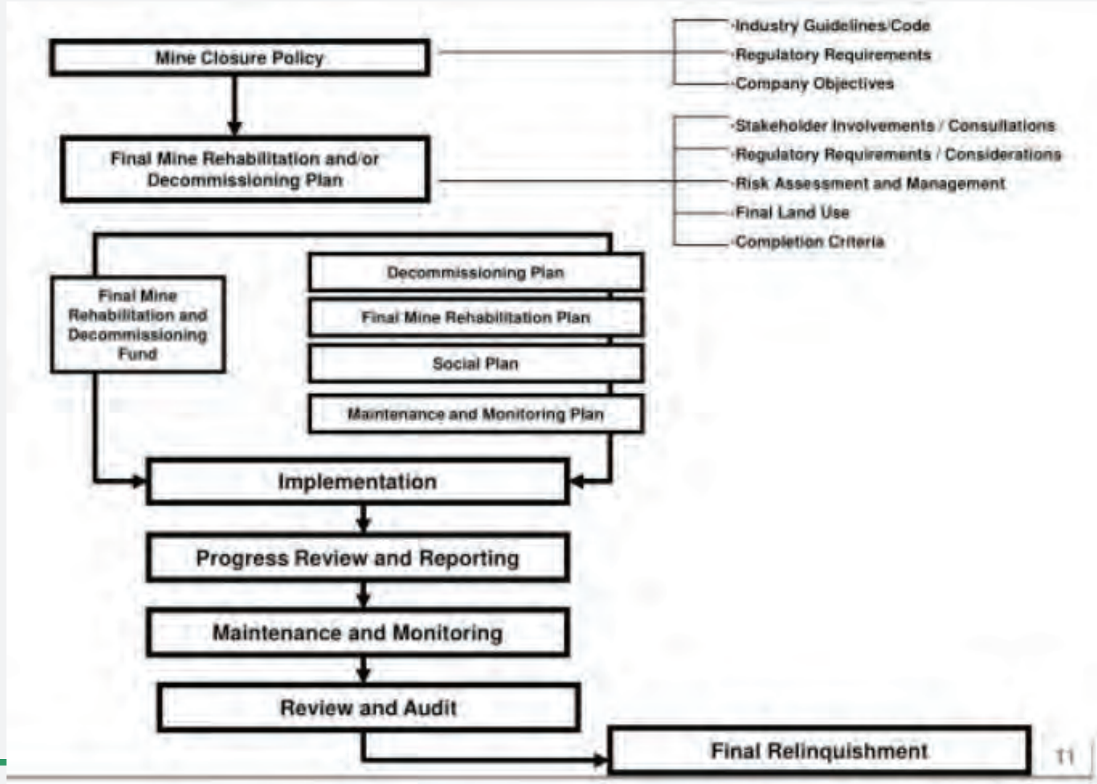


Figure source: Holcim

Closure Planning

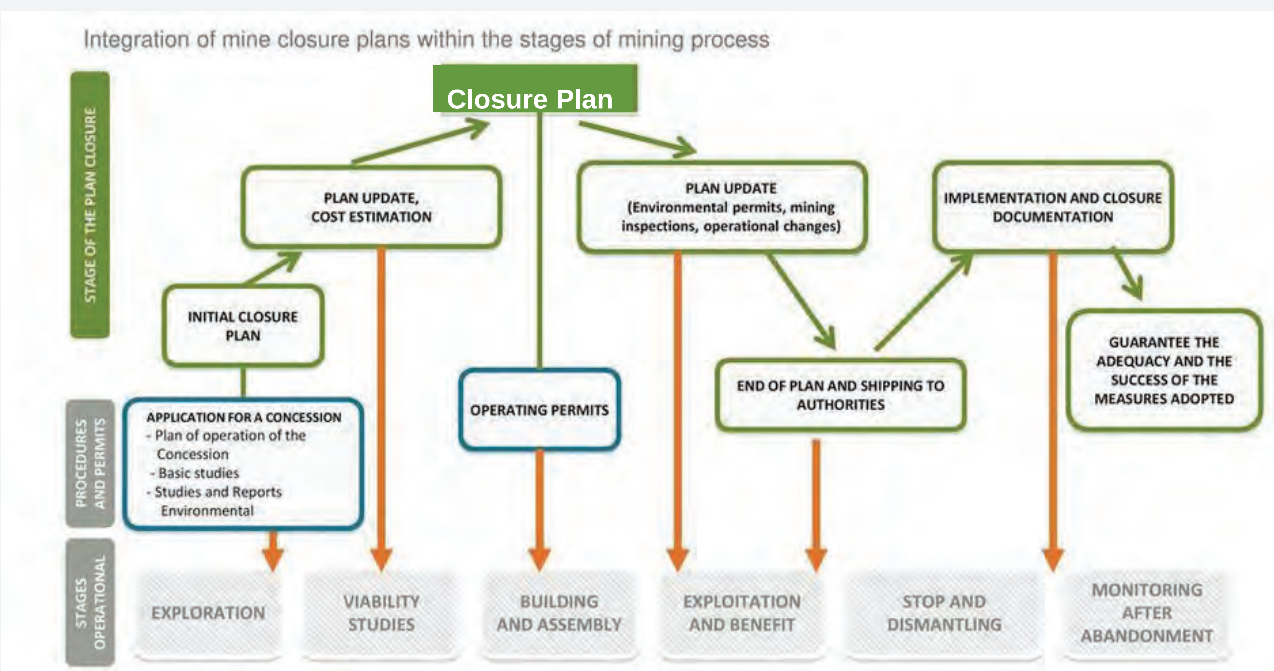


Figure source: TEYDE

Potential mine closure components

C&E

The types of closure activities determine the cost profile of technical works. Generally, following activities need to be considered, depending on the resource and mining type:

- Site Preparation
- Earthworks
- Fencing and Drainage
- Demolition / Decommissioning
- Backfilling
- Relocation
- Groundwater Protection Measures
- Flooding and Water Treatment
- Shaft and Adit Closure
- TMF Dewatering and Closure
- Application of surface sealing
- Recultivation / Revegetation
- Waste disposal.

Figure source: Wismut GmbH

Closure Planning

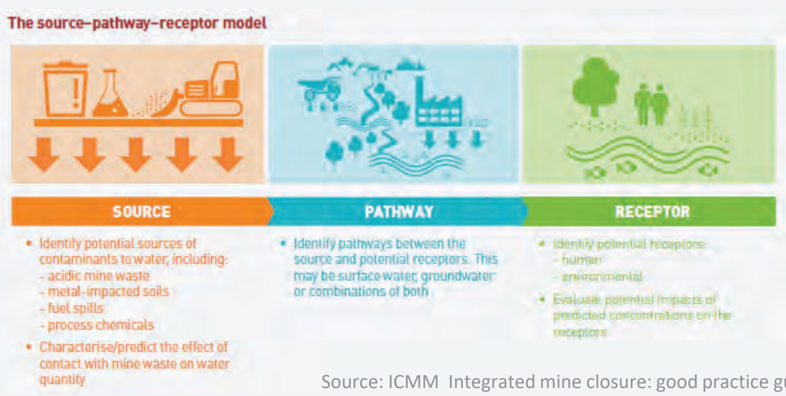
C&E

Description	Applicable closure components			
	Open-cast	Under-ground	Com-bination	oil wells
Dismantling of processing plant and related structures (including overland conveyors and power lines)	yes	yes	yes	no
Demolition of steel buildings and structures	yes	yes	yes	yes
Demolition of reinforced concrete buildings and structures	yes	yes	yes	yes
Rehabilitation of access roads	yes	yes	yes	yes
Demolition and rehabilitation of electrified railway lines	yes	yes	yes	yes
Demolition and rehabilitation of non-electrified railway lines	yes	yes	yes	yes
Demolition of housing and facilities	yes	yes	yes	yes
Opencast rehabilitation including final voids and ramps	yes	no	yes	no
Sealing of shafts, adits and inclines	yes	yes	yes	
Rehabilitation of overburden and spoils	yes	yes	yes	yes
Rehabilitation of processing waste deposits and evaporation ponds (alcaline, salt-producing waste)	yes	yes	yes	yes
Rehabilitation of processing waste deposits and evaporation ponds (acidic, metal-rich waste)	yes	yes	yes	no
Rehabilitation of subsided areas	yes	yes	yes	yes
General surface rehabilitation, including grassing of all devastated areas	yes	yes	yes	yes
River diversions	yes	yes	yes	no
Fencing	yes	yes	yes	yes
Water management (Separating clean and dirty water, managing polluted water and managing the impact on groundwater, including treatment, when required)	yes	yes	yes	yes
maintenance and aftercare	yes	yes	yes	yes

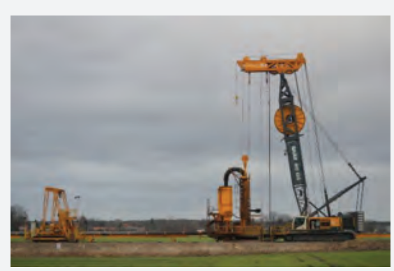
Site Preparation, Earthworks, Demolition / Decommissioning, Backfilling

Figure source: Wismut GmbH

Groundwater Protection Measures



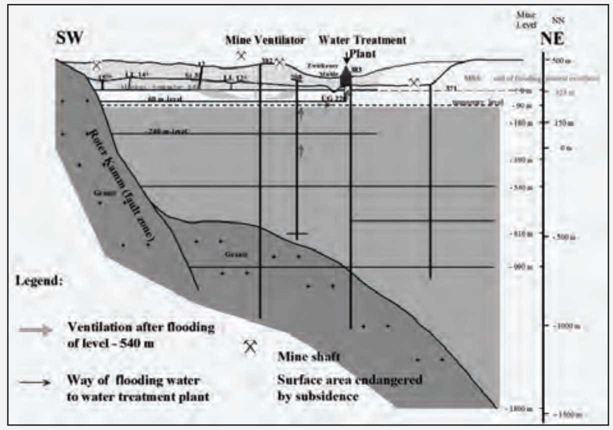
Source: ICMM Integrated mine closure: good practice guide, 2019



Flooding and Water Treatment

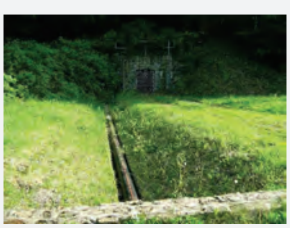
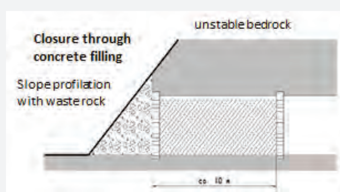


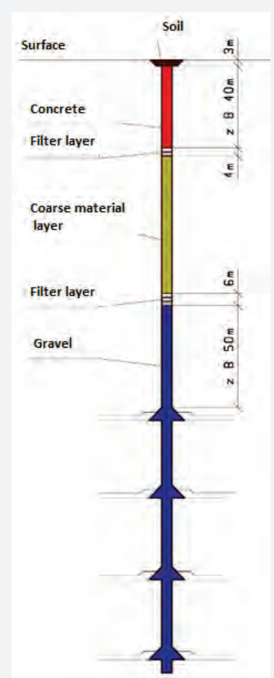


Shaft and Adit Closure



TMF Dewatering and Closure

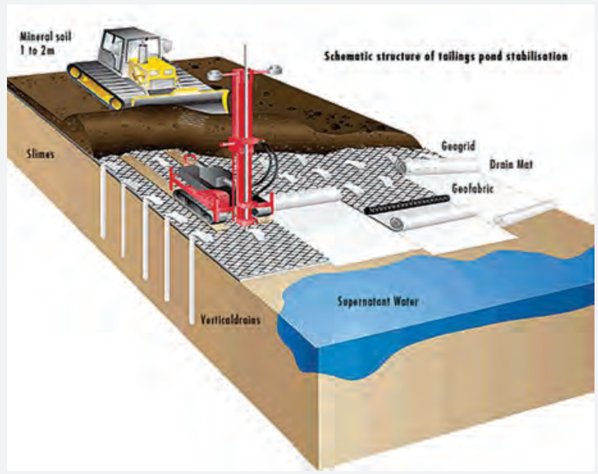


Figure source: Wismut GmbH

Application of Surface Sealing

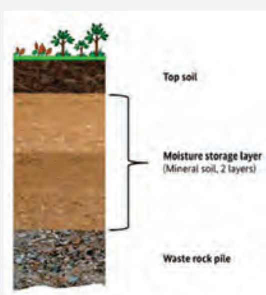
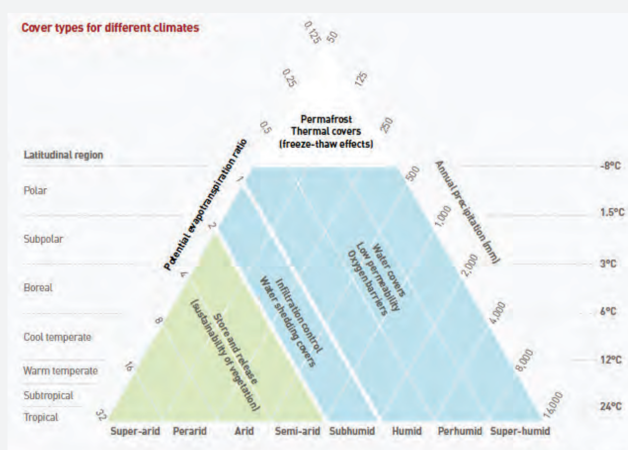


Figure source: BMWI

Figure source: Wismut GmbH



Source: ICMM Integrated mine closure: good practice guide, 2019

Recultivation / Revegetation

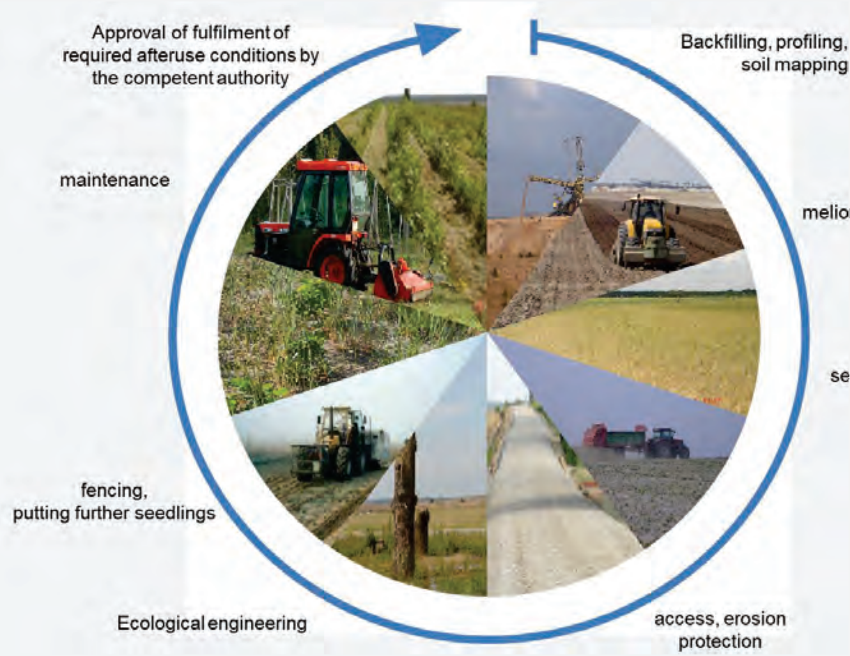
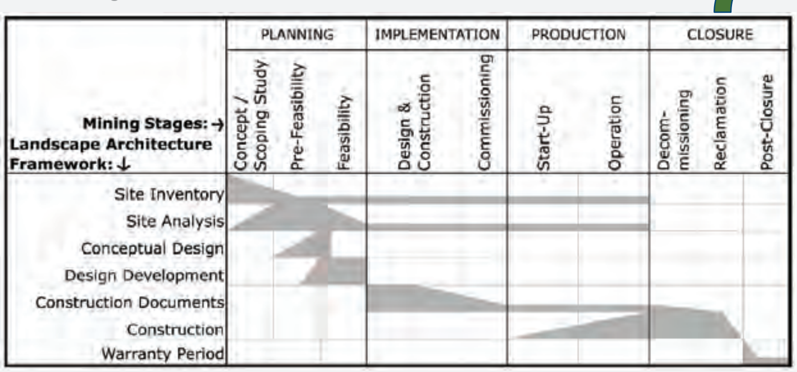


Figure source: VE-M

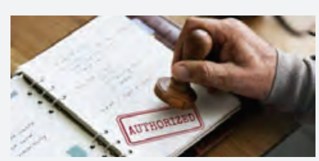
Mine Closure Design

Source: Slingerland&Wilson, 2015



Technical closure design contains:

- Technical design and drawings
- Bills of Quantities (BoQ)
- Quality assurance plan, etc.



BoQ essential for follow-up and verification of the closure design by the competent authority

Costing of Closure Activities

Closure cost:

- Investment and maintenance cost
- Design, engineering and supervision cost
- Administrative cost (permits, fees and taxes)

Post closure cost:

- Aftercare and monitoring cost
- Inspection cost

Costs	Description
Direct closure costs	Calculated using conditions which represent the maximum closure cost.
Indirect closure costs	Contract preparation and administration costs. Calculated by project staff and site specific.
Mobilization and site preparation	1 to 5 % of direct closure cost
Contingencies	Project uncertainties and unexpected natural events, 2 to 5 % of direct closure costs.
Engineering and Design	Redesign to reflect current conditions. 2 to 10 % of direct costs.
Overhead	Company overhead not included in direct cost calculations, 3 to 14 % of direct closure costs.
Closure management	Project inspection and supervision, 2 to 7 % of direct closure costs. Administrative maintenance
Administrative costs	Permitting cost. Country and site specific.
Maintenance costs	Operation of the environmental operation system, water treatment etc. Duration and cost site specific. 2 to 10 % of direct costs.
Monitoring costs	Environmental observation, duration and cost site specific.

Monitoring and Aftercare

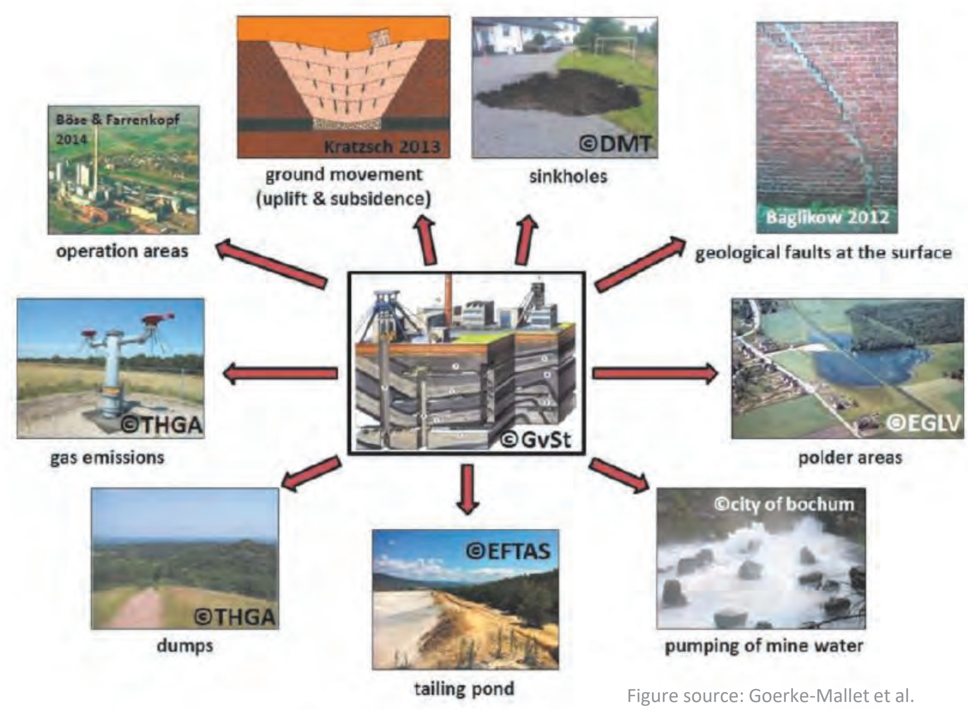


Figure source: Goerke-Mallet et al.

Thank you for your attention!

Part I: Waste Facilities Category A – Closure Planning.

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Some questions for discussion

What do you think about BoQs for closure planning?

Do you apply the FIDIC rules for tendering?

Do you have a methodology for the management of risks resulting from post-closure liabilities where the closure was approved by the competent authority?

ECO EFFICIENCY
CONSULTING & ENGINEERING Ltd

Study supporting the Extractive Waste Directive

Webinar II FINANCIAL GUARANTEES & EXTRACTIVE WASTE MANAGEMENT PLANS

Extractive Waste Management Plans (EWMPs)

Final Workshop Webinar
11 June 2020

EWMPs - Article 5 of the EWD

"Member States shall ensure that the operator draws up a waste management plan for the minimisation, treatment, recovery and disposal of extractive waste, taking account of the principle of sustainable development"

The key concepts that have to be incorporated into the EWMPs:

Article 5.2 (a) & (b)
- Prevention or reduction of waste and its harmfulness
- Recovery of waste by recycling and reusing (where this is environmentally sound)

Article 5.2 (c)
- Assurance short and long-term safe disposal of the extractive waste
- Assurance the long-term geotechnical stability of the EWF

Contents of an EWMP

Description of the operation generating the extractive waste

Characterisation of the waste

- Collection of data according to the requirements laid down Decision 2009/360/EC
- Identification if the waste is inert according to Decision 2009/359/EC
- Investigation if the waste is hazardous or non-hazardous according to Decision 2014/955/EC
- Recognition of the hazardous properties (if it is hazardous) by Regulation (EU) No 1357/2014

Estimation of total quantities to be produced at operational phase

Classification of the extractive waste facility (if applicable)

Documentation over the objectives of Article 5.2 of the EWD

- How the operator prevent or reduce waste production and its harmfulness?
- Does the EWMP provide information for recovery /recycle of extractive waste ?
- Is the assurance of short- and long-term safe disposal of EW sufficiently documented?

Control and monitoring procedures

- pursuant to Articles 10, when applicable, and 11(2)(c)
- measures for the prevention of water status deterioration (Directive 2000/60/EC) and for prevention or minimisation of air and soil pollution pursuant to Article 13

Description of how the environment and human health may be adversely affected by the deposit of such waste and the preventive measures

Closure plans & Long-term management plans

ECOEFFICIENCY

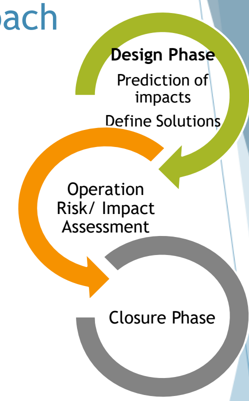
Findings of the study supporting the elaboration of guidance on best practices in the EWMPs

- The majority of the **EWMPs are structured according to Article 5.3**, **but the level of detail vary considerably**
- **The targets of EWD** are fulfilled, however all details are not always presented in the EWMPs but **are addressed in other related documents like the EIA**
- The **amounts of extractive waste are not** always presented in the available EWMPs
- The **BAT** for the management of waste were presented in the available EWMPs
- **Risk management is linked to Category A EWF** and not to the management of waste
- **The long-term stability** as formulated in the EWD **have not been reflected** in the available EWMPs

ECOEFFICIENCY

Risk/Impact assessment approach

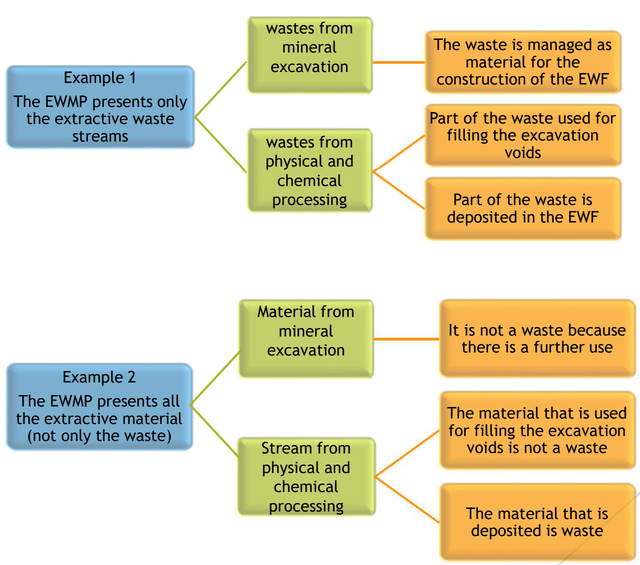
- Effective management of extractive waste requires a risk/impact assessment
- The EWMP among others should also aim to:
  - Minimise the likelihood of adverse environmental impacts
  - Achieve resource efficiency
  - Strengthen the supply chains
  - Reduce the amount of wastes
  - Short and long term stability



EWMPs would mainly act as a vehicle to summarise the risk assessment which have been already undertaken as part of the EIA

EWMPs in different MSs

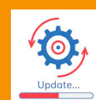
Examples of cases



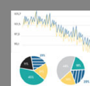
Remarks for the value of the EWMPs

The Article 5 of the EWD provide a wider perspective for the management of waste.

It's not limited to the waste that is deposited into an EWF but covers also cases such recycling of waste and the placing of EW back into the excavation void



The revision of EWMPs every five (5) years provide the flexibility to accommodate the changes for the management of extractive materials (waste or non-waste) without updating the EIA



The information from the EWMPs may feed reporting platforms for extractive materials, extractive waste or by-products

ECOEFFICIENCY

Please comment on the following:

1. **NO extractive waste, NO EWMP ?**
2. **NO obligation for EIA, NO EWMP ?**
3. **The approval of the EWMP** includes,
   a. **the full spectrum** of the management of the **extractive materials** and not only extractive waste?
   b. **other waste** (not extractive waste, like metallurgical waste)?

Annex IV: Presentations Webinar III (12/06/2020)

ECO EFFICIENCY
CONSULTING & ENGINEERING Ltd

Study supporting the Extractive Waste Directive

Webinar III Sustainable and transparent management of extractive waste

Addressing Circular Economy in extractive waste management

Final Workshop
Webinar
12 June 2020

Circular Economy Principles & EWD

The extractive industry actively searches for circularity aspects in relation to extractive waste management plans as well as searches for strategies to maximise resource.

However due to specific geological, geochemical, geotechnical, geomorphological, climatological, ecological, and socio-economic conditions of each site, **cannot all the circular economy practices fit for each site**

Article **5.2 (a) & (b)** of the EWD
Prevention or reduction of waste and the encouragement of recovery

Resource Efficiency

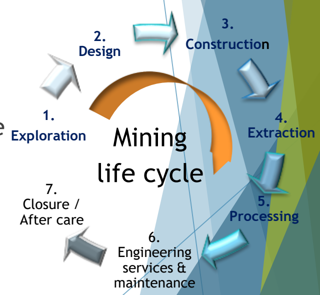
Circular Economy Action Plan

Circular Economy Principles & EWD

"**A circular economy starts at the very beginning of a product's life**. Both the design phase and production processes have an impact on sourcing, resource use and waste generation throughout a product's life".

A well-developed EWMP considering the Circular Economy paradigm should be based on:

1. Optimising the ore extraction by strengthening the role of **the exploration and design phase**
2. **Preventing waste generation** within the possible extent
3. **Minimisation of the environmental impact of waste**
4. **Strengthening of the recycling**



Practices reporting in the EWMPs supporting the Circular Economy :

- Optimisation of extraction from the design phase
- Techniques for filling back excavation voids
- Utilisation waste rock for earthworks or for the structure of EWF
- Recycling or re-using of historical extractive waste
- Segregation and re-use of topsoil

There are cases where circular economy assist for the reduction of deposited waste

The composition of waste or the socio-economic conditions leads to waste deposition

The yearly amounts of waste that is declared is linked to the amounts that is deposited. So the circular economy practices leads to reduction of the total amount of waste (stored or deposited)

Secondary Raw Materials

Circular Economy Principles — Waste can re-enter in the economy → Strengthen the supply chain

How each MS distinguish waste from non waste?

- Inert waste or non-hazardous may be acceptable for certain applications
- Specific properties, the technical, economic and environmental requirements influence the usage

The material stream as by-product — Which legislation is applicable to by-products enforced for each MS?

The MSs are accepted **waste as by-products according to Waste Framework Directive criteria or** the further use is under the principles of **waste management**?

ECO EFFICIENCY

Remarks in relation to the implementation of the EWD

The practices that are linked to the circular economy influence the generation of waste and the amounts that are going to be deposited. It should be highlighted that the EWD and **Article 5 reflected already in 2006 what is in essence a Circular Economy perspective**.

The role **risk-based considerations** play in choosing appropriate solutions is a useful guide that may be applied for the circular economy principles

Using **extracted material as by-product or waste as construction minerals** - as far as it is technically feasible and environmentally sound - leads to less extractive waste being deposited and offsets primary production of construction minerals elsewhere

The utilisation **of historical waste as raw material** increases the long-term value obtained from the original extraction, offsets primary production elsewhere and simultaneously contributes to site rehabilitation

ECO EFFICIENCY

Please comment on the following:

- “how to perform the Circular Economy better ?” Does **EWD** cover the **Circular Economy** aspects?
- Are the practices strengthening the Circular Economy approved under the perspective of **safety** (stability, H&S)?
- The **Circular Economy** principles contribute to the **social acceptance** of an extractive operation. Do you believe is a benefit for the operator to provide a **full spectrum of extractive materials in the EWMPs?**

- Circular economy in the extractive management and reporting.
- Case of Polish company

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The European Green Deal (December 2019):
- Europe to become the first climate neutral continent in the world by 2050
- circular economy as a central part of this sustainable growth strategy.

A new Circular Economy Action Plan (March 2020):
- decouple economic growth and prosperity from consumption of finite resources
- ensuring the competitiveness of the EUs economy in the long term

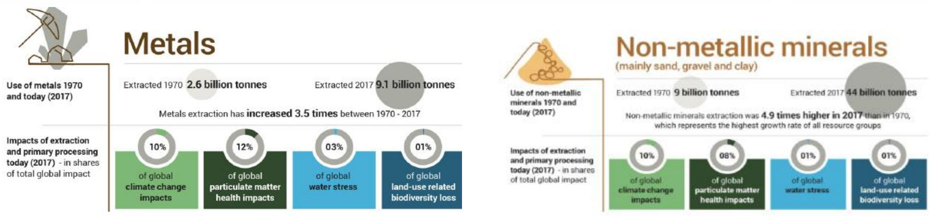
Source: COM(2019)640

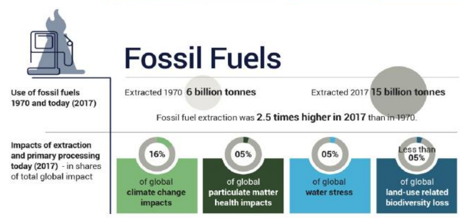
Raw materials:
- Major parts of the economy depend on the supply of raw materials
- Critical raw materials
- Waste from ongoing operations and stored

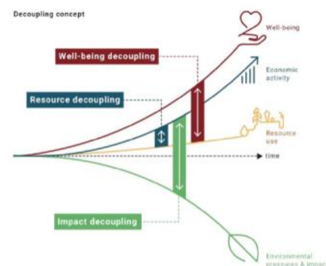
Circular economy
- Resources used are kept in the EU economy as long as possible (prevention) - **Metals can be recycled time and time again without degrading.**
- Waste minimisation – efficiency, new business model, by-product
- Landfill mining

Source: UNEP Resource Panel

UNEP – world perspective



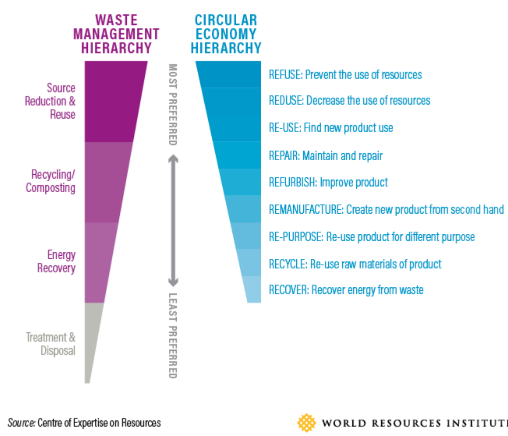




The decoupling of natural resource use and environmental impacts from economic activity and human well-being is an essential element in the transition to a sustainable future.

https://www.resourcepanel.org/reports/global-resources-outlook

Waste Hierarchy -Raw Materials



Circular Economy Hierarchy

- **maximize the use of materials**
- **achievement of the highest-possible level of circularity through a life-cycle based analysis demonstrated by all policies, including taxes**
- **industry eco-innovations**

Lack of transparency is a significant barrier to circular economy approaches, in particular those involving material streams where legacy substances are an issue for value retention and reuse .

CE – challenges in monitoring waste

COM 2018 (32) on the implementation of the circular economy package: options to address the interface between chemical, product and waste legislation

1. **Information on presence of substances of concern is not readily available to those who handle waste and prepare it for recovery**
2. **Waste may contain substances that are no longer allowed in new product - promoting non-toxic material cycles**
3. **EU's rules on end-of-waste are not fully harmonised, making it uncertain how waste becomes a new material and product - materials which have been recycled should no longer be considered waste – rules and clarity for end-of-waste criteria is needed**

Eurometaux

End-of-Waste criteria are not widely applied in the non-ferrous metals industry, instead, our major issue is the lack of harmonised criteria for by-product status

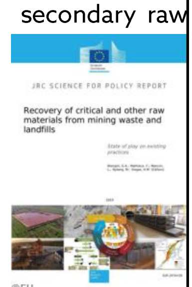
4. **Rules to decide which wastes and chemicals are hazardous are not well aligned and this affects the uptake of secondary raw materials**

Challenges with the practical application

Case studies

Extractive waste facilities can represent a vast, untapped resource for valuable materials

Monitoring raw materials for CE - DMC, EU self-sufficiency, secondary raw materials, patents



EU case studies – JRC reports and RMIS
- JRC - availability of data and information on secondary materials as well as a harmonised legislative framework within the EU appear to be crucial for the large-scale deployment of recovery practices

EU case studies from projects
- H2020
- KIC Raw Materials
- Era-min

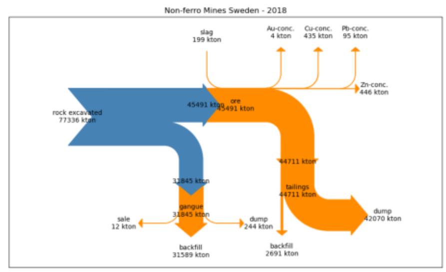
EU case studies in literature (Resource policy)
- Aijala tailings pond – Finland -
- Campello Monti Fe-Ni-Cu-(Co) Italy
- The Gorno mining district Zn-Pb-AG, Italy

JRC - Valuable raw materials are wasted for lack of recycling and proper waste management

CE- methodology based om MFA


JRC TECHNICAL REPORTS

Revision of the material system analyses specifications



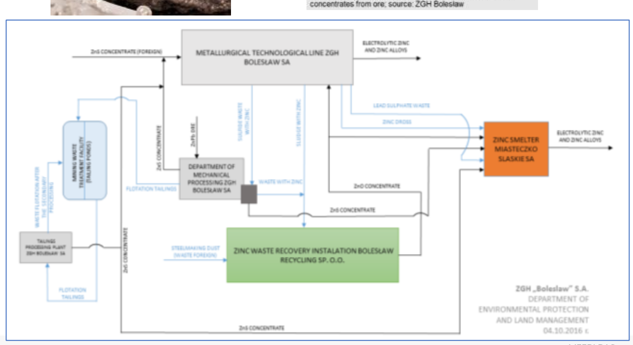
ZGH „Bolesław – good practise

ZGH "Bolesław" S.A.

- **one of the largest companies dealing in zinc mining and recycling in Poland**
- **running activities within capital group covering zinc smelter and companies dealing mainly with production and recovery of zinc and associated metals**

Flotation tailings formed mainly during preparation of Zn-Pb concentrates from ore; source: ZGH Bolesław

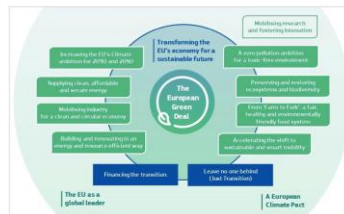
Olkusz Pomorzany mine; photo: Krzysztof Boniecki/ZGH Bolesław



Recovery of Zinc and lead from flotation waste; photo: PTWP

- **The European Green Deal adopted in December 2019 as a new growth strategy with the goal:**
  "transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use"
- **Waste management not mentioned directly within priorities but necessary to achieve defined goals and activities, e.g.:**
  - achieving a climate neutral and circular economy by using the potential in global markets for low-emission technologies, sustainable products and services
  - ensuring the supply of sustainable raw materials, in particular of critical raw materials necessary for clean technologies, digital, space and defence applications, by diversifying supply from both primary and secondary sources
  - Introducing a sustainable product policy with the potential to reduce waste significantly

Source: ecostandard.org



Source: COM(2019)640

ECO EFFICIENCY

euromines

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IGSMiE PAN

MEERI

Thank you

European Union

#CEstakeholderEU

European Circular Economy Stakeholder Platform

A joint initiative by the European Commission and the European Economic and Social Committee

Annex V: Proposal for a new questionnaire

Questionnaire for the report by Member States on the ongoing implementation of Directive 2006/21/EC	
Please provide the following contact information and complete the text boxes:	
Institution/Organisation you are representing:	
Country your Organisation is representing:	
Your Name (Family Name, Surname): <u>Example:</u> Einstein, Albert	
Your email address:	
Your Phone Number: (+International Dialling Code - Local Number) <u>Example</u>: +352 9876 12345	

Please fill in the relevant parts of the form, • "Part A" on applicability & changes must be filled by all countries • If yes to Part A, then "Part B" must be filled in.
You can use your national language to fill in the questionnaire.
Questions below use the same text as Annex III of Commission Decision 20xx/xxx/EC. For clarification of some of the questions featured in part B, please refer to the separate letter sent by the Commission.
Deadline for the submission: 1 February 20xx [2024, 2027, 2030,…]

Part A. Questions to be answered by all MS to update the information on applicability in Member States
(1) Administrative arrangements and general information: **Do you have EWFs on your territory falling under the directive?** **Yes/No** **Has there been any change in national legislation?** **Yes/No** **Please specify:** **Have new Extractive Waste Facilities come into operation since the last reporting period?** **Yes/No** **Have there been any changes to the inventory of closed/abandoned EWFs since the last reporting period?** **Yes/No** **(2) Please indicate the competent authority in charge of reporting to the EC Questionnaire:** **……………………………….**

Part B. Questions to be answered by those MS that have reported changes under Part A.

If possible, using the table provided in Annex, please provide an estimate of the number of extractive waste facilities on the territory of the Member State:

	In Operation	In Transition	In Closure phase	Closed or Abandoned
- Category A that are also "Seveso" installations - Category A that contain hazardous waste but are not "Seveso" installations - Category A installations containing non-hazardous non-inert waste - Category A installations containing inert waste Total Category A Not Category A - Inert waste[3] -Non-hazardous non-inert waste Total				

Please indicate the number of cases of waste facilities of Category "A" in operation on your territory having a potential environmental or human health impact on another Member State:

(2) Waste Management Plans and Permits

(a) Please indicate the competent authority(ies) in charge of verifying and approving the waste management plans proposed by the operators:

(b) Please indicate the competent authority(ies) in charge of issuing the Article 7 permits

(c) Have there been any changes made in national legislation since the last reporting period? Which ones?

[3] Installations treating exclusively inert waste as defined in the Directive

(d) How many Waste Management Plans referred to in Article 5(6) of the Directive are currently in place?
(e) What percentage of Waste Management Plans take the latest EC Guidance into account?
(f) How many permits have been updated since the last BAT note on the Management of the Extractive Wastes has been finalised?
(g) Have you or the operator applied the CEN standards[4] for characterisation of the expected waste?
(h) Have there been any issues with the implementation of the guidance or the BAT note?
(i) Has there been any change in national legislation, or any guidance been issued in relation to the classification of wastes going beyond the EC waste codes and guidance on classification of wastes? If so, please explain.

(3) Financial guarantees

(a) Please indicate the competent authority(ies) in charge of approving and managing the financial guarantee?
(b) Does your national legislation earmark and preserve the guaranteed finances as laid down in Art. 14 of the Directive for the EWFs?
(c) How many Financial Guarantees are currently approved and in place?
(d) How many Financial Guarantees had to be released due to unforeseen or planned closure since the last triennial reporting?
(e) Have you taken into account the new EC guidance on Financial Guarantees?
(f) Have there been any issues with this guidance?
(g) (maybe some more questions after the C&E consultant's report)

(4) Major-accident prevention plans and information

(a) Please indicate the competent authority(ies) in charge of approving and managing the major-accident prevention and information plans and information
(b) Have you encountered any specific problems?
(c) Please provide a comprehensive list of the external emergency plans referred to in Article 6(3) of the Directive:

(5) Inspections

(a) Please indicate the competent authority(ies) in charge of the inspections:
(b) Have there been any issues with implementation of the 2020 technical guidelines?
(c) What percentage of the installations is covered by regular inspections since the last reporting period? Please specify?

(6) Public Participation, Transboundary effects

(a) Please indicate the competent authority(ies) in charge of organising the public and the consultation with neighbouring MS?

[4] CEN/TR 16365:2013; CEN/TS 16229:2011; CEN/TR 16376:2012; CEN/EN 15875:2011; CEN/TR 16363:2012

(b) Which Member States have you consulted as per Article 16 of the Directive, and in relation to how many of your EWFs in total? (c) Which Member States have consulted you as per Article 16 of the Directive, and in relation to how many of their EWFs in total?
(7) Closure and after closure procedures (a) Please indicate the competent authority(ies) in charge supervising the sites during and after closure? (b) How many closures have been started/completed since the last reporting period?
(8) Inventory of closed and abandoned mines (a) Please indicate the competent authority(ies) in charge of compiling the inventory: (b) Has there been an update of the inventory of closed and abandoned facilities? (c) Has there been any new assessment been carried out? Were the criteria changed? In which way? (d) Are there any improvements/safety measures/rehabilitations achieved since the last reporting period?
(9) Other relevant information Have you encountered any particular problems with the implementation of the Directive and its provisions**?**

Annex B: Overview of Websites / organisations providing data on the extractive industry

Organisation	Weblink
Global or European mineral data	
BGS, Minerals UK, Centre for sustainable development	https://www.bgs.ac.uk/mineralsuk/statistics/home.html
Eurostat Generation of waste by economic activity	http://ec.europa.eu/eurostat/data/database https://ec.europa.eu/eurostat/tgm/refreshTableAction.do;jsessionid=ceiZsLlcWHoUGLlB33aUzqFIszFMZdAugboLmPWS0wNQKRIoEPUv!-1097325195?tab=table&plugin=1&pcode=ten00106&language=en
Eurostat, ComExt database	https://ec.europa.eu/eurostat/web/international-trade-in-goods/data/focus-on-comext
Eurostat, PRODCOM database	https://ec.europa.eu/eurostat/web/prodcom
OECD, crude oil production data	https://data.oecd.org/energy/crude-oil-production.htm
USGS	https://www.usgs.gov/centers/nmic/commodity-statistics-and-information https://www.usgs.gov/centers/nmic/minerals-yearbook-metals-and-minerals https://minerals.usgs.gov/minerals/pubs/commodity/ https://www.usgs.gov/centers/nmic/mineral-commodity-summaries USGS (2019)Mineral yearbook 2016 (annual tables, Excel file). Posted 01/10/2019 (EL); 15/11/2019 (ES) https://www.usgs.gov/centers/nmic/europe-and-central-eurasia#hr USGS (2020) Advanced release of the 2017-2018 annual tables (Excel file). Posted 23/01/2020 (PT);23/09/2020 (Cy, EE, MT); 03/12/2020 (DK); 18/11/2020 (SE); 08/12/2020 (SL);17/12/2021 (HR, LT) https://www.usgs.gov/centers/nmic/europe-and-central-eurasia#hr USGS (2021) Advanced release of the 2017-2018 annual tables (Excel file). Posted 13/01/2021 (IE, LV); 08/02/2021 (FR); 25/02/2021 (BG, CZ); 30/03/2021 (PL); 08/04/2021 (RO); 14/04/2021 (FI); 15/04/2021 (SK); 17/05/2021 (IT); 28/07/2021 (AT, DE, Hu) https://www.usgs.gov/centers/nmic/europe-and-central-eurasia#hr
World Energy Council	https://www.worldenergy.org/ https://www.worldenergy.org/data/resources/country/greece/coal/
WMD, World Mining Data (WMD)	http://www.world-mining-data.info/
National data	
AT – BERGIS, Austrian mining information system AT- BMLRT	https://bergis.rmdatacloud.com/Start (Login required) www.bmlrt.gv.at
BE - Statista BE – Wallonia Environmental Agency BE – WalOnMap	https://www.statista.com/statistics/385170/primary-aggregates-production-volume-in-belgium/ http://etat.environnement.wallonie.be/home/home-en.html https://geoportail.wallonie.be/ https://geoportail.wallonie.be/walonmap/#ADU=https://geoservices.wallonie.be/arcgis/rest/services/SOL_SOUS_SOL/DECHETS_MINIERS/MapServer#BBOX=263566.22729459393,271602.9621180636,157124.40627828945,160438.31915611518
BG - Executive Environment Agency (EEA)	http://eea.government.bg/bg/nsmos/soil/opis-na-zakriti-saorazheniya-za-minni-otpadatsi

CY - Ministry of Agriculture, Rural Development and the environment CY – Mine service	http://www.moa.gov.cy/ https://moa.gov.cy/sectors/geology-and-minds/natural-resources-mines-service
CZ - Czech National Geoportal CZ – Geological Survey Mineral commodity summaries of the Czech Republic Annual Reports	https://geoportal.gov.cz/ http://www.geology.cz/ http://www.geology.cz/extranet-eng/download http://www.geology.cz/extranet-eng/publications/online/annual-reports
DE - Federal Institute for Geosciences and Natural Resources DE - Niedersächsisches Landesamt für Bergbau, Energie und Geology DE - BVEG	https://www.bgr.bund.de https://www.bgr.bund.de/EN/Themen/Min_rohstoffe/min_rohstoffe_node_en.html https://www.bgr.bund.de/EN/Home/homepage_node_en.html https://www.lbeg.niedersachsen.de/ https://www.bveg.de/Der-BVEG/Publikationen/Jahresberichte
DK – Geological Survey of Denmark & Greenland, Center for Minerals and Materials (MiMa) DK – Danish Energy Agency, Oil and Gas Related Data site of the Danish Energy Agency DK – Statistics of Denmark	https://eng.geus.dk/mineral-resources/center-for-minerals-and-materials-mima/ https://ens.dk/en/our-services/oil-and-gas-related-data https://www.statbank.dk/
EE – Geological Survey of Estonia EE – Estonian Peat Association (ETL) EE – Estonian Statistical database (ESD)	https://www.egt.ee/en/mineral-resource-prospecting-and-exploration https://www.turbaliit.ee/en/about-us/ https://andmed.stat.ee/et/stat (KK91 "Used Domestic extraction by type of raw material)
EL – Greek Ministry of Environment, Energy and Climate Change (YPEKA), General Secretariat for Energy and Climate Change, Mineral & Aggregate Resources Division	http://www.latomet.gr/ypan/Default.aspx http://www.latomet.gr/ypan/StaticPage1.aspx?pagenb=14493
ES - Geological and Mining Institute of Spain, IGME ES – Minerva, mine production data ES- Spanish Mining Statistics ES – Panorama Minero	http://www.igme.es/servicios/serv.htm https://sedeaplicaciones.minetur.gob.es/Minerva/GenerarInformes.aspx https://energia.gob.es/mineria/Estadistica/Paginas/Consulta.aspx http://www.igme.es/PanoramaMinero/PMLin.htm
FI – Geological Survey of Finland FI – Finish Safety and chemicals Agency	http://en.gtk.fi/ http://en.gtk.fi/informationservices/mineralproduction/minfinl_17.html https://tukes.fi/en/mining HTTPS://TUKES.FI/TEOLLISUUS/KAIVOSTOIMINTA
FR – Statistical data French Ministry on climate change, energy, environment, housing, and transport	https://www.statistiques.developpement-durable.gouv.fr/energie-0 https://www.statistiques.developpement-durable.gouv.fr/bilan-et-chiffres-cles-de-lenergie-0?rubrique=19

HR – Ministry of Economy, Labour and Entrepreneurship, Mining Department HR – Croatian Geological Survey, department of Mineral resources HR – Croatian Bureau of Statistics	https://www.mingor.hr/ https://www.mingor.hr/page/kategorija/rudarstvo http://www.hgi-cgs.hr/zavod-za-mineralne-sirovine.htm https://www.dzs.hr/ https://jisms.gospodarstvo.gov.hr
HU – HGS, Mining and Geological Survey of Hungary	https://mbfsz.gov.hu/en/inventory-mineral-resources https://mbfsz.gov.hu/sites/default/files/file/2020/02/12/mineral_resources_of_hungary_2017_01_01.pdf (data 2015-2016) https://mbfsz.gov.hu/sites/default/files/file/2020/02/12/mineral_resources_of_hungary_2018_01_01.pdf (data 2017, 2018)
IE – Geological Survey of Ireland IE – Sustainable Energu Authority of Ireland	https://www.gsi.ie https://www.gsi.ie/en-ie/data-and-maps/Pages/Minerals.aspx https://www.seai.ie/data-and-insights/seai-statistics/key-statistics/energy-data/ (Energy Flows)
IT – iSTAT, Italian National Institute of Statistics	http://dati.istat.it (Environment & Energy, Quarrying and Mining)
LV - Latvian Peat Association	http://www.latvijaskudra.lv/en/statistika/krajumi_un_ieguve/
LT – Lithuanian Peat Producers Association	https://peat.lt/
MT – Malta Resources Authorithy Annual reports	https://mra.org.mt/ https://mra.org.mt/library/annual-reports/
NL – Environmental data compendium, natural resources NL - NLOG NL – Rijkswaterstaat, Ministery of Infrastructure and Watermanagement, Soil + NL - Geological Survey of the Netherlands, TBO NL - SODM	https://www.clo.nl/indicatoren/nl0067-winning-en-verbruik-van-oppervlaktedelfstoffen https://www.nlog.nl/datacenter/ https://www.bodemplus.nl/onderwerpen/wet-regelgeving/bbk/publicaties/rapportage/ https://www.nlog.nl/ https://www.sodm.nl/sectoren/zoutwinning (saltproduction)
PL – Higher Mining Authority PL - Polish Geological Instititute, Mineral resources of Poland Annual reports PL – Polish Geological Institute, National Research Institute PL – Polish Central Statisyical Office (CSO – GUS) PL – Polish Mining Institute, Central Geological Database PL – Polish Vovoidship reports	https://wug.intracom.com.pl/bhp/nadzorowane_zaklady http://geoportal.pgi.gov.pl/surowce http://geoportal.pgi.gov.pl/portal/page/portal/midas https://www.pgi.gov.pl/en/bilans-zasobow.html https://stat.gov.pl/en/ http://baza.pgi.gov.pl/ https://bip.lodzkie.pl/departament-rolnictwa-i-ochrony-srodowiska/archiwa-rejestry-i-ewidencje/item/662-wojew%C3%B3dzka-baza-danych-dot-wytwarzania-i-gospodarowania-odpadami
PT – DGEG, Directorate-General for Energy and Geology	http://www.dgeg.gov.pt/
RO – NAMR, National Agency for Mineral Resources	http://www.namr.ro/

SE – Geological Survey of Sweden SE - Statistics of the Swedish Mining Industry SE – Statistics Sweden	https://www.sgu.se/en/ https://www.sgu.se/en/mining-inspectorate/mines/mines-in-sweden/ https://resource.sgu.se/produkter/pp/pp2018-1-rapport.pdf https://resource.sgu.se/produkter/pp/pp2018-2-rapport.pdf https://www.scb.se/en/ https://www.scb.se/hitta-statistik/statistik-efter-amne/miljo/markanvandning/torv-produktion-anvandning-och-miljoeffekter-torv/pong/publikationer/torv-2017-produktion-anvandning-och-miljoeffekter-m.m.-/
SI – Geological Survey of Sloveniav - Bulletin Mineral Resources Production of commodities Number of production sites	https://www.geo-zs.si/index.php/en/ https://www.geo-zs.si/index.php/en/products/publications2/periodicals/mineral-resources http://www.geo-zs.si/PDF/Dejavnosti/Prod_Min_Com.pdf http://www.geo-zs.si/PDF/Dejavnosti/Nu_Expl_Sites.pdf
SK – SGIDS, State Geological Institute of Dionýz Štúr Slovak mineral Yearbook	https://www.geology.sk/ https://www.geology.sk/service/publishing-activity/nerastne-suroviny-slovenska/?lang=en
SL – Slovenia Geological Survey	http://prenit.geo-zs.si/geozs/index.php/en/ http://prenit.geo-zs.si/geozs/index.php/en/activities/mineral-resources
EU projects	
Minerals4EU	http://minerals4eu.brgm-rec.fr/m4eu-yearbook/theme_selection.html
MINVENTORY	https://ec.europa.eu/jrc/en/scientific-tool/minventory
ORAMA	https://orama-h2020.eu/
PROMINE	http://promine.gtk.fi/
Sector organisations	
Estonian Peat Association - ETL	https://www.turbaliit.ee/en/about-us/
Euracoal, Coal and lignite production and imports in Europe	https://euracoal.eu/info/euracoal-eu-statistics/
European Aggregates Association, UEPG	http://www.uepg.eu/ http://www.uepg.eu/statistics
European Aluminium, EA	https://www.european-aluminium.eu/
European Association for Coal and Lignite, EURACOAL	https://euracoal.eu/home/
European Lime Association, EULA	https://www.eula.eu/
European Association of Industrial Silica Producers	https://www.eurosil.eu/
IMA Europe	https://www.ima-europe.eu/about-industrial-minerals/industrial-minerals-ima-europe/bentonite
Industrial Mineral Association Europe, IMA	https://www.ima-europe.eu/
International Aluminium Institute, IAI	http://www.world-aluminium.org/
International Copper Study Group, ICSG	http://www.icsg.org/
Kaivosvastuu – Finish Network for Sustainable Mining	https://www.kaivosvastuu.fi/ https://www.kaivosvastuu.fi/en/yrityskortti/outokumpu-chrome-oy/

Outokumpu Chrome Oy – Kemi mine (company figures 2015)	
Mining Companies - Mines	
Abenteuer Erzberg	https://www.abenteuer-erzberg.at/ https://www.abenteuer-erzberg.at/cms/aktiver-erzabbau-am-erzberg/?lang=en (Open pit mining at the Erzberg)
Aitik	https://www.mining-technology.com/projects/aitik/
Atalaya Mining	https://atalayamining.com/ https://atalayamining.com/blog/fourth-quarter-2018-operations-update-and-2019-guidance-new-records-established-at-proyecto-riotinto/
Aughinish Alumina Ltd.	https://rusal.ru/en/about/geography/aughinish-alumina/
Boliden	https://www.boliden.com/
Eldorado Gold Corporation	https://www.eldoradogold.com/about-us/default.aspx
Hellenic Copper Mines Ltd	http://www.hcm.com.cy/site/about-hcm
INA annual reports	https://www.ina.hr/en/home/press-center/publications/reporting/
Kaivosvastuu	https://www.kaivosvastuu.fi/en/yrityskortti/yara-suomi-oy/
Kunimine	https://www.kunimine.co.jp/english/bent/basic.html
Lubin mine	https://kghm.com/en/our-business/mining-and-enrichment/lubin
Mini Maritsa Iztok EAD	https://www.marica-iztok.com/en/
Nordkalk	https://www.nordkalk.com/products/product-information/production-process/
Rudna Mine	https://kghm.com/en/our-business/mining-and-enrichment/rudna
Polkowice-Sieroszowice mine	https://kghm.com/en/our-business/mining-and-enrichment/polkowice-sieroszowice
VastResources Official Website	http://www.vastresourcesplc.com/operation/baita-plai-polymetallic-mine/
Others	
911Metallurgist	https://www.911metallurgist.com/blog/barite-beneficiation-process-plant-flowsheet
ECHA - European Chemicals Agency	https://echa.europa.eu/authorisation-process https://echa.europa.eu/substances-of-potential-concern https://echa.europa.eu/regulations/clp/cl-inventory https://echa.europa.eu/regulations/clp/harmonised-classification-and-labelling
Swedish Chemicals Agency	https://www.kemi.se/prioguiden/start https://www.kemi.se/en/chemical-substances-and-materials/substitution-of-hazardous-substances
Statistic Portal, Statista	https://www.statista.com/

ANNEX C: QUESTIONNAIRE TO ELUCIDATE MEMBER STATES' VIEWS ON THE 2011 ‚GUIDANCE' TO EVALUATE CLOSED AND ABANDONED EXTRACTIVE WASTE FACILITIES

1. Introduction

Article 20 of the Extractive Waste Directive (EC, 2006) obliges MSs to identify closed waste facilities, including abandoned facilities, that cause serious environmental impacts or have the potential of becoming, in the medium or short term, a serious threat to human health or the environment.

Article 21 of the EWD stipulates *inter alia*:
1. The Commission, assisted by the Committee referred to in Article 23, shall ensure that there is an appropriate exchange of technical and scientific information between Member States, with a view to developing methodologies relating to:
(a) the implementation of Article 20;
(b) the rehabilitation of those closed waste facilities identified under Article 20 in order to satisfy the requirements of Article 4. Such methodologies shall allow for the establishment of the most appropriate risk assessment procedures and remedial actions having regard to the variation of geological, hydrogeological and climatological characteristics across Europe.

Article 4 of the EWD specifies *inter alia* that:
1. Member States shall take the necessary measures to ensure that extractive waste is managed without endangering human health and without using processes or methods which could harm the environment, and in particular without risk to water, air, soil and fauna and flora, without causing a nuisance through noise or odours and without adversely affecting the landscape or places of special interest. Member States shall also take the necessary measures to prohibit the abandonment, dumping or uncontrolled depositing of extractive waste.
2. Member States shall ensure that the operator takes all measures necessary to prevent or reduce as far as possible any adverse effects on the environment and human health brought about as a result of the management of extractive waste. This includes the management of any waste facility, also after its closure, and the prevention of major accidents involving that facility and the limiting of their consequences for the environment and human health.

This means that a risk-based approach to developing such inventories is foreseen, but without requiring MSs to follow a specific, or indeed harmonised, procedure. A guidance document for a risk-based ‚Guidance' (STANLEY, et al., 2011) for developing inventories of closed or abandoned waste facilities has been developed to help MSs. However, some MSs had already developed such inventories before the EWD came into force, while other began this process then or when the respective national legislation came into force. In consequence, some MSs used the ‚Guidance', while others used it as guidance to develop their own protocols, and others found their own procedures more appropriate. While the „.. protocol presented in this document should not replace the work already undertaken by MSs." (Stanley, et al., 2011). Cherrier et al. (2017) noted that incomplete and inconsistent national reporting indicates that there may have been problems with the criteria and/or procedures of either the ‚Guidance' or those at national level.

The Commission has now tasked a group of experts with elucidating the practical experience with the ‚Guidance' for developing such inventories of closed sites and on possible needs for updating the methodology related to the inventory. This survey also attempts to receive feedback on whether the ‚Guidance' was used or, if not, why so. The focus is on closed and abandoned sited resulting from the mining of metal ores as these are perceived to be of the highest concern.

Hence, this work addresses two aspects relevant to the development of national inventories namely:

- whether the ‚Guidance' has been an adequate and useful guidance, and
- whether the ‚Guidance' adequately captures the potential risk from closed/abandoned EWFs.

Accordingly, a questionnaire divided into three sections, was developed and is introduced in the following.

2. Section 1: Feedback on the ‚Guidance'

The questionnaire will solicit feedback on the interpretation and possible difficulties with this interpretation of the wording in Article 20 and the application of the Guidance, its use and usefulness. It aims to gather feedback from those experts, who had prepared their national inventories, on their experience with the ‚Guidance' and invite suggestions for improvement, if deemed relevant.

It is also noted that the ‚Guidance' makes certain suggestions for numerical criteria to be used in the assessment of sites. While the respective criteria are based on scientific insight, their values are arbitrary to a certain degree. The experts are invited in the questionnaire to comment on the appropriateness of these choices for the circumstances in their respective Member State and how significant the choices may have been for the inclusion of a site into the inventory or otherwise.

3. Section 2: Design assumptions for the long-term safety of EWFs

Closure designs for the long-term safety of EWFs have to make certain assumptions, for instance about the intensity and duration of rainfalls, (natural) drainage patterns, likely maximum magnitude of earthquakes, etc. These parameters may change over time, particularly those controlled by the climate. Considering the changing climate, the validity of such design assumptions has to be reviewed periodically. The questionnaire invites feedback from the experts on how this is taken into consideration and how such changes may influence the classification of closed sites.

4. Section 3: Current inventories and status of rehabilitation

MSs have submitted their inventories of sites that they consider relevant in compliance with Article 20 EWD. Some of these inventories have been compiled well before the ‚Guidance' was developed and it is not clear, which criteria were used to include sites or not. The following inventories are available on the Commission's Web-site0[35]. Some MSs claim to not have EWFs on their territory, as they do not have any mining activities. On the other hand virtually all MSs have quarrying and industrial mineral mining activities. Some MSs also import ores for processing, which should result in EW that needs to be managed.

A separate issue are the uranium mining legacies in a variety of MSs, as these in some MSs fall under separate jurisdictions. On the other hand, the vast majority of these sites is well known and post-1990 massive rehabilitation actions have been undertaken in all of the MSs. Under these circumstances, it can be expected that very few of these sites would still be listed using the ‚Guidance' under Article 20 EWD.

[35]http://ec.europa.eu/environment/waste/mining/implementation.htm

Questionnaire to Elucidate Member States' Views on the 2011 ‚Protocol' to Evaluate Closed and Abandoned Extractive Waste Facilities	
Country:	
Organisation:	
Responsible Expert:	

QUESTIONNAIRE PART I – THE ‚PROTOCOL'

Practical Note*: This questionnaire is distributed in MS Word-format and boxes are provided for free-text comments. These boxes will adjust themselves to the amount of text inserted.*

FRAMEWORK QUESTIONS

Question 1: Has the protocol been used in developing your list of sites ? *Y/N*	
Question 2: If the protocol has been used, how ? *Tick below as appropriate*	
a) as direct guidance for site selection	
b) as guidance to develop your own catalogue of criteria - *if you have ticked 2b, please enclose your catalogue of criteria as an attachment*	
Question 3: If the protocol has not been used, please explain why not and enclose the method/catalogue of criteria used:	

The following questions are those of the ‚Protocol' and we invite you to comment on them

SECTION 1 – PREVIOUS INCIDENTS

Question 1
Is the closed mine waste facility known to have had an incident that has had a serious impact on human health or the environment?
Rationale: The rationale for this question is to ensure that facilities which had serious incidents are included in the inventory. Note that a serious incident can be either an instantaneous accident or long-term pollution. It may be the case that such an incident has been addressed and the damage from the incident cleaned up so that it is unlikely that such an event will occur again.
Comments from implementing experts:

SECTION 2 - SOURCE

This section of the ‚Protocol' sought to determine the classes of substances contained in the waste facility and its physical stability.

There were two principal sets of questions. The first addressed the contents ('chemical stability') of the facility, while the second addressed the physical stability of the facility. The latter is divided into two – one that addressed tailings ponds (having the potential to flow) and the other to addressed waste heaps (solid wastes).

This was guided by the Annex III of the EWD. Annex III, reproduced below, lists three criteria that would lead to the categorisation of an EWF as Category A.

A waste facility shall be classified under Category A if:

- *a failure or incorrect operation, e.g. the collapse of a heap or the bursting of a dam, could give rise to a major accident, on the basis of a risk assessment taking into account factors such as the present or future size, the location and the environmental impact of the waste facility; or*
- *it contains waste classified as hazardous under Directive 91/689/EEC above a certain threshold (EC, 1991); or*
- *it contains substances or preparations classified as dangerous under Directives 67/548/EEC (EC, 1967) or 1999/45/EC (EC, 1999) above a certain threshold.*

The first indent refers to the physical stability of the facility while the latter two indents refer to the contents of the facility.

Question 2
Did the mine work sulfide minerals or produce a waste containing sulfide minerals?
Rationale: One of the principal contaminants from mining derives from the working of sulfide minerals. Sulfide minerals have the potential to produce acid mine drainage with attendant leaching and transport of heavy metals many of which can be harmful to humans and the environment. This is often an easier question to answer than the other questions in this section.
Comments from implementing experts:

Question 3
***Were any of the following produced from the mined mineral* - Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Te, Tl, U, V, Zn, or asbestos?**
Rationale: Indent 2 of Annex III of the EWD refers to "waste classified as hazardous under Directive 91/689/EEC (EC, 1991) above a certain threshold" concerning the categorisation of a Category A facility. The list in the question was generated from Annex II of Directive 91/689/EEC and its amendments. ***Two issues*** arise in framing this question:
Firstly, satisfying the criterion 'above a certain threshold' would require an analysis of the EWF, which would defeat the purpose of having a **simple**, **desk based** pre-selection protocol.
Comments from implementing experts on how this was handled:
Secondly, one should note that the question was "were any of the following produced from the ore", not "does the ore contain ….“ Most geological materials would contain at least trace quantities of one or more of the constituents on the list. If any one of the elements from the list was produced, it is likely to find them in the EWs.
Comments from implementing experts on whether this was useful criterion:

Question 4
Did the mine use dangerous chemicals to process the mined minerals?
Rationale: Indent 3 of Annex III of the Directive refers to "substances or preparations classified as dangerous under Directives 67/548/EEC (EC, 1967) or 1999/45/EC (EC, 1999) above a certain threshold“ with a view of categorisation of Category A facilities. While for many closed or abandoned facilities this simply cannot be known, it is unlikely that in mines operated before the 20th century process chemicals were used, which results in the response UNKNOWN. However, as in the previous question the issue of 'above a certain threshold' arises. In framing the question no thresholds were mentioned, because answering this would require an analysis, which in turn would defeat the purpose of having a **simple**, **desk based** pre-selection protocol.
Comments from implementing experts on how this was handled:

Question 5
Is the waste facility a tailings lagoon or a waste heap?
Rationale: This question is to determine what kind of waste facility is being assessed. Depending on the answer the assessor is directed to one of two routes.
Comments form the implementing experts on whether this bifurcation was adequate:

Question 6
Is the area of the tailings lagoon greater than 10,000 m^2?
Rationale: The larger a tailings management facility (TMF) the more likely it is to cause damage to humans or the environment should it fail. Some threshold needs to be selected below which, if a failure were to occur, the consequences would not likely be serious. This figure is somewhat arbitrary, but it is up to MSs to select their own value.
Comments form the implementing experts on whether this criterion was adequate or why another value was chosen:

Question 7
Is the height of the tailings lagoon >4 m within 50 m of the facility?
Rationale: The greater the height of the TMF, the more likely it is to cause damage to humans or the environment should it fail. The question seeks to determine the height of the TMF compared to the terrain some 50 m from the TMF. If the natural (or man-made) terrain around the TMF is lower than the pond, then in the event of a failure and the escape of the material contained within the TMF has the potential to move some distance from the facility and potentially cause serious negative environmental impacts. If the terrain surrounding a TMF is higher than the retaining walls, then there is the possibility for any escaped contents to be captured naturally by the topography of the area. Some threshold needs to be selected below which, if a failure were to occur, the consequences would not likely be serious.
Comments from the implementing experts, whether the concept is clear from the question and whether the criteria (height and distance) are adequate:

Question 8
Is the area of the waste heap greater than 10,000 m^2 ?
Rationale: The larger a waste heap the more likely it is to cause damage to humans or the environment should it fail. Some threshold needs to be selected below which, if a failure were to occur, the consequences would not likely be serious.
Comments from the implementing experts, whether the concept is clear from the question and whether the criterion (surface area) is adequate:

Question 9
Is the height of the waste-heap > 20 m ?
Rationale: The higher a waste-heap the greater the risk it poses to humans or the environment. In selecting a threshold value it was considered that waste-heaps do not fail in the same way as TMFs.
Comments from the implementing experts, whether the concept and the criterion (height) are adequate:

Question 10
Is the slope of the foundation >1:12 ?
Rationale: The slope of the foundation upon which a waste heap rests is also of concern with respect to stability. The greater the slope angle the greater the risk of the waste heap failing. The threshold chosen was 1:12 which equates to 8.3% or a slope angle of almost 5°.
Comments from the implementing experts, whether this slope angle was adequate:

SECTION 3 - PATHWAY

This section sought to determine which pathways may be operating in bringing the source into contact with receptors, i.e. humans and/or the environment. There are four principal pathways normally investigated in evaluating risk, namely, surface water, groundwater, the air, and direct contact.

There is one set of questions with one question for each of the four pathways.

Question 11
Is there a water course within 1 km of the mine waste facility?
Rationale: Surface water is one of the pathways by which the source material may come into contact with humans or the environment. Surface waters are a source of drinking water for humans and animals while they are also ecosystems in their own right and support aqueous habitats. A surface water course is any stream, river, canal, lake or reservoir. The threshold distance of 1 km is to a certain extent arbitrary and would also depend on the topography and catchment areas.
Comments from the implementing experts, whether this criterion was adequate:

Question 12
Is there a high permeability layer beneath the mine waste facility?
Rationale: It is possible that a leachate will develop in an EWF, that may contaminate underlying groundwaters and eventually also reach surface waters. Therefore, if the leachate can be kept within the EWF, it will not contaminate the groundwater. This can be achieved by natural or engineered bottom and side liners around the facility. Conversely, high permeability layers would be conducive to contaminant migration and increase the risk. The question sought to determine, if there is such an engineered or natural barrier. Note that the question does not address the efficacy of any such barrier.
Comments from the implementing experts, whether this inverse question lead to the desired answers:

Question 13
Is the material within the mine waste facility exposed to the wind ?
Rationale: Wind may raise dust from uncapped and unvegetated EWFs and thus bring mine waste into contact with humans and animals through inhalation. Wind transport also enlarges the area that could be affected by EW. From a practical point of view an EWF can be said to not be exposed to the wind, if it is 90% or greater covered by vegetation or some other covering material.
Comments from the implementing experts, whether this question provided an useful criterion (see also Q14):

Question 14
Is the mine waste facility uncovered ?
Rationale: Humans or animals may come into contact with waste within the facility if it is not covered, for example by water, by vegetation or by some other material. The difference between this and Question 13 is that in this case humans or animals may come into direct contact with the EW. Direct contact may lead to ingestion or absorption through the skin. An EWF is considered covered, if it is covered by inert material or water (though this water may be contaminated) or by vegetation. From a practical point of view a waste facility can be said to be exposed if it is 10% or less covered by vegetation or some other covering material.
Comments from the implementing experts, whether this question provided an useful criterion (see also Q13):

SECTION 4 - RECEPTORS

This section seeks to determine what, if any, receptors are in the vicinity of the EWF. There is one set of questions comprising four questions – one question addresses humans as potential receptors, two questions address ecosystems only as potential receptors and one questions addresses both humans and ecosystems as potential receptors.

Question 15
Is there a human settlement with >100 people within 1km of the waste facility ?
Rationale: Human habitations are a clear sign of the presence of people within an area. The more people that are in an area, the more likely it is that someone will come in contact with the waste with potentially harmful effects *via* one of the four pathways. The number of 100 is arbitrary, but is considered to be reasonable, as is the choice of buffer of 1 km.
Comments from the implementing experts, whether the two criteria were adequate, or why other values may have been chosen:

Question 16
Is the waste facility within 1 km of a water body that is of less than good status ?
Rationale: This question implies that the quality of a nearby water body may have deteriorated due to emissions from the EWF. If a water body is not of good (or better) status and is within 1 km of a waste facility then the reason for that status must be checked in order to rule out or otherwise a causal relationship of that status with the EWF. The choice of a 1km buffer is arbitrary, but is considered to be reasonable.
Comments from the implementing experts, whether this criterion were adequate, or why another value may have been chosen:

Question 17
Is there a Natura 2000 area within 1 km of the waste facility ?
Rationale: Natura 2000 sites are protected by legislation and regulations. The Natura 2000 Network is a network of important ecological sites across the European Union. It is comprised of areas known as Special Protection Areas (SPAs) and Special Areas of Conservations (SACs). SPAs are a consequence of the EU Habitats Directive (92/43/EEC) while SACs are a consequence of the EU Birds Directive (79/409/EEC). This question seeks to determine if a Natura 2000 area is within 1 km of a waste facility. The choice of a 1 km buffer is arbitrary, but is considered to be reasonable.
Comments from the implementing experts, whether this criterion is adequate, or why another value may have been chosen:

Question 18
Is the waste facility within 1 km of agricultural land or livestock ?
Rationale: Agricultural activity is an important occupation in many Member States. Agriculture as used here refers to both the growing of plants and the rearing of animals. Agricultural activities may be affected by contamination emanating from EWFs and it is therefore important to determine, if agricultural activity is practiced in the vicinity. The choice of a 1 km buffer is arbitrary but is considered to be reasonable.
Comments from the implementing experts, whether this criterion is adequate, or why another value may have been chosen, and also whether there were any difficulties determining the respective land-use:

QUESTIONNAIRE PART 2 – DESIGN ASSUMPTIONS
Note: ‚Scenario-based' in the following means that the design assumed, for instance, certain rainfall-patterns, annual cumulative amounts, rainfall-intensities, drainage-patterns, average erosion rates, slope angles, vegetation patterns, distances of the groundwater table, etc. that all will depend on the climatological conditions. Designs usually have safety margins built in, e.g. assuming higher rainfall intensities than actually measured. However, with changing climatological conditions, this buffer may be used up in the foreseeable future.
‚Design Feature' here means elements such as cappings, surface water diversion culverts, dams, free-board in tailings-ponds, slope-angles, etc.

Question 1
Which design criteria for a EWF were scenario-based ?
Feature 1:
Feature 2:
Feature x: *add more lines to the table, if needed*

Question 2
What kind of predictive methods were used to develop the scenarios ?
Scenario 1:
Scenario 2:
Scenario x: *add more lines to the table, if needed*

Question 3
What mechanisms and regulations are in place to ensure monitoring and updating of the long-term safety features in EWF ?
Feature 1:
Feature 2:
Feature x: *add more lines to the table, if needed*

QUESTIONNAIRE PART 3 – INVENTORY and REHABILITATION

Question 1
How many of sites that were initially listed in the respective inventories have been rehabilitated since ?

Question 2 - Per rehabilitated site:
What rehabilitation measures were undertaken ?
What were the objectives of the rehabilitation (e.g. risk reduction) ?
What did trigger the rehabilitation works apart from risk reduction (e.g. future use of the area) ?
Can you give an indication of the related costs ?

Question 3
Identify examples of best practice for rehabilitation

Question 4
Identify examples of obstacles to rehabilitation

ANNEX D: AGGREGATES (CRUSHED ROCKS, SAND & GRAVEL), OVERVIEW OF PRODUCTION DATA AND NUMBER OF PRODUCTION SITES (EU-27, 2015 – 2017)

Country	Commodity	Unit	2015	2016	2017	Average
AT	crushed rock	Mt	33,00	33,00	33,00	33,00
AT	sand & gravel	Mt	63,00	63,00	63,00	63,00
AT	Total Number of Extraction Sites (Quarries and Pits)		1362	1362	1363	
BE	crushed rock	Mt	45,50	46,00	46,00	45,83
BE	sand & gravel	Mt	13,40	13,00	13,00	13,13
BE	Total Number of Extraction Sites (Quarries and Pits)		112	112	112	
BG	crushed rock	Mt	19,80	20,00	20,60	20,13
BG	sand & gravel	Mt	11,30	11,50	11,80	11,53
BG	Total Number of Extraction Sites (Quarries and Pits)		295	295	295	
CY	crushed rock	Mt	3,90	5,50	7,00	5,47
CY	sand & gravel	Mt	0,00	0,00	0,00	0,00
CY	Total Number of Extraction Sites (Quarries and Pits)		24	24	25	
CZ	crushed rock	Mt	40,00	37,00	38,00	38,33
CZ	sand & gravel	Mt	20,00	18,00	20,00	19,33
CZ	Total Number of Extraction Sites (Quarries and Pits)		373	382	387	
DE	crushed rock	Mt	207,00	218,00	223,00	216,00
DE	sand & gravel	Mt	231,00	247,00	256,00	244,67
DE	Total Number of Extraction Sites (Quarries and Pits)		2771	2660	2733	
DK	crushed rock	Mt	0,20	0,20	0,30	0,23
DK	sand & gravel	Mt	36,70	38,00	41,10	38,60
DK	Total Number of Extraction Sites (Quarries and Pits)		332	432	417	
EE	crushed rock	Mt	5,50	6,00	8,20	6,57
EE	sand & gravel	Mt	7,00	6,50	9,40	7,63
EE	Total Number of Extraction Sites (Quarries and Pits)		290	280	300	
EL	crushed rock	Mt	20,50	42,10	42,50	35,03
EL	sand & gravel	Mt	0,10	0,10	0,20	0,13
EL	Total Number of Extraction Sites (Quarries and Pits)		196	198	198	
ES	crushed rock	Mt	73,00	72,00	85,00	76,67
ES	sand & gravel	Mt	21,00	20,00	25,00	22,00
ES	Total Number of Extraction Sites (Quarries and Pits)		1830	1795	1874	
FI	crushed rock	Mt	43,70	42,80	48,70	45,07
FI	sand & gravel	Mt	32,50	34,50	28,20	31,73
FI	Total Number of Extraction Sites (Quarries and Pits)		2530	2530	2140	
FR	crushed rock	Mt	182,00	184,00	186,00	184,00
FR	sand & gravel	Mt	111,00	114,00	120,00	115,00
FR	Total Number of Extraction Sites (Quarries and Pits)		2723	2684	2822	
HR	crushed rock	Mt	15,50	12,50	13,00	13,67
HR	sand & gravel	Mt	4,30	3,90	4,00	4,07
HR	Total Number of Extraction Sites (Quarries and Pits)		250	225	225	
HU	crushed rock	Mt	16,00	21,00	17,00	18,00
HU	sand & gravel	Mt	40,00	30,00	41,00	37,00
HU	Total Number of Extraction Sites (Quarries and Pits)		760	511	525	

Reference: https://uepg.eu/ (27/10/2020) & UEPG (2017; 2018; 2019)

Annex D: Aggregates (Crushed Rocks, Sand & Gravel), Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

Country	Commodity	Unit	2015	2016	2017	Average
IE	crushed rock	Mt	22,00	26,00	27,80	25,27
IE	sand & gravel	Mt	6,00	7,00	7,50	6,83
IE	Total Number of Extraction Sites (Quarries and Pits)		430,00	430,00	430,00	
IT	crushed rock	Mt	88,00	89,00	91,00	89,33
IT	sand & gravel	Mt	63,00	64,00	65,00	64,00
IT	Total Number of Extraction Sites (Quarries and Pits)		2800,00	2800,00	2800,00	
LT	crushed rock	Mt	3,30	4,90	6,40	4,87
LT	sand & gravel	Mt	7,50	7,90	11,20	8,87
LT	Total Number of Extraction Sites (Quarries and Pits)		205,00	205,00	210,00	
LU	crushed rock	Mt	0,90	0,90	0,90	0,90
LU	sand & gravel	Mt	0,20	0,20	0,20	0,20
LU	Total Number of Extraction Sites (Quarries and Pits)		13,00	13,00	13,00	
LV	crushed rock	Mt	2,20	2,00	2,40	2,20
LV	sand & gravel	Mt	11,70	9,00	9,00	9,90
LV	Total Number of Extraction Sites (Quarries and Pits)		105,00	105,00	105,00	
MT	crushed rock	Mt	1,00	1,00	1,00	1,00
MT	sand & gravel	Mt	0,40	0,40	0,40	0,40
MT	Total Number of Extraction Sites (Quarries and Pits)		10,00	10,00	10,00	
NL	crushed rock	Mt	0,00	0,00	0,00	0,00
NL	sand & gravel	Mt	49,70	43,40	43,60	45,57
NL	Total Number of Extraction Sites (Quarries and Pits)		295,00	288,00	295,00	292,67
PL	crushed rock	Mt	64,00	73,00	85,00	74,00
PL	sand & gravel	Mt	168,00	173,00	187,00	176,00
PL	Total Number of Extraction Sites (Quarries and Pits)		2734,00	2746,00	2786,00	
PT	crushed rock	Mt	25,50	25,60	25,90	25,67
PT	sand & gravel	Mt	4,90	3,90	4,30	4,37
PT	Total Number of Extraction Sites (Quarries and Pits)		252,00	247,00	247,00	
RO	crushed rock	Mt	34,50	34,00	30,00	32,83
RO	sand & gravel	Mt	55,50	53,50	60,00	56,33
RO	Total Number of Extraction Sites (Quarries and Pits)		1100,00	1115,00	1120,00	
SE	crushed rock	Mt	73,00	74,00	83,20	76,73
SE	sand & gravel	Mt	13,00	12,00	12,50	12,50
SE	Total Number of Extraction Sites (Quarries and Pits)		1391,00	1391,00	1391,00	
SI	crushed rock	Mt	8,30	7,50	8,60	8,13
SI	sand & gravel	Mt	2,80	1,80	2,10	2,23
SI	Total Number of Extraction Sites (Quarries and Pits)		154,00	138,00	153,00	
SK	crushed rock	Mt	18,30	15,60	17,60	17,17
SK	sand & gravel	Mt	10,50	9,40	10,30	10,07
SK	Total Number of Extraction Sites (Quarries and Pits)		270,00	260,00	270,00	

Reference: https://uepg.eu/ (27/10/2020) & UEPG (2017; 2018; 2019)

ANNEX E: INDUSTRIAL MINERALS, OVERVIEW OF PRODUCTION DATA AND NUMBER OF PRODUCTION SITES (EU-27, 2015 – 2017)

Table E.1: Industrial minerals, Summary of production data and number of extraction sites per MS

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	Reference	Number of extraction sites 2015	2016	2017	other	Reference
AUSTRIA											
AT	Graphite (production at Grafitbau Kaisersberg)	0,022	0,023	0,024	0,023	BGS	1	1	1		BMWFW (2016, 2017), BMLRT (2020)
AT	Gypsum (incl. anhydrite)	0,715	0,674	0,712	0,701	BGS , BMLRT (2020), USGS (2021), WMD	8	7	8		BMWFW (2016, 2017), BMLRT (2020)
AT	Kaolin	0,013	0,014	0,014	0,013	BGS, WMD	2	2	no data*		BMWFW (2016, 2017)
AT	Magnesite	0,703	0,646	0,730	0,693	BGS , BMLRT (2020), USGS (2021), WMD	8	10	10		BMWFW (2016, 2017), BMLRT (2020)
AT	Salt (rock salt) (t)	248	255	388	297	BMLRT (2020)	6	4	1		BMWFW (2016, 2017), BMLRT (2020)
AT	Talc	0,122	0,123	0,124	0,123	BGS , BMLRT (2020), USGS (2021), WMD	1	3	3		BMWFW (2016, 2017), BMLRT (2020)
Belgium											
BE	Quartz (sand)	2,202	3,049	2,474	2,575	Info from MS	no data*	no data*	no data*		
Bulgaria											
BG	Baryte	0,060	0,070	0,080	0,070	BGS	no data*	no data*	no data*		
BG	Bentonite	0,062	0,037	0,054	0,051	BGS, WMD	no data*	no data*	no data*		
BG	Chalk	0,149	0,074	0,236	0,153	USGS (2021)	no data*	no data*	no data*		
BG	Fluorspar	0,147	0,004	0	0,050	BGS	no data*	no data*	no data*		
BG	Gypsum (incl. anhydrite)	0,109	0,061	0,088	0,086	BGS, WMD	no data*	no data*	no data*		
BG	Kaoline	0,334	0,330	0,322	0,329	BGS	no data*	no data*	no data*		
BG	Lime	1,474	1,518	1,503	1,498	USGS (2021)	no data*	no data*	no data*		
BG	Perlite	0	0	0,005	0,002	BGS	no data*	no data*	no data*		
BG	Sulphur	0,439	0,396	0,501	0,445	WMD	no data*	no data*	no data*		
Cyprus											
CY	Bentonite	0,129	0,119	0,098	0,115	Info from MS	no data*	no data*	5	6 (2018)	Info from MS
CY	Gypsum (incl. anhydrite)	0,315	0,129	0,703	0,382	Info from MS	no data*	no data*	6	1 (2018)	Info from MS
Czech Republic											
CZ	Bentonite	0,369	0,374	0,254	0,332	BGS, CGS (2019), USGS (2021), WMD	7	7	9		CGS (2019)
CZ	Diatomite	0,015	0,026	0,034	0,025	BGS, CGS (2019), USGS (2021), WMD	1	1	1		CGS (2019)
CZ	Dolomite	0,451	0,440	0,450	0,447	CGS (2019), USGS (2021)	2	2	2		CGS (2019)
CZ	Feldspar	0,433	0,454	0,368	0,418	BGS, CGS (2019), USGS (2021), WMD	9	9	9		CGS (2019)
CZ	Gypsum (incl. anhydrite)	0,011	0,010	0,007	0,009	BGS, CGS (2019), WMD	1	1	1		CGS (2019)
CZ	Industrial sands	1,347	1,322	1,311	1,327	CGS (2019), USGS (2021)	12	12	12		CGS (2019)
CZ	Kaolin	3,454	3,540	3,669	3,554	CGS (2019), WMD	15	15	15		CGS (2019)
CZ	Limestone cement	10,568	10,995	10,787	10,783	CGS (2019)	22	22	22		CGS (2019)
CZ	Silica	0,014	0,018	0,017	0,016	CGS (2019)	1	1	1		CGS (2019)
Germany											
DE	Baryte	0,045	0,049	0,034	0,043	BGR (2017, 2018), BGS, USGS (2021)	1	1	1		BGR (2016, 2017, 2018)
DE	Bentonite	0,393	0,393	0,416	0,401	BGR (2017, 2018), BGS, WMD	21	20	no data*		BMWE (2016, 2018)
DE	Chalk	1,700	1,700	1,700	1,700	BGR (2017, 2018)	no data*	no data*	no data*		
DE	Diatomite	0,053	0,055	0,057	0,055	BGR (2017, 2018), BGS	1	1	1		BGR (2016, 2017, 2018)
DE	Feldspar	0,253	0,285	0,277	0,272	BGR (2017, 2018), BGS	24	28	no data*		BMWE (2016, 2018)
DE	Fluorspar	0,050	0,053	0,045	0,049	BGR (2017, 2018), BGS	2	2	2		BGR (2016, 2017, 2018)
DE	Graphite (t)	398	502	422	441	BGR (2017, 2018), BGS	1	1	1		BGR (2016, 2017, 2018)
DE	Gypsum (incl. anhydrite)	4,200	3,970	4,450	4,207	BGR (2017, 2018), BGS	45	46	60		BGR (2018); BMWE (2016, 2018)
DE	Kaolin (China Clay)	3,734	4,740	5,168	4,547	WMD	33	33	no data*		BMWE (2016, 2018)
DE	Potash (Effective)	36,777	31,551	35,973	34,767	BGR (2017, 2018)	6	6	6		BGR (2016, 2017, 2018)
DE	Rock salt	6,124	5,617	6,531	6,091	BGR (2017, 2018)	no data*	7	no data*		BGR (2016)
DE	Quartz	0,033	0,037	0,034	0,035	BGR (2017, 2018)	3	3	3		BGR (2016, 2017, 2018)); Elsner (2016)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	Reference	Number of extraction sites 2015	2016	2017	other	Reference
Denmark											
DK	Bentonite	0,054	0,066	0,070	0,063	BGS, WMD	no data*	no data*	no data*		
DK	Chalk	0,973	1,030	1,058	1,020	USGS (2020)	no data*	no data*	no data*		
DK	Diatomite	0,128	0,114	0,176	0,139	BGS, WMD	no data*	no data*	no data*		
Estonia											
EE	Chalk and dolomite	1,044	0,962	1,348	1,118	ESD	no data*	no data*	no data*		
EE	Clays & Kaolin	0,058	0,065	0,069	0,064	ESD	no data*	no data*	no data*		
EE	Limestone & gypsum	2,441	2,693	2,988	2,707	ESD	no data*	no data*	no data*		
Greece											
EL	Amphibolite	0,019	0,036	0,038	0,031	Ypeka	no data*	no data*	2		
EL	Attapulgite	0,108	0,045	0,054	0,069	BGS, USGS (2019), Ypeka	no data*	no data*	no data*		
EL	Bentonite crude	1,123	0,883	1,088	1,031	BGS, USGS (2019), Ypeka	no data*	no data*	10		
EL	Gypsum (incl. anhydrite)	0,649	0,778	0,547	0,658	BGS, USGS (2019), WMD, Ypeka	no data*	no data*	6		
EL	Huntite	0,016	0,023	0,014	0,017	Ypeka	no data*	no data*	no data*	2 (2013)	Tzeferis P.G. (2015)
EL	Magnesite	0,383	0,398	0,443	0,408	Ypeka, WMD	no data*	no data*	no data*		
EL	Olivine	0,022	0,025	0,023	0,023	Ypeka	no data*	no data*	2		
EL	Perlite	0,891	0,921	0,933	0,915	BGS, USGS (2019), Ypeka	no data*	no data*	7		
EL	Pumice	0,581	0,659	0,971	0,737	Ypeka	no data*	no data*	1		
EL	Quartz	0,075	0,142	no data	-	Ypeka	no data*	no data*	4		
EL	Zeolite (t)	360	110	2454	975	Ypeka	no data*	no data*	1		
Spain											
ES	Attapulgite	0,026	0,029	0,059	0,038	BGS, IGME (2017), SMS (2017), USGS (2019)					IGME (2017), SMS (2017)
ES	Bentonite	0,101	0,155	0,178	0,144	BGS, Eurostat Prodcom, IGME (2017), SMS (2017), WMD	12**	11**	11**		IGME (2017), SMS (2017)
ES	Sepiolite	0,525	0,519	0,483	0,509	BGS					IGME (2017)
ES	Chalk	0,692	0,694	0,701	0,696	Eurostat Prodcom, SMS (2017)	6	6	6		IGME (2017), SMS (2017)
ES	Diatomite	0,048	0,048	0,071	0,055	BGS, IGME (2017), WMD	3	3	no data*		IGME (2017), SMS (2017)
ES	Industrial Dolomite	6,796	6,016	7,404	6,739	IGME (2017), SMS (2017)	54	56	54		IGME (2017), SMS (2017)
ES	Feldspar	0,558	0,635	0,819	0,671	BGS, IGME (2017), SMS (2017)	6	8	8		IGME (2017), SMS (2017)
ES	Fluorspar	0,157	0,163	0,155	0,158	BGS, IGME (2017), SMS (2017)	6	7	6		IGME (2017), SMS (2017)
ES	Gypsum (incl. anhydrite)	7,404	8,936	9,545	8,628	BGS, Eurostat Prodcom, WMD, IGME (2017), SMS (2017)	88	89	92		IGME (2017), SMS (2017)
ES	Kaolin (China clay, not calcined / washed)	0,392	0,347	0,475	0,405	BGS, Eurostat Prodcom, IGME (2017), SMS (2017)	no data*	no data*	8		SMS (2017)
ES	Magnesite	0,465	0,584	0,789	0,612	BGS, IGME (2017), SMS (2017), WMD	3	3	3		IGME (2017)
ES	Potash (total)	1,709	1,839	no data	-	IGME (2017), SMS (2017)	2	2	no data*		IGME (2017)
ES	Quartz	1,102	1,136	1,005	1,081	IGME2017; SMS (2017)	18	19	20		IGME (2017)
ES	Rock Salt	2,437	2,526	2,870	2,611	BGS, IGME (2017), SPM (2017)	6	6	6		IGME (2017)
ES	Sulphur	1,510	1,455	1,518	1,494	IGME (2017), SMS (2017)	4	4	2		IGME (2017), SMS (2017)
ES	Talc	no production	no production	0,012	-	BGS, Panorma Minero (2017)	no production	no production	1		SMS (2017)
Finland											
FI	Apatite concentrate	0,957	0,940	0,979	0,958	Tukes (2010 - 2019), Eurostat Prodcom, USGS (2021)	1	1	1		Tukes Mining Statistics (2015, 2016, 2017)
FI	Biotite	0,038	0,011	0,047	0,032	Tukes (2010 - 2019)	no data*	no data*	no data*		
FI	Feldspar	0,038	0,019	0,015	0,024	BGS, Tukes (2010-2019), USGS (2021), WMD	4	4	4		Tukes Mining Statistics (2015, 2016, 2017)
FI	Magnesite	0,022	0,054	0,064	0,047	Tukes (2010-2019), WMD	3	2	2		Tukes Mining Statistics (2015, 2016, 2017)
FI	Mica concentrate	0,012	0,052	0,011	0,025	Tukes (2010-2019)	no data*	no data*	no data*		
FI	Quartz	0,104	0,093	0,072	0,089	Tukes (2010-2019)	4	3	3	3(2018)	Tukes Mining Statistics (2015, 2016, 2017)
FI	Soapstone	0,017	0,013	0,013	0,014	Tukes (2010-2019)	5	4	5		Tukes Mining Statistics (2015, 2016, 2017)
FI	Talc	0,332	0,346	0,355	0,344	BGS, Tukes (2010-2019), WMD	4	4	4	4 (2018)	Tukes Mining Statistics (2015, 2016, 2017)

MS	Commodity	2015	2016	2017	Average	Reference	Number of extraction sites 2015	2016	2017	other	Reference
		Mt	Mt	Mt	Mt						
France											
FR	Bentonite	0,036	0,043	0,024	0,034	BGS, WMD	5	no data*	no data*		
FR	Chalk	2,626	2,622	3,028	2,759	Eurostat Prodcom, USGS (2021)	12	no data*	16		BRGM (2015, 2020c)
FR	Diatomite	0,090	0,090	0,090	0,090	BGS, WMD	4	no data*	4	2 (2020)	BRGM (2015, 2020a)
FR	Feldspar	0,550	0,550	0,550	0,550	BGS, WMD	11	no data*	no data*		BRGM (2015)
FR	Gypsum (incl. anhydrite)	2,027	4,183	3,014	3,075	Eurostat Prodcom, USGS (2021), WMD	19	no data*	no data*		BRGM (2015)
FR	Kaoline	0,275	0,264	0,279	0,273	BGS, WMD	9	no data*	11		BRGM (2015, 2020b)
FR	Limestone, agricultural and industrial	9,224	6,964	10,526	8,905	USGS (2021)	24	no data*	no data*		BRGM (2015)
FR	Mica	0,021	0,020	0,019	0,020	USGS (2021)	2	no data*	no data*		BRGM (2015)
FR	Rock Salt	0,500	0,500	0,500	0,500	Braun (2019)	1	1	1		Braun (2019)
FR	Talc, steatite & pyrophillite	0,450	0,450	0,470	0,457	WMD	1	no data*	no data*	1 (2020)	BRGM (2015, 2020d)
Croatia											
HR	Gypsum (incl. anhydrite)	0,126	0,150	0,148	0,142	MINGOR, JISMS	7	5	4		MINGOR, JISMS
HR	Salt	0,112	0,112	0,019	0,081	MINGOR, JISMS	0	0	2		MINGOR, JISMS
Hungary											
HU	Bentonite	0,014	0,020	0,035	0,023	HGS	5	4	6		HGS
HU	Diatomite	0,001	0,001	0,001	0,001	BGS	1	1	1		HGS
HU	Perlite	0,031	0,071	0,080	0,061	HGS	2	2	2		HGS
Ireland											
IE	Gypsum (incl. anhydrite)	0,250	0,250	0,200	0,233	BGS, WMD	no data*	no data*	no data*		
Italy											
IT	Bentonite	0,013	0,046	0,086	0,048	BGS, WMD	no data*	no data*	no data*	12 (2018)	ISPRA (mail communication)
IT	Chalk	no data	0,135	no data	-	Eurostat Prodcom	no data*	no data*	no data*		
IT	Feldspar	4,700	4,000	3,500	4,067	BGS, Eurostat Prodcom	no data*	no data*	no data*	14 (2018)	ISPRA (mail communication)
IT	Gypsum	3,306	2,233	2,085	2,541	iSTAT	no data*	no data*	no data*		
IT	Kaolin (China Clay)	0,683	0,839	0,847	0,790	WMD	no data*	no data*	no data*		
IT	Lime (hydrated, hydraulic, and quicklime)	3,500	3,500	3,600	3,533	USGS (2021)	no data*	no data*	no data*		
IT	Salt	2,081	2,085	2,147		iSTAT	no data*	no data*	no data*	8 (2018)	ISPRA (mail communication)
IT	Talc	0,165	0,165	0,165	0,165	BGS, WMD	no data*	no data*	no data*	2 (2018)	ISPRA (mail communication)
Latvia											
LV	Gypsum, incl. anhydrite	0,225	0,224	0,225	0,225	BGS	no data*	no data*	no data*		
Netherlands											
NL	Salt (Rock, brines, marine)	6,743	6,625	6,935	6,768	WMD	no data*	no data*	no data*	5 (recent)	SODM
Poland											
PL	Bentonite (t)	450	1000	0	483	BGS, USGS (2021), WMD	1	1	1		PGI geoportal
PL	Chalk	no data	3,136	3,473	-	Eurostat Prodcom	12	14	12		PGI geoportal
PL	Diatomite (t)	600	500	500	533	BGS, WMD	1	1	1		PGI geoportal
PL	Feldspar	0,077	0,088	0,091	0,085	PIG-PIB (2016, 2017, 2018)	2	2	2		PGI geoportal
PL	Gypsum (incl. anhydrite)	1,018	1,043	1,108	1,056	PIG-PIB (2016, 2017, 2018), WMD	5	4	4		PGI geoportal
PL	Kaoline	0,287	0,300	0,285	0,290	PIG-PIB (2016, 2017, 2018), WMD	2	2	2		PGI geoportal
PL	Magnesite	0,096	0,078	0,102	0,092	BGS, WMD	1	1	1		PGI geoportal
PL	Rock Salt	3,468	4,079	4,660	4,069	PIG-PIB (2016, 2017, 2018)	6	5	5		PGI geoportal
PL	Sulphur	0,651	0,645	0,686	0,661	PIG-PIB (2016, 2017, 2018), WMD	5	5	5		PGI geoportal

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	Reference	Number of extraction sites 2015	2016	2017	other	Reference
Portugal											
PT	Feldspar	0,094	0,132	0,126	0,117	DGEG, WMD	no data*	no data*	no data*		
PT	Gypsum (incl. anhydrite)	0,310	0,255	0,152	0,239	BGS, Eurostat Prodcom, WMD	no data*	no data*	no data*		
PT	Kaoline	0,252	0,284	0,308	0,281	BGS, DGEG, WMD	no data*	no data*	no data*		
PT	Quartz	0,001	0,001	0,205	0,069	DGEG	no data*	no data*	no data*		
PT	Salt (Rock Salt)	0,030	0,006	0,008	0,015	BGS, DGEG, WMD	2	1	1		DGEG
PT	Talc	0,011	0,012	0,014	0,012	BGS, DGEG, WMD	no data*	no data*	no data*		
Total number of extraction sites							118	125	127		DGEG
Romania											
RO	Bentonite	0,016	0,025	0,028	0,023	Eurostat Prodcom, USGS (2021), WMD	4	4	4		NAMR
RO	Gypsum	0,889	0,754	0,814	0,819	BGS, WMD	9	9	9		NAMR
RO	Feldspar	0,013	0,005	0,005	0,007	BGS, WMD	3	2	2		NAMR
RO	Kaoline	0,031	0,031	0,031	0,031	BGS, WMD		no data found / available / provided			NAMR
RO	Lime	1,907	1,951	2,126	1,995	USGS (2021)	3	3	3		NAMR
RO	Salt (rock salt)	0,050	0,052	0,052	0,051	USGS (2021)	9	9	9		NAMR
Sweden											
SE	Diabase	0,265	0,344	0,156	0,255	SGU (2018)	2	2	2		SGU (2016, 2017, 2018)
SE	Dolomite	0,393	0,344	0,473	0,403	SGU (2018)	4	4	4		SGU (2016, 2017, 2018)
SE	Feldspar	0,029	0,022	0,022	0,024	BGS, SGU (2018), WMD	1	1	1		SGU (2016, 2017, 2018)
SE	Graphite	0,009	0,000	0,000	0,003	SGU (2018)	no data	no data	no data		SGU (2016, 2017, 2018)
SE	Kaolin	0,122	no data	0,085	-	Eurostat Prodcom					
SE	Quartz / Quartzite	0,072	0,021	0,056	0,050	SGU (2018)	3	2	3		SGU (2016, 2017, 2018)
SE	Quartz (sand)	0,638	0,656	0,716	0,670	SGU (2018)	4	3	3		SGU (2016, 2017, 2018)
SE	Shale	0,008	0,008	0,009	0,008	SGU (2018)	1	1	1		SGU (2016, 2017, 2018)
SE	Other	0,003	0,002	0,003	0,003	SGU (2018)	2	2	2		SGU (2016, 2017, 2018)
Slovakia											
SK	Baryte	0,020	0,025	0,016	0,020	BGS, USGS (2021)	1	2	no data*		SGIDS (2018)
SK	Bentonite	0,205	0,158	0,226	0,196	BGS	10	11	no data*		SGIDS (2018)
SK	Dolomite	1,630	1,715	no data	-	SGIDT (2018)	9	9	no data*		SGIDS (2018)
SK	Feldspar	0,004	0,008	0,016	0,009	BGS, USGS (2021)	1	1	no data*		SGIDS (2018)
SK	Gypsum, incl. anhydrite	0,067	0,053	0,046	0,055	BGS, USGS (2021), WMD	1	2	no data*		SGIDS (2018)
SK	Kaoline	0,006	0,011	0,021	0,013	BGS, WMD	1	1	no data*		SGIDS (2018)
SK	Magnesite, Mine production	0,773	0,598	no data	-	SGIDS (2018)	3	4	no data*		SGIDS (2018)
SK	Perlite	0,025	0,019	0,048	0,031	BGS, USGS (2021), WMD	1	2	no data*		SGIDS (2018)
SK	Talc	0,001	0,007	0,014	0,007	BGS	1	1	no data*		SGIDS (2018)
Slovenia											
SI	Bentonite (t)	232	182	147	187	BGS, GSS (2018), USGS (2020), WMD	1	1	1		GSS (2018)
SI	Calcite	0,269	0,256	0,221	0,248	GSS (2018)	2	1	1		GSS (2018)
SI	Chert	0,021	0,020	0,016	0,019	GSS (2018), USGS (2020)	1	1	1		GSS (2018)
SI	Dolomite (industrial)	0,173	0,151	0,173	0,165	GSS (2018)	1	1	1		GSS (2018)
SI	Lime	1,103	1,046	1,174	1,108	GSS (2018), USGS (2020)	5	5	5		GSS (2018)
SI	Quartz Sand	0,343	0,338	0,359	0,347	GSS (2018)	7	7	7		GSS (2018)
SI	Raw materials for Cement	1,191	1,149	1,319	1,220	GSS (2018)	5	4	4		GSS (2018)

no data*: no data found / provided / available

** Total number of extratin sites attapulgite, bentonite, sepiolite

Table I.2: Industrial minerals, overall dataset

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
Austria						
AT	Feldspar	0,035	0,035	0,035	0,035	BGS
AT	Feldspar	no data	no data	no data	-	Eurostat Prodcom
AT	Feldspar (production from quartzsand)	0,035	0,035	0,035	0,035	BMLRT (2020)
AT	Feldspar (by-product of silica processing)	0,035	0,035	0,035	0,035	USGS (2021)
AT	Feldspar	0,035	0,035	0,035	0,035	WMD
AT	Graphite, crude / sales	0,022	0,023	0,024	0,023	BGS
AT	Graphite	no data	no data	no data	-	Eurostat Prodcom
AT	Graphite (production at Grafitbau Kaisersberg)	no data	no data	no data	-	BMLRT (2020)
AT	Graphite, amorphous	0,700	0,800	1,000	0,035	USGS (2021)
AT	Graphite	no data	no data	no data	-	WMD
AT	Gypsum (incl. anhydrite)	0,715	0,674	0,712	0,701	BGS
AT	Gypsum (incl. anhydrite)	0,277	0,274	0,298	0,283	Eurostat Prodcom
AT	Gypsum (incl. anhydrite)	0,715	0,674	0,712	0,700	BMLRT (2020)
AT	Gypsum (incl. anhydrite)	0,715	0,674	0,712	0,701	USGS (2021)
AT	Gypsum (incl. anhydrite)	0,715	0,674	0,712	0,701	WMD
AT	Kaolin	0,013	0,014	0,014	0,013	BGS
AT	Kaolin	no data	no data	no data	-	Eurostat Prodcom
AT	Kaolin	0,032	no data	no data	-	BMLRT (2020)
AT	Kaolin	0,032	0,037	0,032	0,034	USGS (2021)
AT	Kaolin (China clay)	0,013	0,014	0,014	0,013	WMD
AT	Magnesite	0,703	0,646	0,730	0,693	BGS
AT	Magnesite	no data	no data	no data	-	Eurostat Prodcom
AT	Magnesite	0,703	0,646	0,730	0,693	BMLRT (2020)
AT	Magnesite	0,703	0,646	0,730	0,693	USGS (2021)
AT	Magnesite	0,703	0,566	0,730	0,666	WMD
AT	Salt (total)	0,986	1,045	1,114	1,048	BGS
AT	Salt (rock salt) (t)	248	244	251	248	BGS
AT	Salt (brine)	0,985	1,045	1,114	1,048	BGS
AT	Salt	no data	no data	no data	-	Eurostat Prodcom
AT	Salt (total)					
	Salt (rock salt) (t)	248	255	388	297	BMLRT (2020)
	Salt solution (Mm³), 1 m³ = 0,3 t)	3,247	3,446	3,853	3,515	BMLRT (2020)
AT	Salt	0,969	1,028	1,150	1,049	USGS (2021)
AT	Salt (rock salt) (t)	248	245	388	294	USGS (2021)
AT	Salt (brine)	0,969	1,028	1,150	1,049	USGS (2021)
AT	Salt (rock, brines, marines	0,974	1,034	1,156	1,055	WMD
AT	Sulphur	no data	no data	no data	-	BGS
AT	Sulphur	no data	no data	no data	-	Eurostat Prodcom
AT	Sulphur (by-product oil production)	0,009	0,005	no data	-	BMWFW (2016, 2017)
AT	Sulphur (byproduct, natural gas and petroleum, S conte	0,009	0,005	0,008	0,007	USGS (2021)
AT	Sulphur (elemental & industrial)	0,009	0,005	0,008	0,007	WMD
AT	Talc	0,122	0,123	0,124	0,123	BGS
AT	Talc	no data	no data	no data	-	Eurostat Prodcom
AT	Talc & Leucophyllite	0,122	0,123	0,124	0,123	MHB (2020)
AT	Talc and related materials, talc, incl. leucophyillite, whit	0,122	0,123	0,124	0,123	USGS (2021)
AT	Talc, steatite & pyrophillite	0,122	0,123	0,124	0,123	WMD
Belgium						
BE	Quartz (sand)	2,202	3,049	2,474	2,575	Info for MS
Bulgaria						
BG	Baryte	0,060	0,070	0,080	0,070	BGS
BG	Baryte	no data	no data	no data	-	Eurostat Prodcom
BG	Baryte	0,059	0,050	0,067	0,059	USGS (2021)
BG	Baryte	0,060	0,050	0,064	0,058	WMD
BG	Bentonite	0,062	0,037	0,054	0,051	BGS
BG	Bentonite	no data	no data	no data	-	Eurostat Prodcom
BG	Bentonite	0,041	0,043	0,052	0,045	USGS (2021)
BG	Bentonite	0,062	0,037	0,054	0,051	WMD

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
Bulgaria						
BG	Chalk	no data	no data	no data	-	BGS
BG	Chalk	0,017	no data	0,026	-	Eurostat Prodcom
BG	Chalk	0,149	0,074	0,236	0,153	USGS (2021)
BG	Chalk	no data	no data	no data	-	WMD
BG	Fluorspar	0,147	0,004	0	0,050	BGS
BG	Fluorspar	no data	no data	no data	-	Eurostat Prodcom
BG	Fluorspar	0,020	0,020	no data	-	USGS (2021)
BG	Fluorspar	0,132	0,004	0	0,045	WMD
BG	Gypsum (incl. anhydrite)	0,109	0,061	0,088	0,086	BGS
BG	Gypsum (incl. anhydrite)	no data	no data	no data	-	Eurostat Prodcom
BG	Gypsum (incl. anhydrite)	0,099	0,041	0,041	0,060	USGS (2021)
BG	Gypsum (incl. anhydrite)	0,109	0,061	0,088	0,086	WMD
BG	Kaolin	0,334	0,330	0,322	0,329	BGS
BG	Kaolin	no data	no data	no data	-	Eurostat Prodcom
BG	Kaolin	0,200	0,190	0,220	0,203	USGS (2021)
BG	Kaolin (China clay)	0,315	0,339	0,323	0,325	WMD
BG	Lime	no data	no data	no data	-	Eurostat Prodcom
BG	Lime	1,474	1,518	1,503	1,498	USGS (2021)
BG	Lime	no data	no data	no data	-	WMD
BG	Perlite	0	0	0,005	0,002	BGS
BG	Perlite	no data	no data	no data	-	Eurostat Prodcom
BG	Perlite	no data	no data	no data	-	USGS (2021)
BG	Perlite	no data	no data	no data	-	WMD
BG	Salt	3,100	3,300	3,400	3,267	BGS
BG	Salt	no data	no data	no data	-	USGS (2021)
BG	Salt (rock, brines, marines)	3,100	3,300	3,400	3,267	WMD
BG	Sulphur	no data	no data	no data	-	BGS
BG	Sulphur	no data	no data	no data	-	Eurostat Prodcom
BG	Sulphur	no data	no data	no data	-	USGS (2021)
BG	Sulphur	0,439	0,396	0,501	0,445	WMD
Cyprus						
CY	Bentonite	0,127	0,117	0,096	0,113	BGS
CY	Bentonite	no data	no data	no data	-	Eurostat Prodcom
CY	Bentonite	0,129	0,119	0,098	0,115	Reports from MS
CY	Bentonite	0,127	0,117	0,096	0,113	USGS (2020)
CY	Bentonite	0,127	0,117	0,096	0,113	WMD
CY	Diatomite	0,053	0,055	0,057	0,055	BGS
CY	Diatomite	no data	no data	no data	-	Eurostat Prodcom
CY	Diatomite		no production		-	Reports from MS
CY	Diatomite	no data	no data	no data	-	USGS (2020)
CY	Diatomite	no data	no data	no data	-	WMD
CY	Gypsum (incl. anhydrite)	0,472	0,682	0,647	0,600	BGS
CY	Gypsum (incl. anhydrite)	no data	no data	no data	-	Eurostat Prodcom
CY	Gypsum	0,315	0,129	0,703	0,382	Reports from MS
CY	Gypsum, crude	0,472	0,682	0,703	0,619	USGS (2020)
CY	Gypsum (incl. anhydrite)	0,472	0,682	0,647	0,600	WMD
Czech Republic						
CZ	Bentonite	0,369	0,374	0,254	0,332	BGS
CZ	Bentonite	0,369	0,374	0,254	0,332	CGS (2019)
CZ	Bentonite	0,184	0,232	0,230	0,215	Eurostat Prodcom
CZ	Bentonite	0,369	0,374	0,254	0,332	USGS (2021)
CZ	Bentonite	0,369	0,374	0,254	0,332	WMD
CZ	Clays	0,569	0,538	0,537	0,548	CGS (2019)
CZ	Diatomite	0,015	0,026	0,034	0,025	BGS
CZ	Diatomite	0,015	0,026	0,034	0,025	CGS (2019)
CZ	Diatomite	no data	no data	no data	-	Eurostat Prodcom
CZ	Diatomite	0,015	0,026	0,034	0,025	USGS (2021)
CZ	Diatomite	0,015	0,026	0,034	0,025	WMD
CZ	Dolomite	no data	no data	no data	-	BGS
CZ	Dolomite	0,451	0,440	0,450	0,447	CGS (2019)
CZ	Dolomite	no data	no data	no data	-	Eurostat Prodcom
CZ	Dolomite	0,451	0,440	0,450	0,447	USGS (2021)
CZ	Dolomite	no data	no data	no data	-	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
CZ	Feldspar	0,433	0,454	0,368	0,418	BGS
CZ	Feldspar	0,433	0,454	0,368	0,418	CGS (2019)
CZ	Feldspar	no data	no data	no data	no data	Eurostat Prodcom
CZ	Feldspar & nepheline syenite	0,433	0,454	0,368	0,418	USGS (2021)
CZ	Feldspar	0,433	0,454	0,368	0,418	WMD
CZ	Gypsum (incl. anhydrite)	0,011	0,010	0,007	0,009	BGS
CZ	Gypsum	0,011	0,010	0,007	0,009	CGS (2019)
CZ	Gypsum (incl. anhydrite)	0,225	0,224	0,242	0,230	Eurostat Prodcom
CZ	Gypsum (incl. anhydrite)	0,011	0,010	0,007	0,009	USGS (2021)
CZ	Gypsum (incl. anhydrite)	0,011	0,010	0,007	0,009	WMD
CZ	Industrial sands	no data	no data	no data	-	BGS
CZ	Industrial sands	1,347	1,322	1,311	1,327	CGS (2019)
CZ	Industrial sands (Glass sand)	0,812	0,801	0,755	0,789	CGS (2019)
CZ	Industrial sands (Foundry sand)	0,535	0,521	0,556	0,537	CGS (2019)
CZ	Industrial sands	no data	no data	no data	-	Eurostat Prodcom
CZ	Industrial sands	1,347	1,322	1,311	1,327	USGS (2021)
CZ	Industrial sands (Glass sand)	0,812	0,801	0,755	0,789	USGS (2021)
CZ	Industrial sands (Silica sand)	0,535	0,521	0,556	0,537	USGS (2021)
CZ	Industrial sands	no data	no data	no data	-	WMD
CZ	Kaolin (beneficiated)	0,648	0,648	0,676	0,657	BGS
CZ	Kaolin	3,454	3,540	3,669	3,554	CGS (2019)
CZ	Kaolin (beneficiated)	0,648	0,648	0,676	0,657	CGS (2019)
CZ	Kaolin, not calcined	0,986	1,038	0,768	0,931	Eurostat Prodcom
CZ	Kaolin	3,450	3,540	3,669	3,553	USGS (2021)
CZ	Kaoline (China clay)	3,454	3,540	3,669	3,554	WMD
CZ	Limestone cement	no data	no data	no data	-	BGS
CZ	Limestone cement	10,568	10,995	10,787	10,783	CGS (2019)
CZ	Limestone cement	no data	no data	no data	-	Eurostat Prodcom
CZ	Lime, hydrated & quick lime	1,006	1,066	0,935	1,002	USGS (2021)
CZ	Limestone cement	no data	no data	no data	-	WMD
CZ	Silica	no data	no data	no data	-	BGS
CZ	Silica	0,014	0,018	0,017	0,016	CGS (2019)
CZ	Silica	no data	no data	no data	-	Eurostat Prodcom
CZ	Silica	no data	no data	no data	-	USGS (2021)
CZ	Silica	no data	no data	no data	-	WMD
Germany						
DE	Baryte	0,045	0,049	0,034	0,043	BGR (2017, 2018)
DE	Baryte	0,045	0,049	0,034	0,043	BGS
DE	Baryte	no data	no data	no data	-	Eurostat Prodcom
DE	Baryte	0,045	0,049	0,034	0,043	USGS (2021)
DE	Baryte	0,068	0,049	0,034	0,051	WMD
DE	Bentonite	0,393	0,393	0,416	0,401	BGR (2017, 2018)
DE	Bentonite	0,393	0,393	0,416	0,401	BGS
DE	Bentonite	no data	no data	no data	-	Eurostat Prodcom
DE	Bentonite	0,395	0,395	0,395	0,395	USGS (2021)
DE	Bentonite	0,393	0,393	0,416	0,401	WMD
DE	Chalk	1,700	1,700	1,700	1,700	BGR (2017, 2018)
DE	Chalk	no data	no data	no data	-	BGS
DE	Chalk	no data	no data	no data	-	Eurostat Prodcom
DE	Chalk	no data	no data	no data	-	USGS (2021)
DE	Chalk	no data	no data	no data	-	WMD
DE	Diatomite	0,053	0,055	0,057	0,055	BGR (2017, 2018)
DE	Diatomite	0,053	0,055	0,057	0,055	BGS
DE	Diatomite	no data	no data	0,052	-	Eurostat Prodcom
DE	Diatomite	0,050	0,052	0,052	0,051	USGS (2021)
DE	Diatomite	no data	no data	no data	-	WMD
DE	Feldspar	0,253	0,285	0,277	0,272	BGR (2017, 2018)
DE	Feldspar	0,253	0,285	0,277	0,272	BGS
DE	Feldspar	no data	no data	no data	no data	Eurostat Prodcom
DE	Feldspar	0,200	0,285	0,277	0,254	USGS (2021)
DE	Feldspar	4,649	5,319	5,300	5,090	WMD
DE	Fluorspar	0,050	0,053	0,045	0,049	BGR (2017, 2018)
DE	Fluorspar	0,050	0,053	0,045	0,049	BGS
DE	Fluorspar	no data	no data	no data	-	Eurostat Prodcom
DE	Fluorspar, acid grade	0,050	0,053	0,045	0,049	USGS (2021)
DE	Fluorspar	0,058	0,053	0,045	0,052	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
DE	Graphite tC-Inh	398	502	422	441	BGR (2017, 2018)
DE	Graphite (t)	398	502	422	441	BGS
DE	Graphite	no data	no data	no data	-	Eurostat Prodcom
DE	Graphite, crystalline flakes	0,400	0,500	0,800	0,567	USGS (2021)
DE	Graphite (t)	398	502	422	441	WMD
DE	Gypsum (incl. anhydrite)	4,200	3,970	4,450	4,207	BGR (2017, 2018)
DE	Gypsum (incl. anhydrite)	4,200	3,970	4,450	4,207	BGS
DE	Gypsum (incl. anhydrite)	1,848	1,945	2,036	1,943	Eurostat Prodcom
DE	Gypsum, mine	2,872	3,090	3,238	3,067	USGS (2021)
DE	Gypsum (incl. anhydrite)	2,574	3,970	4,450	3,665	WMD
DE	Kaolin	1,100	1,023	1,109	1,077	BGR (2017, 2018)
DE	Kaolin washed & dried	1,100	1,023	1,109	1,077	BGS
DE	Kaolin, not calcined	no data	no data	1,278	-	Eurostat Prodcom
DE	Kaolin, marketable	4,300	4,300	5,200	4,600	USGS (2021)
DE	Kaolin (China Clay)	3,734	4,740	5,168	4,547	WMD
DE	Potash salt - Potash products	7,290	6,246	6,687	6,741	BGR (2017,2018)
DE	Effective	36,777	31,551	35,973	34,767	BGR (2017, 2018)
DE	K2O	3,751	3,269	3,587	3,536	BGR (2017, 2018)
DE	Potash (Potassic salts)	3,110	2,694	2,830	2,878	BGS
DE	Potash	no data	no data	no data	-	Eurostat Prodcom
DE	Potash (K2O equivalent)					
DE	Potash (mined)	3,750	3,270	3,587	3,536	USGS (2021)
DE	Potash (marketable)	3,110	2,800	2,900	2,937	USGS (2021)
DE	Potash (K2O)	3,110	2,751	2,964	2,941	WMD
DE	Salt (total)	14,706	14,477	15,568	14,917	BGR (2017, 2018)
DE	Salt (evaporate)	0,965	0,963	0,991	0,973	BGR (2017, 2018)
DE	Salt (rock salt)	6,124	5,617	6,531	6,091	BGR (2017, 2018)
DE	Salt (industrial brine)	7,616	7,897	8,046	7,853	BGR (2017, 2018)
DE	Salt (total)	16,447	16,237	18,435	17,040	BGS
DE	Salt (brine)	2,287	2,278	2,679	2,415	BGS
DE	Salt (rock salt)	6,028	5,634	6,794	6,152	BGS
DE	Salt (in brine)	8,133	8,324	8,962	8,473	BGS
DE	Salt	no data	no data	no data	-	Eurostat Prodcom
DE	Salt, NaCl content	14,169	14,260	14,290	14,240	
DE	Evaporated, including marketable marine salt	0,280	0,290	0,290	0,287	USGS (2021)
DE	Industrial brines, marketable	7,765	7,770	7,800	7,778	USGS (2021)
DE	Rock and other brines, marketable	6,124	6,200	6,200	6,175	USGS (2021)
DE	Salt (rock, brines, marine)	13,958	14,477	15,568	14,667	WMD
DE	Sulphur (by-product Gas & oil production)	0,628	0,578	0,538	0,581	BGR (2017, 2018)
DE	Sulphur	no data	no data	no data	-	BGS
DE	Sulphur	no data	no data	no data	-	Eurostat Prodcom
DE	Sulphur (By-product, S content	1,012	0,930	0,866	0,936	
DE	metallurgy	0,384	0,352	0,328	0,355	USGS (2021)
DE	natural gas & petroleum)	0,628	0,578	0,538	0,581	USGS (2021)
DE	Sulphur (elemental & industrial)	0,628	0,578	0,538	0,581	WMD
DE	Quartz	0,033	0,037	0,034	0,035	BGR (2017, 2018)
DE	Quartz	no data	no data	no data	no data	BGS
DE	Quartz	no data	no data	no data	no data	Eurostat Prodcom
DE	Quartz	no data	no data	no data	no data	USGS (2021)
DE	Quartz	no data	no data	no data	no data	WMD
Denmark						
DK	Bentonite	0,054	0,066	0,070	0,063	BGS
DK	Bentonite	0,054	no data	0,070	-	Eurostat Prodcom
DK	Bentonite (including plastic clay)	0,329	0,322	0,441	0,364	USGS (2020)
DK	Bentonite	0,054	0,066	0,070	0,063	WMD
DK	Chalk	no data	no data	no data	-	BGS
DK	Chalk	0,509	no data	0,528	-	Eurostat Prodcom
DK	Chalk	0,973	1,030	1,058	1,020	USGS (2020)
DK	Chalk	no data	no data	no data	-	WMD
DK	Diatomite	0,128	0,114	0,176	0,139	BGS
DK	Diatomite	no data	no data	no data	-	Eurostat Prodcom
DK	Diatomite	0,469	0,421	0,406	0,432	USGS (2020)
DK	Diatomite	0,128	0,114	0,110	0,117	WMD
DK	Salt	0,580	0,580	0,580	0,580	BGS
DK	Salt	no data	no data	no data	-	Eurostat Prodcom
DK	Salt	no data	no data	no data	-	USGS (2021)
DK	Salt (rock, brines, marine)	0,600	0,600	0,600	0,600	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
DK	Sulphur (elemental & industrial)	0,093	0,006	0,004	0,034	WMD
DK	Sulphur	no data	no data	no data	-	BGS
DK	Sulphur	no data	no data	no data	-	Eurostat Prodcom
DK	Sulphur (byproduct, natural gas and petroleum, S conte	4,447	6,144	4,004	-	USGS (2020)
Estonia						
EE	Chalk	no data	no data	no data	-	BGS
EE	Chalk and dolomite	1,044	0,962	1,348	1,118	ESD
EE	Chalk	no data	no data	no data	-	Eurostat Prodcom
EE	Chalk	no data	no data	no data	-	USGS (2020)
EE	Chalk	no data	no data	no data	-	WMD
EE	Clays & Kaolin	no data	no data	no data	-	BGS
EE	Clays & Kaolin	0,058	0,065	0,069	0,064	ESD
EE	Clays & Kaolin	no data	no data	no data	-	Eurostat Prodcom
EE	Clays & Kaolin	no data	no data	no data	-	USGS (2020)
EE	Clays & Kaolin	no data	no data	no data	-	WMD
EE	Limestone & gypsum	2,4407	2,6928	2,9882	2,707	ESD
EE	Limestone	no data	no data	no data	-	BGS
EE	Limestone	no data	no data	no data	-	Eurostat Prodcom
EE	Lime	0,079	0,042	0,044	0,055	USGS (2020)
EE	Limestone	0,487	0,468	0,771	0,575	USGS (2020)
EE	Limestone	no data	no data	no data	-	WMD
Greece						
EL	Amphibolite	0,019	0,036	0,038	0,031	Ypeka
EL	Attapulgite	0,108	0,045	0,054	0,069	BGS
EL	Attapulgite	no data	0,045	no data	-	Eurostat Prodcom
EL	Attapulgite (Fuller's earth), crude	0,108	0,045	0,054	0,069	USGS (2019)
EL	Attapulgite	no data	no data	no data	-	WMD
EL	Attapulgite	0,108	0,045	0,054	0,069	Ypeka
EL	Bentonite	1,123	0,883	1,088	1,031	BGS
EL	Bentonite	no data	0,894	1,533	-	Eurostat Prodcom
EL	Bentonite processed	0,808	6,826	no data	-	USGS (2019)
EL	Bentonite crude	1,123	0,883	1,100	-	USGS (2019)
EL	Bentonite	1,123	0,883	1,088	1,031	WMD
EL	Bentonite processed	0,808	0,683	no data	-	Ypeka
EL	Bentonite crude	1,123	0,883	1,088	1,031	Ypeka
EL	Gypsum (incl. anhydrite)	0,649	0,778	0,855	0,761	BGS
EL	Gypsum (incl. anhydrite)	no data	no data	0,444	-	Eurostat Prodcom
EL	Gypsum (incl. anhydrite)	0,649	0,778	no data	-	USGS (2019)
EL	Gypsum (incl. anhydrite)	0,649	0,778	0,547	0,658	WMD
EL	Gypsum	0,649	0,778	0,547	0,658	Ypeka
EL	Huntite	no data	no data	no data	-	BGS
EL	Huntite	no data	no data	no data	-	Eurostat Prodcom
EL	Huntite	0,016	0,023	no data	-	USGS (2019)
EL	Huntite	no data	no data	no data	-	WMD
EL	Huntite	0,016	0,023	0,014	0,017	Ypeka
EL	Magnesite	0,383	0,419	0,499	0,434	BGS
EL	Magnesite	no data	no data	no data	-	Eurostat Prodcom
EL	Magnesite, crude ore	0,383	0,398	no data	-	USGS (2019)
EL	Magnesite	0,383	0,398	0,443	0,408	WMD
EL	Magnesite	0,383	0,398	0,443	0,408	Ypeka
EL	Olivine	no data	no data	no data	-	BGS
EL	Olivine	no data	no data	no data	-	Eurostat Prodcom
EL	Olivine	0,023	0,025	no data	-	USGS (2019)
EL	Olivine	no data	no data	no data	-	WMD
EL	Olivine	0,022	0,025	0,023	0,023	Ypeka
EL	Perlite	0,891	0,921	0,933	0,915	BGS
EL	Perlite	no data	no data	no data	-	Eurostat Prodcom
EL	Perlite, crude	0,891	0,921	0,930	-	USGS (2019)
EL	Perlite	0,891	0,921	no data	-	WMD
EL	Perlite	0,891	0,921	0,933	0,915	Ypeka
EL	Pumice	no data	no data	no data	-	BGS
EL	Pumice	no data	no data	no data	-	Eurostat Prodcom
EL	Pumice	0,581	0,659	0,950	-	USGS (2019)
EL	Pumice	no data	no data	no data	-	WMD
EL	Pumice	0,581	0,659	0,971	0,737	Ypeka

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
EL	Quartz	no data	no data	no data	-	BGS
EL	Quartz	no data	no data	no data	-	Eurostat Prodcom
EL	Quartz	no data	no data	no data	-	USGS (2019)
EL	Quartz	no data	no data	no data	-	WMD
EL	Quartz	0,075	0,142	no data	-	Ypeka
EL	Salt (Sea salt)	0,122	0,158	0,164	0,148	BGS
EL	Salt	no data	no data	no data	-	Eurostat Prodcom
EL	Salt (sea salt)	0,122	0,158	no data	-	Ypeka
EL	Salt (all types)	0,122	0,158	no data	-	USGS (2019)
EL	Salt (rock, brines, marine)	0,122	0,158	0,167	0,149	WMD
EL	Sulphur	no data	no data	no data	-	BGS
EL	Sulphur	no data	no data	no data	-	Eurostat Prodcom
EL	Sulphur (S content, mixed sulfide ore, byproduct)	0,155	0,185	no data	-	USGS (2019)
EL	Sulphur (elemental & industrial)	0,155	0,185	0,210	0,183	WMD
EL	Sulphur	0,155	0,185	0,292	0,211	Ypeka
EL	Zeolite	no data	no data	no data	-	BGS
EL	Zeolite	no data	no data	no data	-	Eurostat Prodcom
EL	Zeolite	no data	no data	no data	-	USGS (2019)
EL	Zeolite	no data	no data	no data	-	WMD
EL	Zeolite (t)	360	110	2454	975	Ypeka
Spain						
ES	Attapulgite	0,026	0,029	0,059	0,038	BGS
ES	Attapulgite	no data	no data	no data	-	Eurostat Prodcom
ES	Attapulgite	0,026	0,029	0,059	0,038	IGME (2017), SMS (2017)
ES	Attapulgite	0,025	0,025	0,650	0,038	USGS (2019)
ES	Attapulgite	no data	no data	no data	-	WMD
ES	Baryte	0,003	0,003	0,003	0,003	BGS
ES	Baryte	no data	no data	no data	-	Eurostat Prodcom
ES	Baryte	no data	no data	no data	-	IGME (2017), SMS (2017)
ES	Baryte	no data	no data	no data	-	USGS (2019)
ES	Baryte	no data	no data	no data	-	WMD
ES	Bentonite	0,101	0,155	0,178	0,144	BGS
ES	Bentonite	0,101	0,155	0,178	0,144	Eurostat Prodcom
ES	Bentonite	0,101	0,155	0,178	0,144	IGME (2017), SMS (2017)
ES	Bentonite	0,113	0,113	0,113	0,144	USGS (2019)
ES	Bentonite	0,101	0,155	0,178	0,144	WMD
ES	Chalk	0,692	0,694	0,701	0,696	Eurostat Prodcom
ES	Chalk	no data	no data	no data	-	BGS
ES	Chalk	0,692	0,694	0,701	0,696	SMS (2017)
ES	Chalk	no data	no data	no data	-	USGS (2019)
ES	Chalk	no data	no data	no data	-	WMD
ES	Diatomite	0,048	0,048	0,071	0,055	BGS
ES	Diatomite	no data	no data	no data	-	Eurostat Prodcom
ES	Diatomite	0,048	0,048	no data	-	IGME (2017),
ES	Diatomite	0,050	0,050	0,050	0,050	USGS (2019)
ES	Diatomite	0,048	0,048	0,071	0,055	WMD
ES	Industrial Dolomite	no data	no data	no data	-	BGS
ES	Industrial Dolomite	no data	no data	no data	-	Eurostat Prodcom
ES	Industrial Dolomite	6,796	6,016	7,404	6,739	IGME (2017), SMS (2017)
ES	Industrial Dolomite	no data	no data	no data	-	USGS (2019)
ES	Industrial Dolomite	no data	no data	no data	-	WMD
ES	Feldspar	0,558	0,635	0,819	0,671	BGS
ES	Feldspar	no data	no data	no data	-	Eurostat Prodcom
ES	Feldspar	0,558	0,635	0,819	0,671	IGME (2017), SMS (2017)
ES	Feldspar (mine production)	0,558	0,550	0,600	0,569	USGS (2019)
ES	Feldspar	0,558	0,635	0,819	0,671	WMD
ES	Fluorspar	0,157	0,163	0,155	0,158	BGS
ES	Fluorspar	no data	no data	no data	-	Eurostat Prodcom
ES	Fluorspar	0,157	0,163	0,155	0,158	IGME (2017), SMS (2017)
ES	Fluorspar (CaF_2 content)	0,130	0,130	no data	-	USGS (2019)
ES	Acid grade	0,120	0,120	no data	-	USGS (2019)
ES	Ceramic grade	0,005	0,005	no data	-	USGS (2019)
ES	Metallurgical grade	0,005	0,005	no data	-	USGS (2019)
ES	Fluorspar	0,131	0,130	0,126	0,129	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
ES	Gypsum (incl. anhydrite)	7,404	8,936	9,545	8,628	BGS
ES	Gypsum (incl. Anhydrite)	7,404	8,936	9,545	8,628	Eurostat Prodcom
ES	Gypsum	7,404	8,936	9,545	8,628	IGME (2017), SMS (2017)
ES	Gypsum (incl. Anhydrite) (crude)	7,000	7,000	7,000	7,000	USGS (2019)
ES	Gypsum (incl. Anhydrite)	7,404	8,936	9,545	8,628	WMD
ES	Kaoline (washed)	0,392	0,347	0,475	0,405	BGS
ES	Kaolin, not calcined	0,392	0,347	0,475	0,405	Eurostat Prodcom
ES	Kaolin (washed)	0,371	0,347	0,475	-	IGME (2017), SMS (2017)
ES	Kaolin (Feldspar excavation)	0,047	0,076	NYP	-	IGME2017
ES	Kaolin	0,247	0,330	0,247	0,275	USGS (2019)
ES	Kaolin (China Clay)	0,392	0,347	0,475	0,405	WMD
ES	Magnesite	0,465	0,584	0,789	0,612	BGS
ES	Magnesite	no data	no data	no data	-	Eurostat Prodcom
ES	Magnesite	0,465	0,584	0,789	0,612	IGME (2017), SMS (2017)
ES	Magnesite	0,275	0,300	no data	-	USGS (2019)
ES	Magnesite	0,465	0,584	0,789	0,612	WMD
ES	Potash (Chloride)	0,668	0,672	0,557	0,633	BGS
ES	Potash	no data	no data	no data	-	Eurostat Prodcom
ES	Potash (total)	1,709	1,839	no data	-	IGME (2017), SMS (2017)
ES	Potash (K2O)	0,668	0,667	no data	-	IGME (2017), SMS (2017)
ES	Potash (K2O)	0,690	0,670	0,610	0,657	USGS (2019)
ES	Potash (K2O)	0,668	0,672	0,557	0,633	WMD
ES	Quartz	no data	no data	no data	-	BGS
ES	Quartz	no data	no data	no data	-	Eurostat Prodcom
ES	Quartz	1,102	1,136	1,005	1,081	IGME (2017); SMS (2017)
ES	Quartz (mine production)	0,900	0,900	no data	-	USGS (2019)
ES	Quartz	no data	no data	no data	-	WMD
ES	Salt total	4,590	4,553	4,136	4,426	BGS
ES	Other salt	0,154	0,100	0,098	0,117	BGS
ES	Rock salt	3,032	3,253	2,870	3,052	BGS
ES	Sea salt	1,403	1,200	1,168	1,257	BGS
ES	Salt	no data	no data	no data	-	Eurostat Prodcom
ES	Salt (total)	4,590	4,553	4,136	4,426	IGME (2017), SPM (2017)
ES	Rock salt	2,437	2,526	2,870	2,611	IGME (2017), SPM (2017)
ES	Sea salt	1,403	1,200	1,168	1,257	IGME (2017), SPM (2017)
ES	Brines	0,154	0,100	0,098	0,117	IGME (2017), SPM (2017)
ES	Salt	4,300	4,300	4,500	4,367	USGS (2019)
ES	Rock	2,900	2,900	no data	-	USGS (2019)
ES	Sea, including evaporated	1,400	1,400	no data	-	USGS (2019)
ES	Salt (Rock, brines, marine)	4,590	4,453	4,136	4,393	WMD
ES	Sepiolite	0,525	0,519	0,483	0,509	BGS
ES	Sepiolite	no data	no data	no data	-	Eurostat Prodcom
ES	Sepiolite	no data	no data	0,483	-	IGME (2017), SMS (2017)
ES	Sepiolite	no data	no data	no data	-	USGS (2019)
ES	Sepiolite	no data	no data	no data	-	WMD
ES	Sulphur	no data	no data	no data	-	BGS
ES	Sulphur	no data	no data	no data	-	Eurostat Prodcom
ES	Sulphur (content Na2SO4)	1,510	1,455	1,518	1,494	Panorma Minero (2017), SMS (2017)
ES	Sulphur	no data	no data	no data	-	USGS (2019)
ES	Sulphur (elemental & industrial)	0,520	0,647	0,633	0,600	WMD
ES	Talc	no data	no data	0,012	-	BGS
ES	Talc	no data	no data	no data	-	Eurostat Prodcom
ES	Talc	no production		no data	-	IGME (2017), SMS (2017)
ES	Talc & pyrophyllite	no data	no data	no data	-	USGS (2019)
ES	Talc, steatite & pyrophillite	no data	no data	0,012	-	WMD
Finland						
FI	Phosphate rock, apatite	no data	no data	no data	-	BGS
FI	Phosphate (natural Ca Phosphates & phosphatic chalk)	0,957	0,940	0,979	0,958	Eurostat Prodcom
FI	Apatite	0,957	0,940	0,979	0,958	Tukes (2010-2019)
FI	Phosphate rock, apatite, concentrate (gross weight)	0,957	0,940	0,979	-	USGS (2021)
FI	Phosphates (P2O5)	0,344	0,338	0,523	0,402	WMD
FI	Biotite	no data	no data	no data	-	BGS
FI	Biotite	no data	no data	no data	-	Eurostat Prodcom
FI	Biotite	0,038	0,011	0,047	0,032	Tukes (2010-2019)
FI	Biotite	0,038	0,052	0,047	-	USGS 2017, 2019
FI	Biotite	no data	no data	no data	-	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
FI	Bentonite	no data	no data	no data	-	BGS
FI	Bentonite	0,008	0,004	0,001	0,005	Eurostat Prodcom
FI	Bentonite	no production	no production	no production	-	Tukes (2010-2019), GTK
FI	Bentonite	no data	no data	no data	-	USGS (2021)
FI	Bentonite	no data	no data	no data	-	WMD
FI	Chalk	no data	no data	no data	-	BGS
FI	Chalk	0,050	no data	no data	-	Eurostat Prodcom
FI	Chalk	no production	no production	no production	-	Tukes (2010-2019),
FI	Chalk	no data	no data	no data	-	USGS (2021)
FI	Chalk	no data	no data	no data	-	WMD
FI	Feldspar	0,038	0,019	0,015	0,024	BGS
FI	Feldspar	no data	no data	no data	-	Eurostat Prodcom
FI	Feldspar	0,038	0,019	0,015	0,024	Tukes (2010-2019)
FI	Feldspar	0,038	0,019	0,015	0,024	USGS (2021)
FI	Feldspar	0,038	0,019	0,015	0,024	WMD
FI	Kaoline	no data	no data	no data	-	BGS
FI	Kaoline	no data	0,052	0,047	-	Eurostat Prodcom
FI	Kaoline	no production	no production	no production	-	Tukes (2010-2019), GTK
FI	Kaoline	no data	no data	no data	-	USGS (2021)
FI	Kaoline	no data	no data	no data	-	WMD
FI	Magnesite	no data	no data	no data	-	BGS
FI	Magnesite	no data	no data	no data	-	Eurostat Prodcom
FI	Magnesite	0,022	0,054	0,064	0,047	Tukes (2010-2019)
FI	Magnesite	no data	no data	no data	-	USGS (2021)
FI	Magnesite	0,022	0,054	0,064	0,047	WMD
FI	Mica	0,012	0,011	0,011	0,011	BGS
FI	Mica	no data	no data	no data	no data	Eurostat Prodcom
FI	Mica (concentrate)	0,012	0,052	0,011	0,025	Tukes (2010-2019)
FI	Mica (concentrate)	0,012	0,011	0,011	0,011	USGS (2021)
FI	Mica	no data	no data	no data	no data	WMD
FI	Quartz	no data	no data	no data	-	BGS
FI	Quartz	no data	no data	no data	-	Eurostat Prodcom
FI	Quartz	0,104	0,093	0,072	0,089	Tukes (2010 -2019)
FI	Quartz	no data	no data	no data	-	USGS (2021)
FI	Quartz	no data	no data	no data	-	WMD
FI	Soapstone	no data	no data	no data	-	BGS
FI	Soapstone	no data	no data	no data	-	Eurostat Prodcom
FI	Soapstone	0,017	0,013	0,013	0,014	Tukes (2010-2019)
FI	Soapstone	no data	no data	no data	-	USGS (2021)
FI	Soapstone	no data	no data	no data	-	WMD
FI	Sulphur	no data	no data	no data	-	BGS
FI	Sulphur	no data	no data	no data	-	Eurostat Prodcom
FI	Sulphur	no data	no data	no data	-	Tukes (2010-2019)
FI	Sulphur (pyrite)					
FI	Gross weight	1,040	0,719	0,879	-	USGS (2021)
FI	S content	0,556	0,384	0,470	-	USGS (2021)
FI	Sulphur*	0,847	0,853	0,937	0,879	WMD
	* Statistics Finland: Sulphur dioxide is produced from the burning of fossil fuels and the smelting of mineral ores that contain sulphur					
FI	Talc	0,332	0,346	0,355	0,344	BGS
FI	Talc	0,332	0,346	0,355	0,344	Tukes (2010-2019)
FI	Talc	no data	no data	no data	-	Eurostat Prodcom
FI	Talc	0,332	0,346	0,355	0,344	USGS (2021)
FI	Talc, steatite & pyrophillite	0,332	0,346	0,355	0,344	WMD
France						
FR	Bentonite	0,036	0,043	0,024	0,034	BGS
FR	Bentonite	0,036	0,025	0,024	0,029	Eurostat Prodcom
FR	Bentonite	no data	no data	no data	-	USGS (2021)
FR	Bentonite	0,036	0,043	0,024	0,034	WMD
FR	Chalk	no data	no data	no data	-	BGS
FR	Chalk	2,626	2,622	3,028	2,759	Eurostat Prodcom
FR	Chalk	2,626	2,622	3,028	2,759	USGS (2021)
FR	Chalk	no data	no data	no data	-	WMD
FR	Diatomite	0,090	0,090	0,090	0,090	BGS
FR	Diatomite	no data	no data	no data	-	USGS (2021)
FR	Diatomite	0,090	0,090	0,090	0,090	WMD
FR	Feldspar	0,550	0,550	0,550	0,550	BGS
FR	Feldspar	no data	no data	no data	-	USGS (2021)
FR	Feldspar	0,550	0,550	0,550	0,550	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
FR	Gypsum (incl. anhydrite)	1,808	1,735	1,874	1,806	BGS
FR	Gypsum (incl. anhydrite)	2,027	4,183	3,014	3,075	Eurostat Prodcom
FR	Gypsum (incl. anhydrite)	2,027	4,183	3,014	3,075	USGS (2021)
FR	Gypsum (incl. anhydrite)	2,027	4,183	3,014	3,075	WMD
FR	Kaolin	0,275	0,264	0,279	0,273	BGS
FR	Kaolin, not calcined	0,275	0,274	0,279	0,276	Eurostat Prodcom
FR	Kaolin	0,275	0,274	0,279	0,276	USGS (2021)
FR	Kaolin	0,275	0,264	0,279	0,273	WMD
FR	Lime	no data	no data	no data	-	BGS
FR	Limestone, agricultural and industrial	9,224	6,964	10,526	8,905	USGS (2021)
FR	Lime, quick and hydrated	2,504	2,500	2,600	2,535	USGS (2021)
FR	Lime	no data	no data	no data	-	WMD
FR	Mica	no data	no data	no data	-	BGS
FR	Mica	no data	no data	no data	-	Eurostat Prodcom
FR	Mica	0,021	0,020	0,019	0,020	USGS (2021)
FR	Mica	no data	no data	no data	-	WMD
FR	Sulphur	no data	no data	no data	-	BGS
FR	Sulphur	no data	no data	no data	-	Eurostat Prodcom
FR	Sulphur (by-product of natural gas and petroleum)	no data	no data	no data	-	USGS (2021)
FR	Sulphur (elemental & industrial)	0,380	0,380	0,500	0,420	WMD
FR	Salt in brine	4,266	5,185	4,664	4,705	BGS
FR	Rock Salt	0,500	0,500	0,500	0,500	Braun (2019)
FR	Salt	no data	no data	no data	-	Eurostat Prodcom
FR	Salt (all sources)	6,062	5,463	5,003	5,509	USGS (2021)
FR	Salt (Rock, brines, marine)	6,754	4,266	4,751	5,257	WMD
FR	Talc	0,350	0,370	0,370	0,363	BGS
FR	Talc	no data	no data	no data	-	Eurostat Prodcom
FR	Talc	no data	no data	no data	-	USGS (2021)
FR	Talc, steatite & pyrophillite	0,450	0,450	0,470	0,457	WMD
Croatia						
HR	Bentonite	no data	no data	no data	-	BGS
HR	Bentonite	no data	no data	no data	-	Eurostat Prodcom
HR	Bentonite	no production	no production	no production	-	MINGOR, JISMS
HR	Bentonite	no data	no data	no data	-	USGS (2020)
HR	Bentonite	no data	no data	no data	-	WMD
HR	Gypsum (incl. anhydrite)	0,138	0,170	0,201	0,170	BGS
HR	Gypsum (incl. anhydrite)	0,077	0,103	0,123	0,101	Eurostat Prodcom
HR	Gypsum	0,126	0,150	0,148	0,142	MINGOR, JISMS
HR	Gypsum (incl. anhydrite)	0,138	0,170	0,201	0,142	USGS (2020)
HR	Gypsum (incl. anhydrite)	0,126	0,150	0,148	0,142	WMD
HR	Salt	0,052	0,040	0,053	0,048	BGS
HR	Salt	no data	no data	no data	-	Eurostat Prodcom
HR	Salt	0,000	0,000	0,019	0,006	MINGOR, JISMS
HR	Salt (all sources)	0,052	0,040	0,053	0,006	USGS (2020)
HR	Salt (Rock, brines, marine)	0,021	0,016	0,019	0,018	WMD
Hungary						
HU	Bentonite	0,011	0,016	0,010	0,012	BGS
HU	Bentonite (t)	397	140	242	260	Eurostat Prodcom
HU	Bentonite	0,014	0,020	0,035	0,023	HGS
HU	Bentonite	0,010	0,014	0,020	0,015	USGS (2021)
HU	Bentonite	0,014	0,016	0,025	0,018	WMD
HU	Diatomite	0,001	0,001	0,001	0,001	BGS
HU	Diatomite	no data	no data	no data	-	Eurostat Prodcom
HU	Diatomite	0,001	0,001	0,001	-	USGS (2021)
HU	Diatomite	no data	no data	no data	-	WMD
HU	Perlite	0,065	0,076	0,071	0,071	BGS
HU	Perlite	no data	no data	no data	-	Eurostat Prodcom
HU	Perlite	0,031	0,071	0,080	0,061	Hungarian Geological society
HU	Perlite	0,065	0,075	0,071	0,071	USGS (2021)
HU	Perlite	0,031	0,031	0,035	0,032	WMD
Ireland						
IE	Gypsum (incl. anhydrite)	0,250	0,250	0,200	0,233	BGS
IE	Gypsum	no data	no data	no data	-	Eurostat Prodcom
IE	Gypsum	0,250	0,250	0,200	-	USGS (2021)
IE	Gypsum (incl. anhydrite)	0,250	0,250	0,200	0,233	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
Italy						
IT	Bentonite	0,013	0,046	0,086	0,048	BGS
IT	Bentonite	0,013	0,046	0,086	0,048	Eurostat Prodcom
IT	Bentonite	0,013	0,049	no data	-	USGS (2021)
IT	Bentonite	0,013	0,046	0,086	0,048	WMD
IT	Chalk	no data	no data	no data	-	BGS
IT	Chalk	no data	0,135	no data	-	Eurostat Prodcom
IT	Chalk	no data	no data	no data	-	USGS (2021)
IT	Chalk	no data	no data	no data	-	WMD
IT	Feldspar	4,700	4,000	3,500	4,067	BGS
IT	Feldspar	4,700	4,000	3,500	4,067	Eurostat Prodcom
IT	Feldspar	4,500	4,000	3,500	4,000	USGS (2019a; 2021)
IT	Feldspar	2,200	2,200	2,200	2,200	WMD
IT	Gypsum (incl. anhydrite)	0,572	0,617	0,469	0,553	BGS
IT	Gypsum (incl. anhydrite)	0,572	0,617	0,469	0,553	Eurostat Prodcom
IT	Gypsum	3,306	2,233	2,085	2,541	iSTAT
IT	Gypsum	no data	no data	no data	-	USGS (2021)
IT	Gypsum (incl. anhydrite)	0,572	0,617	0,469	0,553	WMD
IT	Kaolin	0,180	0,180	0,180	0,180	BGS
IT	Kaolin	no data	no data	no data	-	Eurostat Prodcom
IT	Kaolin	no data	no data	no data	-	USGS (2021)
IT	Kaolin (China Clay)	0,683	0,839	0,847	0,790	WMD
IT	Lime	no data	no data	no data	-	BGS
IT	Lime (hydrated, hydraulic, and quicklime)	3,500	3,500	3,600	3,533	USGS (2019a; 2021)
IT	Lime	no data	no data	no data	-	WMD
IT	Salt	2,081	2,085	2,147		iSTAT
IT	Salt	no data	no data	no data	-	BGS
IT	Salt	no data	no data	no data	-	Eurostat Prodcom
IT	Salt (industrial)	3,031	2,535	no data	-	USGS (2019a; 2021)
IT	Salt (Rock, brines, marine)	3,031	2,551	2,283	2,622	WMD
IT	Sulphur	no data	no data	no data	-	BGS
IT	Sulphur	no data	no data	0,511	-	USGS (2021)
IT	Sulfur, byproduct, S content:e					
	Metallurgy	0,040	0,040			USGS (2021)
	Petroleum	0,510	0,510			USGS (2021)
IT	Sulphur (elemental & industrial)	0,683	0,839	0,847	0,790	WMD
IT	Talc	0,165	0,165	0,165	0,165	BGS
IT	Talc	no data	no data	no data	-	Eurostat Prodcom
IT	Talc (and related materials, steatite and talc)	0,165	0,165	no data	-	USGS (2021)
IT	Talc, steatite & pyrophillite	0,165	0,165	0,165	0,165	WMD
Lithuania						
LT	Sulphur	no data	no data	no data	-	BGS
LT	Sulphur	no data	no data	no data	-	Eurostat Prodcom
LT	Sulphur (byproduct, natural gas and petroleum, S conte	0,084	0,095	0,094	0,091	USGS (2020)
LT	Sulphur (elemental & industrial)	0,084	0,095	0,094	0,091	WMD
Latvia						
LV	Gypsum (incl. anhydrite)	0,225	0,224	0,225	0,225	BGS
LV	Gypsum	no data	no data	no data	-	Eurostat Prodcom
LV	Gypsum	no data	no data	no data	-	USGS (2021)
LV	Gypsum (incl. anhydrite)	0,225	0,224	0,278	0,243	WMD
Luxemburg						
LU	no data available					
Malta						
MT	Salt	0,001	0,001	0,001	0,001	BGS
MT	Salt	no data	no data	no data	-	Eurostat Prodcom
MT	Salt	no data	no data	no data	-	USGS (2020)
MT	Salt (Rock, brines, marine) (t)	0,002	0,002	0,002	0,002	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
Netherlands						
NL	Salt	6,700	6,625	6,935	6,753	BGS
NL	Salt	no data	no data	no data	-	Eurostat Prodcom
NL	Salt (solar)	1,600	2,000	2,020	1,873	USGS (2020)
NL	Salt (Rock, brines, marine)	6,743	6,625	6,935	6,768	WMD
Poland						
PL	Bentonite (t)	450	1.000	0	483	BGS
PL	Bentonite	no data	no data	no data	-	Eurostat Prodcom
PL	Bentonite (t)	450	1.000	no data	-	WMD
PL	Bentonite (t)	450,00	1.000	no data	-	USGS (2019a; 2021)
PL	Chalk	no data	no data	no data	-	BGS
PL	Chalk	no data	3,136	3,473	-	Eurostat Prodcom
PL	Chalk	0,170	0,180	no data	-	PIG-PIB (2016, 2017, 2018)
PL	Chalk	no data	no data	no data	-	USGS (2019a; 2021)
PL	Chalk	no data	no data	no data	-	WMD
PL	Diatomite (t)	600	500	500	533	BGS
PL	Diatomite (t)	600	500	no data	-	USGS (2019a; 2021)
PL	Diatomite (t)	600	500	500	533	WMD
PL	Feldspar	0,538	0,511	0,569	0,539	BGS
PL	Feldspar	no data	no data	no data	-	Eurostat Prodcom
PL	Feldspar	0,077	0,088	0,091	0,085	PIG-PIB (2016, 2017, 2018)
PL	Feldspar (crude ore)	0,400	0,691	0,691	0,594	USGS (2019a; 2021)
PL	Feldspar	0,077	0,088	0,091	0,085	WMD
PL	Gypsum (incl. anhydrite)	1,099	1,118	1,108	1,109	BGS
PL	Gypsum (incl. anhydrite)	1,099	no data	no data	-	Eurostat Prodcom
PL	Gypsum	1,018	1,043	1,108	1,056	PIG-PIB (2016, 2017, 2018)
PL	Gypsum (incl. anhydrite)	1,018	1,035	no data	-	
	Anhydrite, natural	0,136	0,137	no data	-	USGS (2021)
	Rock, natural	0,882	0,898	no data	-	USGS (2021)
PL	Gypsum (incl. anhydrite)	1,018	1,043	1,108	1,056	WMD
PL	Kaolin (washed)	0,147	0,149	0,144	0,146	BGS
PL	Kaolin, not calcined	0,171	0,175	0,176	0,174	Eurostat Prodcom
PL	Kaolin	0,287	0,300	0,285	0,290	PIG-PIB (2016, 2017, 2018)
PL	Kaolin (crude)	0,287	0,300	no data	-	USGS (2021)
PL	Kaolin (China Clay)	0,287	0,300	0,285	0,290	WMD
PL	Magnesite	0,096	0,078	0,102	0,092	BGS
PL	Magnesite	no data	no data	no data	-	Eurostat Prodcom
PL	Magnesite	no data	no data	no data	-	USGS (2021)
PL	Gross weight	0,111	0,098	no data	-	USGS (2021)
PL	Concentrate	0,096	0,078	no data	-	USGS (2021)
PL	Magnesite	0,096	0,078	0,102	0,092	WMD
PL	Salt total	3,925	4,163	4,419	4,169	BGS
PL	Brine salt	2,798	2,965	2,989	2,917	BGS
PL	Other salt	0,487	0,500	0,446	0,478	BGS
PL	Rock salt	0,640	0,699	0,984	0,774	BGS
PL	Salt	no data	no data	no data	-	Eurostat Prodcom
PL	Rock Salt	3,468	4,079	4,660	4,069	PIG-PIB (2016, 2017, 2018)
PL	Salt			4,450	-	USGS (2021)
PL	Evaporated	0,671	0,647	no data	-	USGS (2021)
PL	Other, brine and desalination of mine waste water	2,798	2,965	no data	-	USGS (2021)
PL	Rock	0,650	0,709	no data	-	USGS (2021)
PL	Salt (Rock, brines, marine)	3,468	4,079	4,660	4,069	WMD
PL	Sulphur	no data	no data	no data	-	BGS
PL	Sulphur	no data	no data	no data	-	Eurostat Prodcom
PL	Sulphur	0,651	0,645	0,686	0,661	PIG-PIB (2016, 2017, 2018)
PL	Sulphur					USGS (2021)
PL	By-product Metallurgy	0,280	0,300	no data	-	USGS (2021)
PL	By-product Natural gas	0,024	0,025	no data	-	USGS (2021)
PL	By-product Petroleum, oil refineries and coking plant	0,269	0,269	no data	-	USGS (2021)
PL	Native	0,628	0,621	no data	-	USGS (2021)
PL	Sulphur	0,651	0,645	0,686	0,661	WMD
Portugal						
PT	Feldspar, incl. feldspatic sand	0,179	0,250	0,228	0,219	BGS
PT	Feldspar	0,094	0,132	0,126	0,117	DGEG
PT	Feldspar	no data	no data	no data	-	Eurostat Prodcom
PT	Feldspar (mine production)	0,094	0,132	no data	-	USGS (2020)
PT	Feldspar	0,094	0,132	0,126	0,117	WMD

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
PT	Gypsum (incl. anhydrite)	0,310	0,255	0,152	0,239	BGS
PT	Gypsum	no data	no data	no data	-	DGEG
PT	Gypsum (incl. anhydrite)	0,310	0,255	no data	-	Eurostat Prodcom
PT	Gypsum (incl. anhydrite)	0,310	0,255	no data	-	USGS (2020)
PT	Gypsum (incl. anhydrite)	0,310	0,255	0,152	0,239	WMD
PT	Kaolin	0,252	0,284	0,308	0,281	BGS
PT	Kaolin	0,252	0,284	0,308	0,281	DGEG
PT	Kaolin, not calcined	0,252	0,280	0,308	0,280	Eurostat Prodcom
PT	Kaolin (washed & unwashed)	0,252	0,278	no data	-	USGS (2020)
PT	Kaolin (China Clay)	0,252	0,284	0,308	0,281	WMD
PT	Quartz	no data	no data	no data	-	BGS
PT	Quartz	0,001	0,001	0,205	0,069	DGEG
PT	Quartz	no data	no data	no data	-	Eurostat Prodcom
PT	Quartz	0,001	0,001	no data	-	USGS (2019a; 2020)
PT	Quartz	no data	no data	no data	-	WMD
PT	Salt total	0,147	0,112	0,122	0,127	BGS
PT	Rock salt	0,030	0,006	0,008	0,015	BGS
PT	Sea salt	0,117	0,106	0,115	0,113	BGS
PT	Salt (Rock Salt)	0,030	0,006	0,008	0,015	DGEG
PT	Salt	no data	no data	no data	-	Eurostat Prodcom
PT	Salt (rock)	0,030	0,006	no data	-	USGS (2020)
PT	Salt (Rock, brines, marine)	0,030	0,006	0,008	0,015	WMD
PT	Talc	0,011	0,012	0,014	0,012	BGS
PT	Talc	0,011	0,012	0,014	0,012	DGEG
PT	Talc	no data	no data	no data	-	Eurostat Prodcom
PT	Talc & related minerals	0,011	0,012	no data	-	USGS (2020)
PT	Talc, steatite & pyrophillite	0,011	0,012	0,014	0,012	WMD
Romania						
RO	Bentonite	0,019	0,027	0,034	0,027	BGS
RO	Bentonite	0,016	0,025	0,028	0,023	Eurostat Prodcom
RO	Bentonite	0,016	0,025	0,028	0,023	USGS (2021)
RO	Bentonite	0,019	0,025	0,028	0,024	WMD
RO	Gypsum (incl. anhydrite)	0,889	0,754	0,814	0,819	BGS
RO	Gypsum (incl. anhydrite)	0,840	0,714	0,765	0,773	Eurostat Prodcom
RO	Gypsum	0,840	0,714	0,765	0,773	USGS (2021)
RO	Gypsum (incl. anhydrite)	0,889	0,714	0,765	0,789	WMD
RO	Feldspar	0,013	0,005	0,005	0,007	BGS
RO	Feldspar	no data	no data	no data	-	no data
RO	Feldspar	0,008	0,005	0,008	-	USGS (2021)
RO	Feldspar	0,013	0,005	0,005	0,008	WMD
RO	Kaolin	0,031	0,031	0,031	0,031	BGS
RO	Kaolin	no data	no data	no data	-	Eurostat Prodcom
RO	Kaolin	0,030	0,030	no data	-	USGS (2021)
RO	Kaolin (China Clay)	0,031	0,031	0,031	0,031	WMD
RO	Lime	no data	no data	no data	-	BGS
RO	Lime	1,907	1,951	2,126	1,995	USGS (2021)
RO	Lime	no data	no data	no data	-	WMD
RO	Salt	no data	no data	no data	-	BGS
RO	Salt	no data	no data	no data	-	Eurostat Prodcom
RO	Salt	2,150	2,052	2,352	2,185	USGS (2021)
RO	Rock salt	0,050	0,052	0,052	0,051	USGS (2021)
RO	Other	2,100	2,000	2,300	2,133	USGS (2021)
RO	Salt (Rock, brines, marine)	2,180	2,100	2,340	2,207	WMD
Sweden						
SE	Clay	no data	no data	no data	-	BGS
SE	Clay	0,157	0,180	0,174	0,170	SGU (2018)
SE	Clay	no data	no data	no data	-	USGS (2020)
SE	Clay	no data	no data	no data	-	WMD
SE	Diabase	no data	no data	no data	-	BGS
SE	Diabase	no data	no data	no data	-	Eurostat Prodcom
SE	Diabase	0,265	0,344	0,156	0,255	SGU (2018)
SE	Diabase	no data	no data	no data	-	USGS (2020)
SE	Diabase	no data	no data	no data	-	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
SE	Dolomite	no data	no data	no data	-	BGS
SE	Dolomite	no data	no data	no data	-	Eurostat Prodcom
SE	Dolomite	0,393	0,344	0,473		SGU (2018)
SE	Dolomite	no data	no data	no data	-	USGS (2020)
SE	Dolomite	no data	no data	no data	-	WMD
SE	Feldspar	0,029	0,022	0,022	0,024	BGS
SE	Feldspar	no data	no data	no data	-	Eurostat Prodcom
SE	Feldspar	0,029	0,022	0,022	0,024	SGU (2018)
SE	Feldspar	0,021	0,016	no data	-	USGS (2020)
SE	Feldspar	0,029	0,022	0,022	0,024	WMD
SE	Graphite (t)	113	0	0	-	BGS
SE	Graphite	no data	no data	no data	-	Eurostat Prodcom
SE	Graphite	0,009	0,000	0,000	0,003	SGU (2018)
SE	Graphite, natural	no data	no data	no data	-	USGS (2020)
SE	Graphite	no data	no data	no data	-	WMD
SE	Kaolin	no data	no data	no data	-	BGS
SE	Kaolin	0,122	no data	0,085	-	Eurostat Prodcom
SE	Kaolin	no data	no data	no data	-	USGS (2020)
SE	Kaolin	no data	no data	no data	-	WMD
SE	limestone	no data	no data	no data	-	BGS
SE	Limestone	6,715	6,949	6,757	6,807	SGU (2018)
SE	lime	0,640	0,640	no data	-	USGS (2020)
SE	limestone	no data	no data	no data	-	WMD
SE	Quartz / Quartsite	no data	no data	no data	-	BGS
SE	Quartz / Quartsite	no data	no data	no data	-	Eurostat Prodcom
SE	Quartz / Quartzite	0,072	0,021	0,056	0,050	SGU (2018)
SE	Quartz / Quartsite	no data	no data	no data	-	USGS (2020)
SE	Quartz / Quartsite	no data	no data	no data	-	WMD
SE	Quartz (sand)	no data	no data	no data	-	BGS
SE	Quartz (sand)	no data	no data	no data	-	Eurostat Prodcom
SE	Quartz (sand)	0,638	0,656	0,716	0,670	SGU (2018)
SE	Quartz (sand)	no data	no data	no data	-	USGS (2020)
SE	Quartz (sand)	no data	no data	no data	-	WMD
SE	Shale	no data	no data	no data	-	BGS
SE	Shale	no data	no data	no data	-	Eurostat Prodcom
SE	Shale	0,008	0,008	0,009	0,008	SGU (2018)
SE	Shale	no data	no data	no data	-	USGS (2020)
SE	Shale	no data	no data	no data	-	WMD
SE	Other	no data	no data	no data	-	BGS
SE	Other	no data	no data	no data	-	Eurostat Prodcom
SE	Other	0,003	0,002	0,003	0,003	SGU (2018)
SE	Other	no data	no data	no data	-	USGS (2020)
SE	Other	no data	no data	no data	-	WMD
Slovakia						
SK	Baryte	0,020	0,025	0,016	0,020	BGS
SK	Baryte	no data	no data	no data	-	Eurostat Prodcom
SK	Baryte	0,020	0,025	no data	-	SGIDS (2018)
SK	Baryte	0,020	0,025	0,016	0,020	USGS (2021)
SK	Baryte	0,020	0,023	0,016	0,020	WMD
SK	Bentonite	0,205	0,158	0,226	0,196	BGS
SK	Bentonite	0,164	0,129	0,159	0,151	Eurostat Prodcom
SK	Bentonite	0,205	0,195	no data	-	SGIDS (2018)
SK	Bentonite	0,164	0,129	0,159	0,151	USGS (2021)
SK	Bentonite	0,228	0,174	0,226	0,209	WMD
SK	Dolomite	no data	no data	no data	-	BGS
SK	Dolomite	no data	no data	no data	-	Eurostat Prodcom
SK	Dolomite	1,630	1,715	no data		SGIDS (2018)
SK	Dolomite	no data	no data	no data	-	USGS (2021)
SK	Dolomite	no data	no data	no data	-	WMD

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
SK	Feldspar	0,004	0,008	0,016	0,009	BGS
SK	Feldspar	no data	no data	no data	-	Eurostat Prodcom
SK	Feldspar	0,004	0,008	no data	-	SGIDS (2018)
SK	Feldspar	0,004	0,008	0,016	0,009	USGS (2021)
SK	Feldspar	0,029	0,022	0,022	0,024	WMD
SK	Gypsum (incl. anhydrite)	0,067	0,053	0,046	0,055	BGS
SK	Gypsum	no data	no data	no data	-	Eurostat Prodcom
SK	Gypsum (incl. anhydrite)	0,057	0,043	no data	0,050	SGIDS (2018)
SK	Gypsum (incl. anhydrite)	0,067	0,053	0,046	0,055	USGS (2021)
SK	Gypsum (incl. anhydrite)	0,066	0,052	0,046	0,055	WMD
SK	Kaolin	0,006	0,011	0,021	0,013	BGS
SK	Kaolin, not calcined	0,011	0,012	0,014	0,012	Eurostat Prodcom
SK	Kaolin	0,006	0,011	no data	-	SGIDS (2018)
SK	Kaolin	0,011	0,012	0,014	0,012	USGS (2021)
SK	Kaolin (China Clay)	0,006	0,012	0,021	0,013	WMD
SK	Magnesite	0,501	0,434	0,610	0,515	BGS
SK	Magnesite	no data	no data	no data	-	Eurostat Prodcom
SK	Magnesite					SGIDS (2018)
SK	Magnesite (Mine production)	0,773	0,598	no data	-	
SK	Magnesite (Concentrate)	0 501	0,434	no data	-	
SK	Magnesite (concentrate)	0,501	0,431	0,450	0,461	USGS (2021)
SK	Magnesite	0,878	0,683	0,975	0,846	WMD
SK	Perlite	0,025	0,019	0,048	0,031	BGS
SK	Perlite	no data	no data	no data	-	Eurostat Prodcom
SK	Perlite	0,025	0,019	no data	-	SGIDS (2018)
SK	Perlite	0,025	0,019	0,048	0,031	USGS (2021)
SK	Perlite	0,025	0,019	0,048	0,031	WMD
SK	Talc	0,001	0,007	0,014	0,007	BGS
SK	Talc	no data	no data	no data	-	Eurostat Prodcom
SK	Talc	0,001	0,001	no data	0,001	SGIDS (2018)
SK	Talc	0,001	0,001	0,014	-	USGS (2021)
SK	Talc, steatite & pyrophillite (t)	1400	800	14000	5400	WMD
Slovenia						
SI	Bentonite (t)	232	182	147	187	BGS
SI	Bentonite (t)	no data	no data	no data	-	Eurostat Prodcom
SI	Bentonite (t)	232	182	147	187	GSS (2018)
SI	Bentonite (t)	232	182	147	-	USGS (2020)
SI	Bentonite (t)	232	182	147	187	WMD
SI	Calcite	no data	no data	no data	-	BGS
SI	Calcite	0,269	0,256	0,221	0,248	GSS (2018)
SI	Calcite	no data	no data	no data	-	USGS (2020)
SI	Calcite	no data	no data	no data	-	WMD
SI	Chert	no data	no data	no data	-	BGS
SI	Chert	no data	no data	no data	-	Eurostat Prodcom
SI	Chert	0,021	0,020	0,016	0,019	GSS (2018)
SI	Chert	0,021	0,020	0,016	0,019	USGS (2020)
SI	Chert	no data	no data	no data	-	WMD
SI	Industrial Dolomite	no data	no data	no data	-	BGS
SI	Industrial Dolomite	no data	no data	no data	-	Eurostat Prodcom
SI	Industrial Dolomite	0,173	0,151	0,173	0,165	GSS (2018)
SI	Industrial Dolomite	no data	no data	no data	-	USGS (2020)
SI	Industrial Dolomite	no data	no data	no data	-	WMD
SI	Lime	no data	no data	no data	-	BGS
SI	Lime	no data	no data	no data	-	Eurostat Prodcom
SI	Lime	1,103	1,046	1,174	1,108	GSS (2018)
SI	Lime	1,103	1,046	1,174	1,108	USGS (2020)
SI	Lime	no data	no data	no data	-	WMD
SI	Quartz Sand	no data	no data	no data	-	BGS
SI	Quartz Sand	no data	no data	no data	-	Eurostat Prodcom
SI	Quartz Sand	0,343	0,338	0,359		GSS (2018)
SI	Quartz Sand	no data	no data	no data	-	USGS (2020)
SI	Quartz Sand	no data	no data	no data	-	WMD

Annex E: Industrial Minerals, Overview Of Production Data And Number Of Production Sites (EU-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
SI	Raw materials for Cement	1,191	1,149	1,319	1,220	GSS (2018)
SI	Raw materials for Cement	no data	no data	no data	-	BGS
SI	Raw materials for Cement	no data	no data	no data	-	Eurostat Prodcom
SI	Raw materials for Cement	no data	no data	no data	-	USGS (2020)
SI	Raw materials for Cement	no data	no data	no data	-	WMD
SI	Salt (sea salt)(t)	2.191	2.417	2.335	2.314	BGS
SI	Salt	no data	no data	no data	-	Eurostat Prodcom
SI	Salt (t)	2.191	2.417	2.335	2.314	GSS (2018)
SI	Salt (sea salt) (t)	2.191	2.417	2.335	2.314	USGS (2020)
SI	Salt (Rock, brines, marine) (t)	2.191	2.417	2.335	2.314	WMD

ANNEX F: CERAMIC CLAYS, OVERVIEW OF PRODUCTION DATA AND NUMBER OF PRODUCTION SITES (EU-27, 2015 – 2017)

Annex F: Ceramic Clays, Overview Of Production Data And Number Of Production Sites (Eu-27, 2015 – 2017)

Table F.1: Ceramic clays, summary of production data in the 27 MS (2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	Reference
AT	Clay, incl. bentonite	1,891	1,728	1,893	1,837	BMWFW (2016,2017)
BE	Clay and loam	active excavation, no data* reported (cf. confidentiality)				Eurostat Prodcom; USGS (2020)
BG	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic) clays);	0,815	1,118	0,837	0,923	Eurostat Prodcom
CY	For brick and tile manufacture	0,058	0,076	0,107	0,080	USGS (2020)
CZ	Brick clay	1,219	1,325	1,579	1,374	CGS (2019)
DE	Clay (sum)	19,258	20,201	19,313	19,591	BGR (2016;2017)
EE	Clay, unspecified, including kilts, used in construction	0,058	0,047	0,061	0,055	Eurostat Prodcom; USGS (2020)
EL	Clay (cement products and ceramic bricks)	1,501	1,604	2,077	1,727	Ypeka
ES	Common clay, refractory clay	9,107	9,342	9,626	9,358	IGME (2017); SMS (2017); USGS (2019)
FR	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,476	0,400	0,567	0,481	Eurostat Prodcom
HU	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,048	0,052	0,050	0,050	Eurostat Prodcom
IE	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data**	0,089	no data**	-	Eurostat Prodcom
IT	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	2,925	3,684	4,569	3,726	Eurostat Prodcom
LV	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	active excavation, no data* reported (cf. confidentiality)				Eurostat Prodcom
LT	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,326	0,324	0,340	0,330	Eurostat Prodcom
PL	Clays for ceramic industry (building, refractory, ceramic clays)	3,760	3,680	3,600	3,680	PIG-PIB (2016, 2017, 2018)
PT	Clays for ceramic industry	3,760	2,345	2,398	2,834	DGEG (2016, 2017); Eurostat Prodcom
SK	Ceramic clays	0,023	0,011	-	-	SGIDS (2018)
SI	Clays for ceramic industry	0,202	0,203	0,173	0,195	GSS (2018); USGS (2020)

no data: data not found / available / provided

Table F.2: Ceramic clays, overview number of extraction sites in the 27 MS (2015 – 2017)

MS	Number of extraction sites 2015	2016	2017	other	Reference
AT	55	47	no data*		BMWFW (2016,2017,
BE	no data*	no data*	no data*		
BG	no data*	no data*	no data*		
CY	no data*	no data*	no data*		
CZ	24	20	25		CGS (2019)
DE	205	210	no data*		
EE	no data*	no data*	no data*		
EL	no data*	no data*	no data*		
ES	199	197	198		IGME (2017); SMS (2017)
FR				195 (2015)	BRGM (2015)
HU	no data*	no data*	no data*		
IE	no data*	no data*	no data*		
IT	no data*	no data*	no data*		
LV	no data*	no data*	no data*		
LT	no data*	no data*	no data*		
PL	184	224	216		PIG-PIB (2016, 2017, 2018)
PT	75	83	84		DGEG (2017)
SK	4	3	-		SGIDS (2018)
SI	9	11	10		GeoZS (2018)

no data*: data not found / available / provided

Table F.3: Ceramic clays, detailed overview of reported production data for the 27 MS (2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	Reference
Austria						
AT	Clay, incl. bentonite	1,891	1,728	1,893	1,837	BMWFW (2016,2017,
AT	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data*	no data*	no data*	no data*	Eurostat, prodcom
AT	Clay, Unspecified, including bentonite, brick clay, and illite	1,923	1,736	1,901	1,853	USGS (2021)
Belgium						
BE	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data**	no data**	no data**	-	Eurostat, prodcom
BE	Clay, Flanders	1,075	no data*	no data*		MDO (2015)
BE	Clays	no data*	no data*	no data*	-	USGS (2021)
Bulgaria						
BG	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,815	1,118	0,837	0,923	Eurostat, prodcom
BG	Ceramic clays	no data*	no data*	no data*	-	USGS (2021)
Cyprus						
CY	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data*	no data*	no data*	-	Eurostat, prodcom
CY	For brick and tile manufacture	0,058	0,076	0,107	0,080	USGS (2020)
Czech Republic						
CZ	Brick clay (1000 m^3)	677	736	877	763	CGS (2019)
	1000 m^3 = 1,8 kt	1,219	1,325	1,579	1,374	CGS (2019)
CZ	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,861	no data**	no data**	-	Eurostat, prodcom
CZ	Brick clay	1,622	1,984	1,672	1,759	USGS (2021)
Germany						
DE	Clay & Loam (excl. bentonite & kaolin) (Ziegelton)	12,858	14,838	13,276	13,657	BGR (2016;2017)
DE	Specialton (industrial mineral?) Ceramic cl	6,400	5,363	6,037	5,933	BGR (2016;2017)
DE	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	3,678	4,134	4,357	4,056	Eurostat, prodcom
DE	Ceramic, including refractory	3,800	3,800	3,800	3,800	USGS (2021)
Denmark						
DK	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data*	no data*	no data*	-	Eurostat, prodcom
DK	Clay (other than bentonite and plastic clay (1000 m3)	378	504	492	458	Statbank Denmark
DK	Clay (other than bentonite and plastic clay	0,627	0,837	0,816	0,760	USGS (2020)
Estonia						
EE		see "Industrial minerals Clays & kaolin"				CFS, ESD
EE	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,058	0,047	0,061	0,055	Eurostat, prodcom
EE	Clay, unspecified, including kilts, used in construction	0,058	0,047	0,061	0,055	USGS (2020)
Greece						
EL	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data**	no data**	no data**	-	Eurostat, prodcom
EL	Clays for cement products	1,181	1,372	1,436	1,329	Ypeka
EL	Clays for ceramic bricks	0,320	0,232	0,641	0,397	Ypeka
EL	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2019)
Spain						
ES	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	9,010	8,537	8,913	8,820	Eurostat, prodcom
ES	Common clay	8,647	8,274	8,586	8,502	IGME (2017); SMS (2017)
ES	Common clay	8,646	8,700	no data*	-	USGS (2019)
ES	Refractory clay	0,460	1,068	1,040	0,856	IGME (2017); SMS (2017)
ES	Refractory clay	0,460	0,460	no data*	-	USGS (2019)
France						
FR	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,476	0,400	0,567	0,481	Eurostat, prodcom
FR	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2021)
Hungary						
HU	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,048	0,052	0,050	0,050	Eurostat, prodcom
HU	Clays for ceramic industry	no unambiguous data			-	MBFSZ
HU	Clay, refractory - chamotte	0,200	0,200	0,200	0,200	USGS (2021)

Annex F: Ceramic Clays, Overview Of Production Data And Number Of Production Sites (Eu-27, 2015 – 2017)

MS	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	Reference
Ireland						
IE	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data**	0,089	no data**	-	Eurostat, prodcom
IE	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2021)
Italy						
IT	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	2,925	3,684	4,569	3,726	Eurostat, prodcom
Latvia						
LV	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data**	no data**	no data**	-	Eurostat, prodcom
LV	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2021)
Lithuania						
LT	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,326	0,324	0,340	0,330	Eurostat, prodcom
LT	Clay	0,326	0,324	0,340	0,330	USGS (2020)
Luxembourg						
LU	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data**	no data**	no data**	-	Eurostat, prodcom
LU	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2021)
Malta						
MT	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data*	no data*	no data*	-	Eurostat, prodcom
MT	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2020)
Netherlands						
NL	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data**	no data**	no data**	-	Eurostat, prodcom
NL	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2020)
Poland						
PL	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	5,591	2,071	2,033		Eurostat, prodcom
PL	Clays for ceramic industry (ceramic clays & building ceramic clays)	3,760	3,680	3,600	3,680	
PL	Ceramic clays	0,340	0,440	0,460	0,413	PIG-PIB (2016, 2017, 2018)
PL	Refractory clays	0,090	0,080	0,060	0,077	PIG-PIB (2016, 2017, 2018)
PL	Building ceramic clays	3,330	3,160	3,080	3,190	PIG-PIB (2016, 2017, 2018)
PL	Fire clay, crude	0,116	0,103	no data*	-	USGS (2021)
Portugal						
PT	Clays for ceramic industry	1,989	2,345	2,398	2,244	
PT	Clay & kaolin	1,770	2,151	2,197	2,039	DGEG (2016, 2017)
PT	Common clay	1,771	1,670	1,687	1,710	DGEG (2016, 2017)
PT	Special clay	0,219	0,195	0,201	0,205	DGEG (2016, 2017)
PT	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	1,771	1,670	1,680		Eurostat, prodcom
PT	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2020)
Romania						
RO	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data**	no data**	no data**	-	Eurostat, prodcom
RO	Clays for ceramic industry	no data**	no data**	no data**	-	USGS (2021)
Sweden						
SE	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data*	no data*	no data*	-	Eurostat, prodcom
SE	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2020)
Slovakia						
SK	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,005				Eurostat, prodcom
SK	Ceramic clays	0,023	0,011	-	-	SGIDT (2018)
SK	Clays for ceramic industry	no data*	no data*	no data*	-	USGS (2021)
Slovenia						
SI	Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	no data*	no data*	no data*	-	Eurostat, prodcom
SI	Clays for ceramic industry	0,202	0,203	0,173	0,195	
	Brick clay	0,195	0,203	0,168	0,188	GSS (2018)
	Ceramic clay	0,008	-	0,005	0,007	GSS (2018)
SI	Clays for ceramic industry	0,202	0,203	0,173	0,195	
SI	Brick	0,195	0,203	0,168	0,188	USGS (2020)
SI	Ceramic, crude	0,008	-	0,005	0,007	USGS (2020)

no data**: no data* found / provided / available

ANNEX G: DIMENSION STONES, OVERVIEW OF PRODUCTION DATA AND NUMBER OF PRODUCTION SITES (EU-27, 2015 – 2017)

Annex G: Dimension Stones, Overview Of Production Data And Number Of Production Sites (Eu-27, 2015 – 2017)

Table G1: Dimension stone, Summary of production data and number of extraction sites per MS

MS	Commodity	2015	2016	2017	Average	Reference	Number of extraction sites				Reference
		t	t	t			2015	2016	2017	other	
AT	Dimension stone	1.457.388	1.507.696	1.424.900	1.463.328	Eurostat Prodcom					
BG	Dimension stone	4.320.644	2.465.337	1.870.637	2.885.539	Eurostat Prodcom					
CY	Dimension stone, unspecified	60.100	102.720	73.380	78.733	USGS (2020)					
CZ	Dimension stone, unspecified (m^3)	187.000	156.000	111.000	151.333	CGS (2019)	54	64	63		CGS (2019)
DE	Dimension stone	443.574	429.925	462.646	445.382	BGR (2016;2017); USGS (2021)					
DK	Dimension stone	472	no data	307	-	Eurostat Prodcom					
EE	Marble, granite, sandstone, pophyry, basalt, others (exl. Slate)	339.600	337.700	600.000	425.767	Esti Statistica					
EL	Dimension stone (Marble, slate stone - 2,8 g/cm³)	543.250	510.170	535.700	529.707	Ypeka					
ES	Dimension stones	6.269.909	5.968.157	6.158.681	6.132.249	IGME (2017); SMS (2015; 2016; 2017)	550	527	492		
FI	Dinmensionstone (soapstone)	470.687	350.081	470.372	430.380	Tukes (2015; 2016; 2017)	5	4	5		Tukes (2015; 2016; 2017)
FR	Dimension stone	1.451.102	2.224.232	2.799.321	2.158.218	Eurostat Prodcom				721 (2015)	BRGM (2015b)
HR	Dimension stones	531.209	482.187	517.380	510.259	Eurostat Prodcom					
HU	Dimension stones	43.689	130.716	233.250	135.885	Eurostat Prodcom,HGS, USGS (2021)	20	20	21		HGS
IT	Dimension stone	8.721.000	9.001.000	no data	-	USGS (2021)					
LV	Dimensione stone (dolomite)	no data	615.761	no data	-	Eurostat Prodcom					
LT	Dimension stone	2.647.246	2.857.148	1.265.226	2.256.540	Eurostat Prodcom					
MT	Dimension stone	176.078	173.064	158.800	169.314	USGS (2020)					
PT	Dimension stone	2.887.076	2.808.148	3.275.144	2.990.123	DGEG	364	363	344		DGEG
RO	Dimension stone	4.551.822	2.619.441	2.373.006	3.181.423	Eurostat Prodcom	4	4	4		NAMR
SE	Dimension stone	1.005.000	888.000	1.424.000	1.105.667	SGU (2017;2018)	52	56	56		SGU (2017;2018)
SK	Dimensione stone (dolomite)	819.422	826.569	844.237	830.076	Eurostat Prodcom, USGS (2021)					
SI	Dimension stone	136.326	136.427	142.325	138.359	GSS (2018), USGS (2020)	30	29	25		GSS (2018)

Table G2: Dimension stone, Detailed overview of production data

MS	Commodity	2015 t	2016 t	2017 t	Average	Reference
AUSTRIA						
AT	Dimension stone	1.457.388	1.507.696	1.424.900	1.463.328	Eurostat Prodcom
	. Ecaussine and other calcareous monumental or building stone of an apparent specific gravity >= 2,5	329.111	388.032	430.190	382.444	Eurostat Prodcom
	. Granite, crude or roughly trimmed	169.233	124.659	181.661	158.518	Eurostat Prodcom
	. Granite merely cut into rectangular (including square) blocks or slabs	857.233	925.974	747.471	843.560	Eurostat Prodcom
	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	101.811	69.031	65.578	78.807	Eurostat Prodcom
AT	Dimension stone		Only crushed rocks			USGS (2021)
Belgium						
BE	Dimension stone	no data	no data	no data	-	Eurostat Prodcom
BE	Dimension stone	no data	no data	no data	-	USGS (2021)
Bulgaria						
BG	Dimension stone	4.320.644	2.465.337	1.870.637	2.885.539	Eurostat Prodcom
BG	. Ecaussine and other calcareous monumental or building stone of an apparent specific gravity >= 2,5	70.396	81.970	75.039	75.802	Eurostat Prodcom
BG	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or buildstone of gravity >= 2,5; granite and sandstone)	4.117.625	2.187.639	1.603.573	2.636.279	Eurostat Prodcom
BG	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated and crushed dolomite and brolen or crushed dolomite for concrete aggregates, road metalling or railway or	132.622	195.729	192.025	173.459	Eurostat Prodcom
BG	Dimension stone, unspecified	4.118.000	1.874.000	1.604.000	2.532.000	USGS (2021)
Cyprus						
CY	Dimension stone	no data	no data	no data	-	Eurostat Prodcom
CY	Dimension stone, unspecified	60.100	102.720	73.380,000	78.733	USGS (2020)
Czech Republic						
CZ	Dimension stone, unspecified (m³)	187.000	156.000	111.000	151.333	CGS (2019)
CZ	Dimension stone	473.054	522.991	294.470	430.172	Eurostat Prodcom
CZ	. Granite, crude or roughly trimmed	445.849	500.285	273.536	406.557	Eurostat Prodcom
CZ	. Granite merely cut into rectangular (including square) blocks or slabs	27.205	22.706	20.934	23.615	Eurostat Prodcom
CZ	Dimension stone, unspecified	654.000	551.000	389.000	531.333	USGS (2021)

MS	Commodity	2015 t	2016 t	2017 t	Average	Reference
Germany						
DE	Dimension stone	443.574	429.925	462.646	445.382	BGR (2016;2017)
DE	Dimension stone	230.535	307.072	397.698	311.768	Eurostat Prodcom
DE	. Marble and travertine, crude or roughly trimmed	140.970	113.838	103.633	119.480	Eurostat Prodcom
DE	. Marble and travertine merely cut into rectangular or square blocks or slabs		170.241	127.132	148.687	Eurostat Prodcom
DE	. Ecaussine and other calcareous monumental or building stone of an apparent specific gravity >= 2,5	69.088		99.717	84.403	Eurostat Prodcom
DE	. Granite, crude or roughly trimmed	12.384	15.703	60.812	29.633	Eurostat Prodcom
DE	. Granite merely cut into rectangular (including square) blocks or slabs	8.093	7.290	6.404	7.262	Eurostat Prodcom
DE	Dimension, unspecified, including partially worked	444.000	450.000	462.000	452.000	USGS (2021)
Denmark						
DK	Dimension stone	472	no data	307	-	Eurostat Prodcom
DK	. Granite, crude or roughly trimmed	217	no data	148	-	Eurostat Prodcom
DK	. Granite merely cut into rectangular (including square) blocks or slabs	106	no data	103	-	Eurostat Prodcom
DK	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	24	no data	4	-	Eurostat Prodcom
DK	. Slate, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs	124	no data	52	-	Eurostat Prodcom
DK	Dimension stone		no data reported			USGS (2020)
Estonia						
EE	Marble, granite, sandstone, pophyry, basalt, others	339.600	337.700	600.000	425.767	Esti Statistica
EE	Dimension stone	644	5.345	2.189	2.726	Eurostat Prodcom
EE	. Marble and travertine merely cut into rectangular or square blocks or slabs		959	1.620	1.289	Eurostat Prodcom
EE	. Granite merely cut into rectangular (including square) blocks or slabs	63	4.372	557	1.664	Eurostat Prodcom
EE	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	568			568	
EE	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or	13	14	12	13	Eurostat Prodcom
EE	Dolomite, size & shape unspecified	38	21	34	31	USGS (2020)
EE	Limestone, size & shape unspecified	487.000	468.000	771.000	575.333	USGS (2020)

MS	Commodity	2015 t	2016 t	2017 t	Average	Reference
Greece						
EL	Dimension stone	1.451.868	1.530.899	1.338.702	1.440.490	Eurostat Prodcom
EL	. Marble and travertine, crude or roughly trimmed	387.594	624.351	724.641	578.862	Eurostat Prodcom
EL	. Marble and travertine merely cut into rectangular or square blocks or slabs	153.993	172.123	124.414	150.177	Eurostat Prodcom
EL	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	260.692	274.538	153.915	229.715	Eurostat Prodcom
EL	. Slate, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs	649.589	459.886	335.732	481.736	Eurostat Prodcom
EL	Marble, rough shapeless blocks	291.530	344.830	368.120	334.827	Ypeka
EL	Slate stones (m^3)	89.900	59.050	59.850	69.600	Ypeka
EL	Calcium carbonate, size, and shape, unspecified	384.000	380.000	no data	-	USGS (2019)
EL	Olivinite, size, and shape, unspecified	23.020	24.890	no data	-	USGS (2019)
Spain						
ES	Dimension stone	12.151.857	11.375.572	13.005.279	12.177.569	Eurostat Prodcom
ES	. Marble and travertine, crude or roughly trimmed	2.493.489	2.472.405	2.662.137	2.542.677	Eurostat Prodcom
ES	. Ecaussine and other calcareous monumental or building stone of an apparent specific gravity >= 2,5	1.301.057	1.127.242	1.048.524	1.158.941	Eurostat Prodcom
ES	. Granite, crude or roughly trimmed	578.312	647.113	676.504	633.976	Eurostat Prodcom
ES	. Sandstone	169.432	156.642	171.857	165.977	Eurostat Prodcom
ES	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	35.828	24.604	23.894	28.109	Eurostat Prodcom
ES	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or	6.795.916	6.015.767	7.403.563	6.738.415	Eurostat Prodcom
ES	. Slate, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs	777.823	931.799	1.018.800	909.474	Eurostat Prodcom

MS	Commodity	2015	2016	2017	Average	Reference
		t	t	t		
ES	Dimension stones	6.269.909	5.968.157	6.158.681	6.132.249	IGME (2017); SMS (2015; 2016; 2017)
ES	. Alabast	18.842	17.038	11.836	15.905	IGME (2017); SMS (2015; 2016; 2017)
ES	. Sandstone	441.011	269.567	282.325	330.968	IGME (2017); SMS (2015; 2016; 2017)
ES	Ornamental	169.432	156.642	171.857	165.977	IGME (2017); SMS (2015; 2016; 2017)
ES	Other applications	271.579	112.925	110.468	164.991	IGME (2017); SMS (2015; 2016; 2017)
ES	. Limestone	2.091.389	1.768.226	1.354.907	1.738.174	IGME (2017); SMS (2015; 2016; 2017)
ES	Ornamental	1.282.215	1.110.204	1.037.385	1.143.268	IGME (2017); SMS (2015; 2016; 2017)
ES	Other applications	809.174	658.022	317.522	594.906	IGME (2017); SMS (2015; 2016; 2017)
ES	. Quartzite	57.028	24.604	28.255	36.629	SMS (2015; 2016; 2017)
ES	Ornamental	35.828	24.604	23.894	28.109	SMS (2015; 2016; 2017)
ES	Other applications	21.200	no data	4.361	12.781	SMS (2015; 2016; 2017)
ES	. Diorite	3.000	5.080	no data	-	IGME (2017); SMS (2015; 2016; 2017)
ES	. Granite	742.687	869.988	1.126.246	912.974	IGME (2017); SMS (2015; 2016; 2017)
ES	Ornamental	578.312	647.113	676.504	633.976	IGME (2017); SMS (2015; 2016; 2017)
ES	Other applications	164.375	222.875	449.742	278.997	IGME (2017); SMS (2015; 2016; 2017)
ES	. Marble	2.121.980	2.061.391	2.266.303	2.149.891	IGME (2017); SMS (2015; 2016; 2017)
ES	Ornamental	600.653	717.737	598.235	638.875	IGME (2017); SMS (2015; 2016; 2017)
ES	Other applications	1.521.327	1.343.654	1.668.068	1.511.016	IGME (2017); SMS (2015; 2016; 2017)
ES	. Slate	851.000	976.867	1.088.809	972.225	IGME (2017); SMS (2015; 2016; 2017)
ES	Ornamental	778.000	931.799	1.018.800	909.533	IGME (2017); SMS (2015; 2016; 2017)
ES	Other applications	73.000	45.068	70.009	62.692	IGME (2017); SMS (2015; 2016; 2017)
ES	Dimension stone	7.294.000	3.735.000	no data	-	USGS (2019)
ES	. Dimension, Porphyry	645.000	645.000	no data	-	USGS (2019)
ES	. Dimension, Slate	4.000.000	400.000	no data	-	USGS (2019)
ES	. Ophite, size & shape unspecified	2.067.000	2.100.000	no data	-	USGS (2019)
ES	. Phonolite, size & shape unspecified	582.000	590.000	no data	-	USGS (2019)
Finland						
FI	Dimension stone	252.488	176.835	232.840	220.721	Eurostat Prodcom
FI	. Granite, crude or roughly trimmed	186.988	133.215	136.453	152.219	Eurostat Prodcom
FI	. Granite merely cut into rectangular (including square) blocks or slabs	no data	no data	3.080	-	Eurostat Prodcom
FI	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or	65.500	43.620	93.307	67.476	Eurostat Prodcom
FI	Soapstone	470.687	350.081	470.372		Tukes (2015; 2016; 2017)
FI	Dimension stone		no data reported			USGS (2021)

MS	Commodity	2015 t	2016 t	2017 t	Average	Reference
France						
FR	Dimension stone	1.451.102	2.224.232	2.799.321	2.158.218	Eurostat Prodcom
FR	. Marble and travertine, crude or roughly trimmed	17.374	17.795	no data	-	
FR	. Marble and travertine merely cut into rectangular or square blocks or slabs	no data	3.016	3.872	3.444	Eurostat Prodcom
FR	. Ecaussine and other calcareous monumental or building stone of an apparent specific gravity >= 2,5	589.666	1.511.975	1.480.464	1.194.035	Eurostat Prodcom
FR	. Granite, crude or roughly trimmed	217.511	243.514	238.310	233.112	Eurostat Prodcom
FR	. Granite merely cut into rectangular (including square) blocks or slabs	72.870	74.037	75.822	74.243	Eurostat Prodcom
FR	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	151.070	137.129	453.526	247.242	Eurostat Prodcom
FR	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or	419.985	248.847	547.326	405.386	Eurostat Prodcom
FR	. Slate, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs	no data	5.714	no data	-	Eurostat Prodcom
FR	Dimension, marble, including travertine	17.374	17.795	no data	-	Eurostat Prodcom USGS (2021)
Croatia						
HR	Dimension stones	531.209	482.187	517.380	510.259	Eurostat Prodcom
HR	. Marble and travertine, crude or roughly trimmed	99.708	106.955	133.458	113.374	Eurostat Prodcom
HR	. Marble and travertine merely cut into rectangular or square blocks or slabs	53.079	54.323	34.305	47.236	Eurostat Prodcom
HR	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	19.223	27.398	34.020	26.880	Eurostat Prodcom
HR	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or	359.199	293.511	315.597	322.769	Eurostat Prodcom
HR	Dimension stone, unspecified	1.417.694	1.378.882	1.320.579	1.372.385	USGS (2020)

MS	Commodity	2015 t	2016 t	2017 t	Average	Reference
Hungary						
HU	Dimension stones	7.889.336	7.651.110	6.128.680	7.223.042	Eurostat Prodcom
HU	. Ecaussine and other calcareous monumental or building stone of an apparent specific gravity >= 2,5	no data	127.837	229.387	-	Eurostat Prodcom
HU	. Granite, crude or roughly trimmed	no data	no data	558	-	Eurostat Prodcom
HU	. Granite merely cut into rectangular (including square) blocks or slabs	80	132	226	146	Eurostat Prodcom
HU	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	2.980.443	1.617.813	1.606.822	2.068.359	Eurostat Prodcom
HU	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or	4.908.813	5.905.328	4.291.687	5.035.276	Eurostat Prodcom
HU	Dimension stone	14.146.620	11.805.301	13.160.762		USGS (2021)
HU	. Dimension stone, dolomite	7.400.000	5.800.000	6.111.000	6.437.000	USGS (2021)
HU	. Dimension stone, limestone	6.700.000	6.000.000	7.041.000	6.580.333	USGS (2021)
HU	. Dimension stone, marl	3.011	2.554	5.683	3.749	USGS (2021)
HU	. Dimension stone, sandstone	43.609	2.747	3.079	16.478	USGS (2021)
HU	Dimension stone (1000 m³)	5.293	4.997	5.073	5.121	HGS
Ireland						
IE	Dimension stones	538.498	1.226.268	1.491.916	1.085.561	Eurostat Prodcom
IE	. Granite, crude or roughly trimmed	17.422	20.067	47.208	372.979	Eurostat Prodcom
IE	. Granite merely cut into rectangular (including square) blocks or slabs	35.284	48.729	59.063	481.569	Eurostat Prodcom
IE	. Sandstone	79.091	79.946	115.228	692.823	Eurostat Prodcom
IE	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	406.702	1.077.526	1.270.417	1.270.417	Eurostat Prodcom
IE	Dimension stone		no data reported			USGS (2021)

MS	Commodity	2015 t	2016 t	2017 t	Average	Reference
Italy						
IT	Dimension stone	11.429.527	14.193.039	17.277.181	14.299.916	Eurostat Prodcom
IT	. Marble and travertine, crude or roughly trimmed	1.310.215	1.462.732	1.589.566	1.454.171	Eurostat Prodcom
IT	. Marble and travertine merely cut into rectangular or square blocks or slabs	2.296.009	2.842.885	3.068.935	2.735.943	Eurostat Prodcom
IT	. Ecaussine and other calcareous monumental or building stone of an apparent specific gravity >= 2,5	5.121.562	6.682.276	9.080.179	6.961.339	Eurostat Prodcom
IT	. Granite, crude or roughly trimmed	673.169	546.596	487.140	568.968	Eurostat Prodcom
IT	. Granite merely cut into rectangular (including square) blocks or slabs	144.478	225.170	217.276	195.641	Eurostat Prodcom
IT	. Sandstone	322.389	444.278	570.146	445.604	Eurostat Prodcom
IT	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	987.102	1.350.512	1.479.606	1.272.407	Eurostat Prodcom
IT	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or other ballast)	515.989	595.399	742.994	618.127	Eurostat Prodcom
IT	. Slate, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs	58.614	43.191	41.339	47.715	Eurostat Prodcom
IT	Dimension stone	8.721.000	9.001.000	no data	-	USGS (2021)
IT	. Alabaster, calcareous	5.122.000	5.687.000	no data	-	USGS (2021)
IT	. Chalk, calcareous	719.000	700.000	no data	-	USGS (2021)
IT	. Dolomite, calcareous	516.000	426.000	no data	-	USGS (2021)
IT	. Granite	673.000	673.000	no data	-	USGS (2021)
IT	. Marble, including travertine, crude, calcareous	1.310.000	1.070.000	no data	-	USGS (2021)
IT	. Sandstone	322.000	415.000	no data	-	USGS (2021)
IT	. Slate	59.000	30.000	no data	-	USGS (2021)
Latvia						
LV	Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or other ballast)	no data	615.761	no data	-	Eurostat Prodcom
LV	Dimension stone		no data reported			USGS (2021)

MS	Commodity	2015 t	2016 t	2017 t	Average	Reference
Lithuania						
LT	Dimension stone	2.647.246	2.857.148	1.265.226	2.256.540	Eurostat Prodcom
	. Granite merely cut into rectangular (including square) blocks or slabs	no data	no data	1.615	-	Eurostat Prodcom
LT	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	453	117	12	194	Eurostat Prodcom
LT	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or	2.646.793	2.857.031	1.263.599	2.255.807	Eurostat Prodcom
LT	Dimension stone	no data	no data	no data	-	USGS (2020)
Luxembourg						
LU	Dimension stone	no data	no data	no data	-	Eurostat Prodcom
LU	Dimension stone	no data	no data	no data	-	USGS (2021)
Malta						
MT	Dimension stone	no data	no data	no data	-	Eurostat Prodcom
MT	Dimension stone	176.078	173.064	158.800	169.314	USGS (2020)
MT	. Dimension, Hardstone, coralline limestone	66.916	55.254	50.800	57.657	USGS (2020)
MT	. Dimension, Softstone, globigerina limestone	109.162	117.810	108.000	111.657	USGS (2020)
Netherlands						
NL	Dimension stone	no data	no data	no data	-	Eurostat Prodcom
NL	Dimension stone	no data	no data	no data	-	USGS (2020)
Poland						
PL	Dimension stone	6.588.812	7.428.287	6.917.547	6.978.215	Eurostat Prodcom
PL	. Granite, crude or roughly trimmed	2.390.737	2.558.219	2.627.145	2.525.367	Eurostat Prodcom
PL	. Granite merely cut into rectangular (including square) blocks or slabs	17.585	17.900	6.297	13.927	Eurostat Prodcom
PL	. Sandstone	1.471.891	972.389	no data	1.222.140	
PL	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	956.314	1.593.900	1.523.461	1.357.892	Eurostat Prodcom
PL	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or	3.068.868	3.258.268	2.760.644	3.029.260	Eurostat Prodcom
PL	. Slate, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs	155.308	no data	no data	-	
PL	Dimension and crushed stone		no separated dataset			PIG-PIB (2016, 2017, 2018)
PL	Dimension stone, unspecified	3.900.000	3.900.000	no data	-	USGS (2021)

MS	Commodity	2015 t	2016 t	2017 t	Average	Reference
Portugal						
PT	Dimension stone	2.887.076	2.808.148	3.275.144	2.990.123	DGEG
PT	Dimension stone	2.938.293	1.101.860	1.265.605	178.586	Eurostat Prodcom
PT	. Marble and travertine, crude or roughly trimmed	171.820	171.250	213.150	185.407	Eurostat Prodcom
PT	. Ecaussine and other calcareous monumental or building stone of an apparent specific gravity >= 2,5	692.013	691.568	844.474	742.685	Eurostat Prodcom
PT	. Granite, crude or roughly trimmed	1.937.595			-	
PT	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or	88.470	185.519	146.077	140.022	Eurostat Prodcom
PT	. Slate, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs	48.393	53.523	61.905	54.607	Eurostat Prodcom
PT	Dimension stone		no data reported			USGS (2020)
Romania						
RO	Dimension stone	9.807.337	5.374.445	6.676.885	7286222	Eurostat Prodcom
RO	. Marble and travertine merely cut into rectangular or square blocks or slabs	no data	no data	508	-	Eurostat Prodcom
RO	. Ecaussine and other calcareous monumental or building stone of an apparent specific gravity >= 2,5	4.551.822	2.619.441	2.372.498	3.181.254	Eurostat Prodcom
RO	. Granite, crude or roughly trimmed	1.837.733	2.067.913	1.256.729	1.720.792	Eurostat Prodcom
RO	. Porphyry, basalt, quartzites and other monumental or building stone, crude, roughly trimmed or merely cut (excluding calcareous monumental or building stone of a gravity ≥ 2,5, granite and sandstone)	2.764.907	no data	2.676.911	-	Eurostat Prodcom
RO	. Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or other ballast)	652.875	687.091	370.239	570.068	Eurostat Prodcom
RO	Dimension stone	no data	no data	no data	-	USGS (2021)

MS	Commodity	2015 t	2016 t	2017 t	Average	Reference
Sweden						
SE	Dimension stone	28.137	179.116	33.282	80.178	Eurostat Prodcom
SE	. Granite, crude or roughly trimmed	no data	138.580	no data	-	
SE	. Slate, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs	28.137	40.536	33.282	33.985	Eurostat Prodcom
SE	Dimension stone	1.005.000	888.000	1.424.000	1.105.667	SGU (2017;2018)
SE	. Diabas and gabbro	331.000	257.000	285.000	291.000	SGU (2017;2018)
SE	. Gneiss	241.000	205.000	289.000	245.000	SGU (2017;2018)
SE	. Granite	323.000	351.000	690.000	454.667	SGU (2017;2018)
SE	. Limestone (marble)	70.000	56.000	141.000	89.000	SGU (2017;2018)
SE	. Others	40.000	19.000	19.000	26.000	SGU (2017;2018)
SE	Dimension stone	922.000	922.000	no data	-	USGS (2020)
SE	Granite	88.000	88.000	no data	-	USGS (2020)
SE	Limestone	22.000	22.000	no data	-	USGS (2020)
SE	Sandstone	630.000	630.000	no data	-	USGS (2020)
SE	Other	82.000	82.000	no data	-	USGS (2020)
SE	Unspecified	100.000	100.000	no data	-	USGS (2020)
Slovakia						
SK	Dolomite, crude, roughly trimmed or merely cut into rectangular or square blocks or slabs (excluding calcined or sintered dolomite, agglomerated dolomite and broken or crushed dolomite for concrete aggregates, road metalling or railway or other ballast)	819.422	826.569	844.237	830.076	Eurostat Prodcom
SK	Dimension, dolomite	819.000	827.000	844.000	830.000	USGS (2021)
Slovenia						
SI	Dimension stone	no data	no data	14.968	-	Eurostat Prodcom
SI	Marble and travertine merely cut into rectangular or square blocks or slabs	no data	no data	14.968	-	Eurostat Prodcom
SI	Dimension stone	136.326	136.427	142.325	138.359	GSS (2018)
	. Limestone	99.541	101.991	107.630	103.054	GSS (2018)
	. Tonalite	26.995	26.746	28.544	27.428	GSS (2018)
	. Other	9.790	7.690	6.151	7.877	GSS (2018)
SI	Dimension, limestone, including tonalite	136.326	136.427	142.325	138.359	USGS (2020)

Annex H: Overview of all active metallic mineral mine sites d.d. 2017

NUTS	siteName	primary commodity	latitude	longitude	status
AT	Erzberg	iron	47° 32' 16"	14° 53' 30"	Operating
AT	Mittersill	tungsten	47° 13' 31"	12° 29' 17"	Operating
BG	Assarel Milin Kamak	copper	42° 32' 18"	24° 09' 10"	Operating
BG	Assarel Panagyurishte Mining and Processing Complex	copper	42° 32' 48"	24° 08'0 8"	Operating
BG	Chala	gold	41° 56' 20"	25° 22'0 4"	Operating
BG	Chelopech Mine Dundee Precious Metals	copper	42° 40' 9"	24° 04' 59"	Operating
BG	Dimov Dol	lead - zinc	41° 26' 24"	24° 49' 48"	Operating
BG	Djurkovo	lead - zinc	41° 46' 08"	24° 49' 04"	Operating
BG	Ellatzite	copper	42° 45' 00"	24° 01' 59"	Operating
BG	Krushev dol	lead - zinc	41° 26' 43"	24° 56' 07"	Operating
BG	Obrochishte	manganese	43° 24' 59"	28° 00' 32"	Operating
BG	Petrovitsa	lead - zinc	41° 27' 28"	24° 57' 10"	Operating
BG	Sedefche	gold	41° 31' 04"	25° 29' 57"	Operating
BG	Varba-Batantsi	lead - zinc	41° 27' 32"	24° 56' 23"	Operating
BG	Zlatograd - Marzyan-North	lead - zinc	41° 25' 10"	24° 58' 23"	Operating
BG	Zlatograd - Shumachevski dol-Androw	lead - zinc	41° 23' 24"	25° 04' 48"	Operating
CY	Skouriotissa	copper	35° 5' 59"	32° 52' 60"	Operating
CZ	Stráž pod Ralskem	uranium	50° 42' 0"	14° 48' 36"	Operating
DE	Sanierungsbetriebes Königstein	uranium	50° 55' 12"	14° 01' 48"	Operating
EL	Agios Ioannis	nickel	38° 31' 11"	23° 15' 50"	Operating
EL	Agios Ioannis	nickel	38° 29' 12"	23° 14' 49"	Operating
EL	Agios Ioannis	nickel	38° 30' 44"	23° 14' 19"	Operating
EL	Agios Ioannis	nickel	38° 33' 32"	23° 14' 35"	Operating
EL	Evoia Mines	nickel	38° 39' 52"	23° 34' 41"	Operating
EL	Evoia Mines	nickel	38° 38' 51"	23° 37' 17"	Operating
EL	Evoia Mines	nickel	38° 40' 31"	23° 36' 47"	Operating
EL	Evoia Mines	nickel	38° 39' 43"	23° 43' 57"	Operating
EL	Gkiona (13 sites)	bauxite	38° 39' 07"	22° 15' 29"	Operating
EL	Itea Mine	bauxite	38° 41' 20"	22° 15' 55"	Operating
EL	Kastorias Mines	nickel	40° 34' 15"	21° 05' 29"	Operating
EL	Kastorias Mines	nickel	40° 35' 46"	21° 05' 26"	Operating
EL	Kastorias Mines	nickel	40° 36' 36"	21° 01' 12"	Operating
EL	Madem Lakkos - Stratoni	lead - zinc	40° 31' 02"	23° 49' 45"	Operating
EL	Mount Oiti region (1 site)	bauxite	38° 51' 00"	22° 18' 00"	Operating
EL	Olympias	lead - zinc	40° 36' 04"	23° 44' 58"	Operating
EL	Parnassos	bauxite	38° 34'0 6"	22° 26' 32"	Operating
EL	Parnassos	bauxite	38° 37' 43"	22° 24' 31"	Operating
EL	Parnassos	bauxite	38° 30' 33"	22° 28' 53"	Operating
EL	Sidirolakkos	lead - zinc	40° 31' 18"	23° 47' 23"	Operating

NUTS	siteName	primary commodity	latitude	longitude	status
ES	Aguablanca mine, once	nickel	37° 57' 58"	-07° 49' 08"	Care And Maintenance
ES	Atalaya - Riotinto	copper	37° 42' 07"	-07° 23' 54"	Operating
ES	Carles Skarn	gold	43° 21' 00"	-07° 46' 00"	Care
ES	El Valle Gold Mine	gold	43° 16' 34"	-07° 41' 28"	Operating
ES	Las Cruces	copper	37° 30' 02"	-07° 54' 25"	Operating
ES	Los Santos	tungsten	40° 31' 60"	-06° 13' 60"	Operating
ES	MATSA Magdalena	copper	37° 46' 44"	-07° 14' 28"	Operating
ES	MATSA, Aguas Teñidas	copper	37° 46' 31"	-07° 08' 26"	Operating
ES	MATSA, Sotiel	copper	37° 36' 00"	-07° 09' 14"	Operating
ES	MINERA DEL DUERO (Barruecopardo)	tin	41° 02' 49"	-07° 19' 52"	Operating
ES	Penouta Mine	tin	42° 11' 08"	-8° 59' 10"	Operating
ES	San Finx Mine	tungsten	42° 45' 11"	-9° 10' 41"	Operating
FI	Jokisivu	gold	61° 07' 48"	22° 39' 36"	Operating
FI	Kaapelinkulma Gold Mine	gold	61° 14' 38"	24° 05' 10"	Operating
FI	Kemi	chromium	65° 47' 35"	24° 36' 42"	Operating
FI	Kevitsa	copper	67° 41' 53"	26° 57' 56"	Operating
FI	Kittila	gold	67° 54' 50"	25° 23' 59"	Operating
FI	Kylylahti	copper	62° 50' 58"	29° 20' 12"	Operating
FI	Laiva, Raahe	gold	64° 24' 50"	25° 8' 32"	Care and maintenance
FI	Orivesi - Kutemajärvi	gold	61° 39' 06"	24° 14' 42"	Care and maintenance
FI	Pahtavaara	gold	67° 38' 06"	26° 24' 37"	Care and maintenance
FI	Pampalo	gold	62° 58' 11"	31° 16' 47"	Operating
FI	Pyhasalmi	copper	63° 40' 60"	25° 58' 60"	Operating
FI	Rämepuro	gold	62° 54' 32"	31° 14' 53"	Operating
FI	Taivalhopea	lead - zinc	63° 56' 10"	29° 02' 17"	Operating
FI	Talvivaara - Terrafamen Sotkamon kaivos	nickel	63° 58' 00"	28° 04' 06"	Operating
HU	Bokonyoszlop	bauxite	47° 3' 54"	17° 32' 6"	Operating
HU	Feny?f? I	bauxite	47° 23' 17"	17° 48' 47"	Care and Maintenance
HU	Fenyõfõ II	bauxite	47° 23' 60"	17° 48' 0"	Care and Maintenance
HU	Nyirád Mine	bauxite	46° 58' 8"	17° 24' 58"	Care and Maintenance
IE	Lisheen	lead - zinc	52° 44' 31"	-08° 19' 46"	Care
IE	Navan Tara Mines	lead - zinc	53° 39' 20"	-07° 16' 60"	Operating

NUTS	siteName	primary commodity	latitude	longitude	status
PL	Glogow	copper	51° 40' 44"	15° 59' 49"	Operating
PL	Klucze I	lead - zinc	50° 21' 11"	19° 34' 08"	Operating
PL	Lubin-Malomice	copper	51° 26' 02"	16° 09' 29"	Operating
PL	Olkusz	lead - zinc	50° 16' 30"	19° 35' 38"	Operating
PL	Polkowice	copper	51° 30' 29"	16° 01' 12"	Operating
PL	Pomorzany	lead - zinc	50° 17' 06"	19° 31' 55"	Operating
PL	Radwanice - Gaworzyce	copper	51° 37' 26"	15° 52' 37"	Operating
PL	Rudna	copper	51° 31' 0"	16° 04' 19"	Operating
PL	Sieroszowice	copper	51° 30' 25"	16° 1' 12"	Operating
PT	Aljustrel	copper	37° 52' 29"	-9° 50' 48"	Operating
PT	Minas de Cassiterite de César de Almeida Figueiredo & Filho, Lda	tin	40° 26' 54"	-8° 9' 36"	Operating
PT	Neves-Corvo	copper	37° 34' 30"	-8° 01' 19"	Operating
PT	Panasqueira	tungsten	40° 09' 14"	-8° 15' 08"	Operating
RO	Baita Plai	copper	46° 29' 15"	22° 36' 56"	Care and Maintenance
RO	Manaila	copper	47° 35' 33"	25° 13' 16"	Operating
RO	Rosia Poieni	copper	46° 18' 53"	23° 10' 17"	Operating
SE	Bjorkdal	gold	64° 55' 57"	20° 35' 19"	Operating
SE	Boliden Copper Mine, Aitik, Sweden	copper	67° 4' 24"	20° 57' 56"	Operating
SE	Dannemora	iron	60° 12' 21"	17° 51' 38"	Care And Maintenance
SE	Garpenberg	lead - zinc	60° 19' 57"	16° 13' 40"	Operating
SE	Gruvberget	iron	67° 38' 42"	20° 59' 27"	Operating
SE	Kankberg	lead - zinc	64° 55' 16"	20° 15' 54"	Operating
SE	Kaunisvaara	iron	67° 24' 09"	23° 19' 59"	Operating
SE	Kiruna	iron	67° 50' 15"	20° 11' 09"	Operating
SE	Kristineberg	lead - zinc	65° 03' 53"	18° 33' 46"	Operating
SE	Leveäniemi	iron	67° 37' 59"	21° 01' 20"	Operating
SE	Lovisa	lead - zinc	59° 44' 53"	15° 10' 08"	Operating
SE	Malmberget	iron	67° 04' 21"	20° 57' 26"	Operating
SE	Mertainen	iron	67° 42' 23"	20° 47' 08"	Care and Maintenance
SE	Renström	lead - zinc	64° 55' 24"	20° 05' 34"	Operating
SE	Svartliden - Fäboliden Gold Mine	gold	64° 47' 06"	17° 39' 25"	Operating
SE	Zinkgruvan	lead - zinc	58° 48' 46"	15° 06' 25"	Operating
SK	Kremnica mine	gold	48° 42' 43"	18° 54' 29"	Operating

ANNEX I: ENERGY MINERALS, OVERVIEW OF PRODUCTION DATA EU-27 (2015 – 2017)

Table I.1: Production of oil & gas
(references: BGS – world mineral statistics 2008-2017, OECD_CrudeOil_Proddata, IGME, 2015-2017 (Panorama Minero), USGS Min. 2012-2016, Mining Departments of Ministries and geological surveys of Member States (MS))

Oil (Mt)	2015	2016	2017	Average
Austria	0,91	0,81	0,74	0,82
Bułgaria	0,02	0,02	0,02	0,02
Czech Republic	0,13	0,12	0,11	0,12
Germany	2,41	2,36	2,22	2,33
Greece	0,50	0,60	0,60	0,57
Spain	0,23	0,14	0,12	0,16
France	6,57	6,77	5,97	6,44
Croatia	0,61	0,68	0,68	0,66
Hungary	0,63	0,77	0,71	0,70
Italy	5,45	3,74	4,14	4,44
Lithuania	0,07	0,06	0,06	0,06
Netherlands	2,00	1,56	1,47	1,68
Poland	0,93	1,00	1,00	0,97
Romania	3,86	3,69	3,53	3,70
Slovenia	0,00	0,00	0,00	0,00
Slovakia	0,01	0,01	0,01	0,01
EU 27 total	**24,34**	**22,33**	**21,36**	**22,68**

Gas (Mm3)	2015	2016	2017	Average
Austria	1.183,00	1.253,00	1.742,00	1.392,67
Bulgaria	85,00	80,00	65,00	76,67
Czech Republik	200,00	169,00	171,00	180,00
Germany	9.323,00	8.608,00	7.932,00	8.621,00
Greece	4,00	9,00	8,00	7,00
Spain	12,00	8,00	13,00	11,00
France	28,00	28,00	28,00	28,00
Croatia	1.828,00	1.690,00	1.530,00	1.682,67
Hungary	1.872,00	1.986,00	1.605,00	1.821,00
Italy	6.880,00	6.020,00	5.650,00	6.183,33
Netherlands	52.177,00	50.373,00	43.915,00	48.821,67
Poland	5.624,00	5.493,00	5.408,00	5.508,33
Romania	11.436,00	10.090,00	13.536,00	11.687,33
Slovenia	3,00	5,00	8,00	5,33
Slovakia	104,00	87,00	88,00	93,00
EU 27 total	**90.759,00**	**85.899,00**	**81.699,00**	**86.,00**

Table I.2: Production of oil shale, coal, lignite and peat, summary

Country	Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	References
AT	Oil shale (t)	68	169	170	136	BMWFW (2016, 2017), WMD
BG	Coal	2,407	2,581	2,720	2,569	BMGK
BG	Lignite	35,900	31,200	34,400	33,833	Euracoal, USGS (2021)
CZ	Coal	7,640	6,074	4,870	6,195	BGS (2020), CGS (2019
CZ	Lignite	38,351	38,646	39,310	38,769	CGS (2019)
DE	Coal	6,223	3,849	3,669	4,580	BGR (2016, 2017), WMD
DE	Lignite	178,064	171,547	171,286	173,632	BGR (2016, 2017), BGS (2020), Euracoal, WMD
EE	Peat (Fuel)	0,089	0,089	0,013	0,06	USGS (2020)
EE	Oil shale	14,908	12,69	15,63	14,41	EESTI Energia (2019), ESD
EL	Lignite	46,308	32,675	37,803	38,929	BGS (2020), Euracoal, WMD, Ypeka
ES	Coal	3,042	1,832	2,995	2,623	BGS (2020), Panorama Minero (2017)
FI	Peat (Fuel)	9,638	8,287	8,366	8,764	SVT (2019)
HU	Coal	0,006	0,001	0,001	0,002	BGS (2020)
HU	Lignite	9,257	9,232	7,973	8,821	BGS (2020), Euracoal, WMD
IE	Peat (Fuel)	0,769	0,679	0,744	0,731	Energy by Fuel
IT	Coal	0,073	0,059	0,047	0,060	WMD
LT	Peat (Fuel)	0,074	0,017	0,024	0,04	USGS (2018)
LV	Peat (Fuel)	0,049	0,033	0,040	0,041	Krigere (2019)
PL	Coal	72,686	70,784	65,967	69,812	BGS (2020)
PL	Lignite	63,140	60,270	63,060	62,157	PGI website browncoal
RO	Coal	1,419	1,069	0,784	1,091	BGS (2020)
RO	Lignite	25,425	22,157	25,232	24,271	BGS (2020)
SE	Peat (Fuel)	0,992	1,239	0,957	1,063	SGU (2020)
SK	Lignite	1,733	1,817	1,675	1,742	BGS (2020)
SI	Lignite	3,168	3,349	3,356	3,291	BGS (2020), WMD

Table I.3: Production of oil shale, coal, lignite and peat, overall dataset

Country	Commodity	2015 Mt*	2016 Mt*	2017 Mt*	Average Mt*	References
Austria						
AT	Shale oil (t)	68	169	no data	-	BMWFW (2016, 2017), BMLRT (2020)
AT	Shale oil (t)	68	55	55	59	USGS (2021)
AT	Shale oil (t)	68	169	170	136	WMD
Bulgaria						
BG	Coal	2,165	2,140	2,452	2,252	BGS (2020)
BG	Coal	2,407	2,581	2,720	2,569	BMGK
BG	Coal	no data	no data	no data	-	Euracoal
BG	Coal	2,07	no data	no data	-	USGS (2021)
BG	Coal					
BG	Coking coal	no data	no data	no data	no data	WMD
BG	Coal (steam coal)	0,01	0,01	0,00	-	WMD
BG	Lignite	33,773	29,294	32,137	31,735	BGS (2020)
BG	Lignite	no data	no data	no data	-	BMGK
BG	Lignite	35,900	31,200	34,400	33,833	Euracoal
BG	Lignite	35,863	31,229	34,412	33,835	USGS (2021)
BG	Lignite	35,938	31,434	34,588	33,987	WMD
Czech Republic						
CZ	Coal	7,640	6,074	4,870	6,195	BGS (2020)
CZ	Coal	7,640	6,074	4,870	6,195	CGS (2019)
CZ	Coal	8,200	6,800	5,500	6,833	Euracoal
CZ	Coal	3,951	2,855	2,289	3,032	USGS (2021)
CZ	Coal (sum)	7,512	5,957	5,066	6,178	
CZ	Coal (steam coal)	3,756	2,979	2,533	3,089	WMD
CZ	Coal (coking coal)	3,756	2,979	2,533	3,089	WMD
CZ	Lignite	38,251	38,646	39,310	38,736	BGS (2020)
CZ	Lignite	38,351	38,646	39,310	38,769	CGS (2019)
CZ	Lignite	38,100	38,500	39,300	38,633	Euracoal
CZ	Lignite	38,251	38,646	39,310	38,736	USGS (2021)
CZ	Lignite	38,251	38,646	39,310	38,736	WMD
Germany						
DE	Coal	6,223	3,849	3,669	4,580	BGR (2016, 2017)
DE	Coal	6,650	4,079	3,840	4,856	BGS (2020)
DE	Coal	6,700	4,100	3,900	4,900	Euracoal
DE	Coal	6,650	4,079	3,840	4,856	USGS (2021)
DE	Coal (sum)	6,223	3,849	3,669	4,580	WMD
DE	Coal (steam coal)	2,627	1,807	1,483	1,972	WMD
DE	Coal (coking coal)	3,596	2,042	2,185	2,608	WMD
DE	Lignite	178,064	171,547	171,286	173,632	BGR (2016, 2017)
DE	Lignite	178,065	171,547	171,286	173,633	BGS (2020)
DE	Lignite	178,100	171,500	171,300	173,633	Euracoal
DE	Lignite	178,178	171,545	171,286	173,670	USGS (2021)
DE	Lignite	178,065	171,552	171,286	173,634	WMD
DE	Peat		only for horticultural use			USGS, Industrieverband Garten e.V.
Denmark						
DK	Peat	0,04	0,04	0,03	0,04	Statistics Denmark
DK	Peat	no data	no data	no data	-	USGS (2018)
DK	Peat		only for horticultural use			Stenild et al. (2010)

Annex I: Energy minerals, overview of production data eu-27 (2015 – 2017)

Country	Commodity	2015 Mt*	2016 Mt*	2017 Mt*	Average Mt*	References
Estonia						
EE	Peat	0,716	0,517	0,677	0,637	ESD
EE	Peat	0,716	0,517	0,645	0,626	Niitlaan et al. (2019)
EE	Peat	0,809	0,872	0,942	0,87	
EE	Fuel	0,089	0,089	0,013	0,06	USGS (2020)
EE	Horticultural	0,720	0,783	0,929	0,81	USGS (2020)
EE	Shale oil	14,908	12,69	15,63	14,41	EESTI Energia (2019)
EE	Shale oil	14,908	12,69	15,63	14,41	ESD
EE	Shale oil	19,616	15,76	21,63	19,00	USGS (2021)
EE	Shale oil	19,616	15,76	21,63	19,00	WMD
Greece						
EL	Lignite	46,308	32,675	37,803	38,929	BGS (2020)
EL	Lignite	45,400	32,600	37,700	38,567	Euracoal
EL	Lignite	46,308	32,675	no data	-	USGS (2019)
EL	Lignite	46,308	32,675	37,803	38,929	WMD
EL	Lignite	46,308	32,675	37,803	38,929	Ypeka
Spain						
ES	Coal	3,042	1,832	2,995		BGS (2020)
ES	Anthracite	1,113	0,736	0,370		BGS (2020)
ES	Bituminous	0,610	0,366	0,791		BGS (2020)
ES	Sub-bituminous	1,319	0,730	1,833		BGS (2020)
ES	Coal	3,000	1,700	2,800	2,500	Euracoal
ES	Coal	3,042	1,832	no data	-	Panoram Minero (2017)
ES	Coal	3,043	1,742	2,781	2,522	Statista
ES	Coal (sum)					WMD
ES	Coal (steam coal)	1,557	1,102	1,162	1,274	WMD
ES	Coal (coking coal)	no data	no data	no data	-	WMD
Finland						
FI	Peat (Fuel) (1000 m³)	10.945	9.411	9.500	9.952	SVT (2019)
FI	Peat (Fuel) (converted)	9,638	8,287	8,366	8,764	
FI	Peat	10,647	10,953	10,400	10,667	USGS (2021)
FI	Fuel	9,634	9,907	9,410	9,65	USGS (2021)
FI	Horticultural	1,01	1,05	0,97	1,01	USGS (2021)
Hungary						
HU	Coal bituminous	0,006	0,001	0,001	0,002	BGS (2020)
HU	Lignite	9,257	9,232	7,973	8,821	BGS (2020)
HU	Lignite	9,095	9,164	7,890	8,716	BGS (2020)
HU	Brown coal	0,162	0,068	0,083	0,105	BGS (2020)
HU	Lignite	9,300	9,200	8,000	8,833	Euracoal
HU	Lignite	9,263	9,233	7,973	8,823	WMD
Ireland						
IE	Peat	0,769	0,679	0,744	0,731	Energy by Fuel
IE	Peat (Fuel)	3,138	2,779	3,590	3,169	USGS (2018)

Country	Commodity	2015 Mt*	2016 Mt*	2017 Mt*	Average Mt*	References
Italy						
IT	Coal	no data	no data	no data	-	BGS (2020)
IT	Coal	no data	no data	no data	-	Euracoal
IT	Coal	no data	no data	no data	-	USGS (2021)
IT	Coal (sum)					WMD
IT	Coal (steam coal)	0,073	0,059	0,047	0,060	WMD
IT	Coal (coking coal)	no data	no data	no data	-	WMD
Lithuania						
LT	Peat	0,553	0,386	0,418	0,452	USGS (2018)
LT	Fuel	0,074	0,017	0,024	0,04	USGS (2018)
LT	Horticultural	0,479	0,369	0,394	0,414	USGS (2018)
LT	Peat (1000 m³)	3.180	2.350	2.507	2.679	Kavaliauskas (2019)
LT	Peat (converted)	2,800	2,069	2,208	2,359	
Latvia						
LV	Peat	1,222	0,813	1,000	1,012	Krigere (2019)
LV	Peat (fuel: 4%)	0,049	0,033	0,040	0,040	Krigere (2019)
LV	Peat (Fuel & Horticultural)	1,805	1,767	2,000	1,857	USGS (2018)
Poland						
PL	Coal (sum)	72,686	70,784	65,967	69,812	
PL	Cooking coal	12,985	13,204	12,482	12,482	BGS (2020)
PL	Other bituminous coal	59,701	57,580	53,485	53,485	BGS (2020)
PL	Coal	72,700	70,400	65,500	69,533	Euracoal
PL	Coal (hardcoal)	65,070	66,480	56,820	62,790	PGI website hardcoal
PL	Coal (sum)	72,176	70,385	65,379	69,313	WMD
PL	Coal (steam coal)	59,191	57,181	52,999	56,457	WMD
PL	Coal (coking coal)	12,985	13,204	12,380	12,856	WMD
PL	Lignite	63,135	60,273	63,060	62,156	BGS (2020)
PL	Lignite	63,100	60,200	65,500	62,933	Euracoal
PL	Lignite	63,140	60,270	63,060	62,157	PGI website browncoal
PL	Lignite	63,135	60,273	63,060	62,156	WMD
PL	Peat (Fuel & Horticultural)	0,88	0,91	0,68	0,82	USGS (2018)
Romania						
RO	Coal (anthracite & bitumin	1,419	1,069	0,784	1,091	BGS (2020)
RO	Coal	1,300	no data	no data		Euracoal
RO	Coal (sum)					WMD
RO	Coal (steam coal)	0,010	0	0		WMD
RO	Coal (coking coal)	no data	no data	no data		WMD
RO	Lignite	25,425	22,157	25,232	24,271	BGS (2020)
RO	Lignite	24,000	23,000	25,700	24,233	Euracoal
RO	Lignite	25,492	22,980	25,752	24,741	WMD
Sweden						
SE	Peat (Fuel) (1000 m³)	1.127	1,407	1,087	376	SCB (2020)
SE	Peat (converted)	0,992	1,239	0,957	1,063	
SE	Peat	2,107	2,716	2,421	2,415	USGS (2018)
SE	Fuel	0,992	1,240	0,957	1,063	USGS (2018)
SE	Horticultural	1,115	1,476	1,464	1,352	USGS (2018)

Country	Commodity	2015 Mt*	2016 Mt*	2017 Mt*	Average Mt*	References
Slovakia						
SK	Lignite	1,733	1,817	1,675	1,742	BGS (2020)
SK	Lignite	0,097	0,195	0,056	0,116	
SK	Brown coal	1,636	1,622	1,619	1,626	
SK	Lignite	1,800	1,800	1,800	1,800	Euracoal
SK	Lignite	1,941	1,957	1,861	1,919	WMD
Slovenia						
SI	Lignite	3,168	3,349	3,356	3,291	BGS (2020)
SI	Lignite	3,200	3,300	3,400	3,300	Euracoal
SI	Lignite	3,168	3,349	3,356	3,291	WMD

Table I.4: Number of production sites for coal and lignite

Country	Commodity	number of production sites					Reference
		Alves Dias et al. (2018) 2015	2015	2016	2017	JRC (2021) 2018	
BG	Coal	8					
BG	Lignite	4				13	
CZ	Coal	3	8	8	7	3	CGS (2019)
CZ	Lignite	6	9	10	10	5	CGS (2019)
DE	Coal	2	3	2	no data	2	BMWE (2016; 2018)
DE	Lignite	10	13	12	no data	10	BMWE (2016; 2018)
EL	Lignite	9				6	
ES	Coal	26	21	16		10	Panorama Minero
HU	Coal		1	1	1		HGS (2019)
HU	Lignite	2	7	7	7	2	HGS (2019)
IT	Coal	1				1	
PL	Coal	31	51	50	50	19	PIG-PIB (2016, 2017, 20
PL	Lignite	4	9	9	8	5	PIG-PIB (2016, 2017, 20
RO	Coal	6				4	
RO	Lignite	1				6	
SI	Lignite	1	1	1	1	1	Statista website
SK	Lignite	4				3	

Table I.5: Number of production sites for peat

Country	Commodity	number of production sites			Reference	JRC (2021)
		2015	2016	2017		2018
EE	Peat		266		Niitlaan (2017)	26
FI	Peat					606
IE	Peat					3
LT	Peat		68		Januska (2016)	8
LV	Peat		96		Krigere (2017)	3
SE	Peat	84	79	63	SGU (2018)	40*

ANNEX J: POLAND, EXAMPLE OF AN ALTERNATIVE APPROACH TO REPORT DATA ON EXTRACTIVE WASTE

→ Data collection

In Poland, different sources of data for extractive waste were identified. The main sources are:

1. the Polish Geological Institute which hosts;
   - the MIDAS database providing access to information on 1) mineral deposits, 2) mining areas and mining countries as well as related concessions, and 3) mineral resources management (http://geoportal.pgi.gov.pl/portal/page/portal/midas).
   - the Polish Central Geological Database https://www.pgi.gov.pl/en/data-bases.html, and
   - Corporate Social Responsibility reports of individual mining companies.
2. the Polish Industrial Development Agency (IDA) collecting data on total mining and sale of coal and stocks of hard coal over time.
3. Provincial (voivodship) reports – Waste management database.

In addition, companies in Poland report information on generated waste to the regional database and nowadays also to the central national database. The information includes waste generated, the management of the various types of waste, detailed recovery and disposal methods, permits for collection, transport, recovery or disposal of waste and waste management plans and reporting. The type and scope of waste reporting is regulated by the Regulation of the Minister of the Environment. The scope of information is presented in Figure H1. The most detailed official data come from provincial reports, in which data are reported according to the waste codes for mining companies in Poland (Table H1).

Section 2. Summary of data on types and amounts of waste generated

No	Waste code		Waste type 13)	Mass of waste generated (Mg)	
				mass of waste	dry mass of waste

Section 9. Summary of data on extractive waste treatment facilities

<table>
<tr><th colspan="6">General information</th></tr>
<tr><td rowspan="4">1</td><th colspan="5">Address of waste treatment facility</th></tr>
<tr><td colspan="5">Name of waste treatment facility</td></tr>
<tr><td>Voivodship</td><td>District</td><td>City</td><td>Phone</td><td>Fax</td></tr>
<tr><td colspan="2">Street</td><td>House no</td><td>Apartment no</td><td>Zip code</td></tr>
<tr><td rowspan="2">2</td><th colspan="5">Address of the owner of the facility</th></tr>
<tr><td colspan="5">Name of authority managing extractive waste treatment facility</td></tr>
</table>

Figure H1: Extract from the Regulation of the Minister of the Environment on the scope of information and model forms for the preparation and submission of collective waste data statements covering information on code of waste, type of waste, volume of waste (T) in mass and in dry mass, and additional information on detailed addresses of waste facilities and owner of waste, etc.

Table H1: Waste generated during the extraction of aggregates, other construction minerals, industrial minerals and energy minerals in Poland according code of waste (in million tons)

Waste code	Waste name	2000	2010	2017
Chapter 01 01	**Waste from mineral excavation**	**2,4**	**3,2**	**7,7**
01 01 02	Waste from mineral non-metalliferous excavation	2,3	3,0	7,6
Chapter 01 02	Waste from pre-treatment of extracted ore	1,1	Na	Na
01 02 02	Waste from pre-treatment of ores of other raw materials not containing metals	1,0	Na	Na
Chapter 01 04	**Wastes from physical and chemical processing of non-metalliferous minerals**	**41,8**	**29,6**	**21,5**
01 04 01	Crushed rocks	2,6		
01 04 02	Waste sand and clays	1,0		
01 04 03	Waste with the consistency of dusts and powders	0,0		
01 04 05	Wastes and sludges arising during rinsing and cleaning of mineral raw materials	0,4		
01 04 06	Wastes generated during cutting, rinsing and processing of rocks and minerals	0,0		
01 04 07	processing wastes from coal enrichment	35,4		
01 04 08	Waste from coal floatation/waste gravel and crushed rocks other than those mentioned in 01 04 07	2,1	0,2	1,0
01 04 09	Waste from floatation enrichment of sulfur ores/waste sand and clays	Na	0,0	0,0
01 04 10	Dusty and powdery wastes other than those mentioned in 01 04 07	Na	0,0	0,0
01 04 12	Tailings and other waste from washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11	Na	27,8	19,4
01 04 13	Waste from stone cutting and sawing other than those mentioned in 01 04 07	Na	0,0	0,0
01 04 81	Waste from coal flotation enrichment	Na	1,4	1,1
01 04 99	Waste not otherwise specified	0,2	0,0	0,0
Chapter 01 05	**Drilling muds and other drilling wastes**	**0,0**	**0,1**	**0,0**
01 05 08	Chloride-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06	0,0	0,1	0,0

According to data of the Polish Central Statistical Office (GUS, 2017) 140 Mt of waste was generated in Poland in 2016, out of which 52% constituted waste from the mining and quarrying industry, 21% from industrial processing, and 16% from the generation and provision of electricity. In 2016, approximately 56% constituted waste generated during the exploration, extraction, physical and chemical processing of ores and other minerals (22% waste from thermal processes).

An illustration of the waste notification form, excluding municipal waste, applied by the Polish Central Statistical Office is given below (Figure H2). Every year, each company has to fill in this form according to the type of waste in accordance with the waste code and sections of the Polish Classification of Activities.

In 2017, a total amount of 128,307 Mt of waste associated with the domestic mining industry was generated in Poland distributed to the types:

- 25.0%, waste generated by washing and cleaning minerals,
- 24.0%, industrial waste, not mentioned,
- 24.3%, waste from floatation dressing of nonferrous metal ores,
- 8.9%, dust-slag compounds from wet treatment of furnace waste,
- 5.8%, soil and stones,
- 4.9%, waste from non-metalliferous mineral excavation,
- 2.5%, coal fly-ash,
- 2.5%, wastes from the processing of slag,
- 2.3% dust-slag compounds from wet treatment of furnace waste.

→ **Data evaluation**

During the collection of data regarding waste generation the following problems were identified:

1. The waste code covers both coal and other non-metallic minerals – it is difficult or impossible to separate data for individual minerals.
2. The waste codes do not separate waste from primary and secondary production – it is difficult to derive the volume of waste from the volume of extraction. Data on the volume of extraction from all individual deposits and the volume of total extraction in Poland differs by approximately 15% (probably due to secondary production of coal from old dumps).
3. It is possible to obtain information for companies (perhaps operating many mines) , but not on waste for individual deposits or mines (one mine may extract from several deposits).
4. Mining (about 20%) and processing waste are deposited on heaps close to the mine or a central one. A significant part of the waste is used to fill natural or anthropogenic voids and used for land rehabilitation. Some of it is used as aggregates and material for construction and building industry.
5. Some waste from processing – i.e. Haldex company 460 473 t, Barosz – Gwimet Sp. Z o.o. – 9 438 t, BM Recykling Sp. Z o.o. – 49 308 t – has also been (mis-)reported under code 010102 as waste from the extractive industry.
6. The most detailed data based on provincial reports collate data for each entity within the group – i.e. PGNiG Capital Group (oil and gas producer) includes PGNiG SA and 33 subsidiaries located in different parts of Poland (different province), as data on waste are reported in the province where waste is generated; thus to obtain a complete data-set for individual minerals is onerous.

Figure H2: Example of waste notification form (not including municipal waste), applied by the polish central statistical office (gus)

GŁÓWNY URZĄD STATYSTYCZNY, al. Niepodległości 208, 00-925 Warszawa ***www.stat.gov.pl***

Name and address of the reporting entity	**OS-6** **Waste report** **(excluding municipal waste)**	GUS reporting portal portal.stat.gov.pl Urząd Statystyczny 40-158 Katowice ul. Owocowa 3
Identification number - REGON	**za rok 2018**	Deadline for submission: January 29, 2019

The obligation to provide data results from Art. 30 sec. 1 point 3 of the Act of June 29, 1995 on Public Statistics (Journal of Laws of 2018, item 997, as amended).

(e-mail of the secretariat of the reporting unit - FILL IN IN CAPITAL LETTERS)

Location of the plant (specify the location of the waste production plant and not the adress of the company, in the case of waste storage only, the place of waste storage)

Location of the plant	**Symbols entered in the Tax Office**
Voivodeship:	
District:	
Community:	
City:	
Polish Classification of Activities - **PKD 2007:**	

Section 1. Types and amount of waste in thousands of tons (decimal places: 1)

Annex J: Poland, example of an alternative approach to report data on extractive waste

	Waste types (see "Explanations")	Waste codes (see "Explanations")	Waste generated during the year														Waste previously stored (accumulated) in own facilities (c) (as at the end of the year)
			Total (columns 3 + 7 + 11 + 15)	**recovered** in house				**conditioned** in house				transferred to other recipients				temporarily stored	
				subtotal (columns 4 + 5 + 6)	composted	filling own and other excavations	in a different way (*a*)	subtotal (columns 8+9+10)	thermally	stored in own facilities	in a different way (b)	subtotal	for the recovery	for disposal			
														subtotal	incl. stored in facilities (c)		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
01	**TOTAL** (lines 2 – 30)																
02																	
......																	
29																	
30																	
31	From line 01 **„TOTAL"** amount for waste	stored during the year in **ponds**															
32		stored in **landfills, mining waste treatment facilities (including heaps)**															
33		accumulated in own ponds – as at the end of the year (from column 16)															
34		filling own excavations (from column 5)															
35	Waste recovered on site or / and transferred to other facilities from previously stored (accumulated) in landfills, mining waste treatment facilities (including heaps, ponds) by January 1, 2018.																

a) In the "Comments" part of the form, the applied waste recovery process should be shown using the symbols "R" according to Annex 1 to the Act of December 14, 2012 on waste (Journal of Laws of 2013, item 21, as amended). b) In the "Remarks" part of the form, the symbol of the waste disposal process should be indicated using the symbols "D" according to Annex 2 to the Act of 14 December 2012 on waste (Journal of Laws of 2013, item 21, as amended), c) On landfills, mining waste treatment facilities (including heaps, sediment basins)

ANNEX K: EXAMPLE OF THE POLISH WASTE CLASSIFICATION RELATED TO (SHALE) GAS EXPLORATION

As an example for the possible classification of such oil and gas drilling waste the Polish procedure (PIG-PIB, Gospodarka odpadami – część I (Waste Management – part I), https://infolupki.pgi.gov.pl/pl/srodowisko/gospodarka-odpadami-czesc-1-0) during shale gas exploration and assessment is given described. The following types of wastes were generated:

- drill cuttings,
- used scrubber,
- post-treatment fluid from fracturing (so-called flowback),
- reservoir waters,

and are classified according to the Polish waste catalogue (Journal of Laws No. 112, item 1206) into group 01 05 - Drilling muds and other drilling wastes, including two hazardous waste groups: 01 05 05 * petroleum-containing drilling muds and wastes and 01 05 06 * drilling muds and wastes containing dangerous substances petroleum-containing drilling muds and wastes.

It has been estimated that the average amount of waste (drilling mud and drill cuttings) generated by drilling one exploration hole is between 2,500 and 6,000 tons (the average for the period 2010-2012 is 2,442 tons of 01 05 waste generated per one exploration hole).
The amount of generated waste and its properties vary for each hole and depend on the following factors:

- hole depth and structure,
- the type of rocks drilled,
- drilling technology,
- type of scrubber and method of scrubber management,
- treatments performed (e.g. hydraulic fracturing).

The process of reservoir stimulation (e.g. hydraulic fracturing) also produces specific waste. Their number and properties are difficult to estimate due to the large number of determining factors. Forecasting the amount of waste generated during the exploration and recognition of shale gas deposits is difficult.

However some indicator for waste (e.g. for exploration activities - waste for 1 m of drilling, and for mining activities - drilling waste in relation to the waste in general) can be obtained from literature and companies reporting. Based on example of the PGNiG Group, which is the largest Polish enterprise engaged in the exploration and production of natural gas and crude oil, the biggest amount of waste from extraction industry was generated during exploitation phase under the waste code 010102) and processing - drilling muds and waste with codes 01 05 08, 01 05 07, and in some cases 01 05 05*.. Drilled out rock chips are separated from the drilling fluid by vibrating sieves and other means such as desanders and mud removers. Drilling fluid waste is generated during the replacement of one circulation fluid with another type, if there is a need for a change in technology, or when drilling is completed and the drilling fluid is not needed anymore (PGNiG, 2014).

Thanks to the introduction of new technologies, as well as the use of ecological materials and products, the amount of generated waste can be minimised. The amounts of generated waste in a given period depend on the exploration and production work carried out, as well as the types of investments and modernization works carried out in enterprises. Extractive waste management in PGNiG is about 100 000 tons whereas production is about 1 200 000 tons of oil and 4,5 milliard m3 of gas. The management of extractive waste by PGNiG is presented in Table K.1.

Table K.1: Extractive waste management in PGNiG Group (PGNiG, 2019)

Extractive waste 2019		Stored in disposal facilities [t]	Recovered [t]	Disposed [t]	Reused [t]	Stored [t]	Stored in the rock mass [t]
Hazardous waste	PGNiG Capital Group	-	2 380,4	25,9	-	-	-
	Of which PGNiG	-	2 380,4	25,9	-	-	-
Non-hazardous waste	PGNiG Capital Group	748,1	85 349,9	20 571,3	-	990,6	11 139,5
	Of which PGNiG	-	80 700,6	10 417,6	-	149,1	11 139,5

Extractive waste is generated mainly during exploration and exploitation drilling, which constituted for PGNiG about 80% of waste (PGNiG, 2019).

Therefore, focus was given to waste data and the so-called drilling related indicator which represents the ratio of drilling waste in relation to the waste in general. More detailed data were presented by the State Geological Institute in Poland based on data about shale gas exploration drilling in last 10 years. The type of waste generated in each phase of production during shale gas exploration drilling is presented in Figure K1.

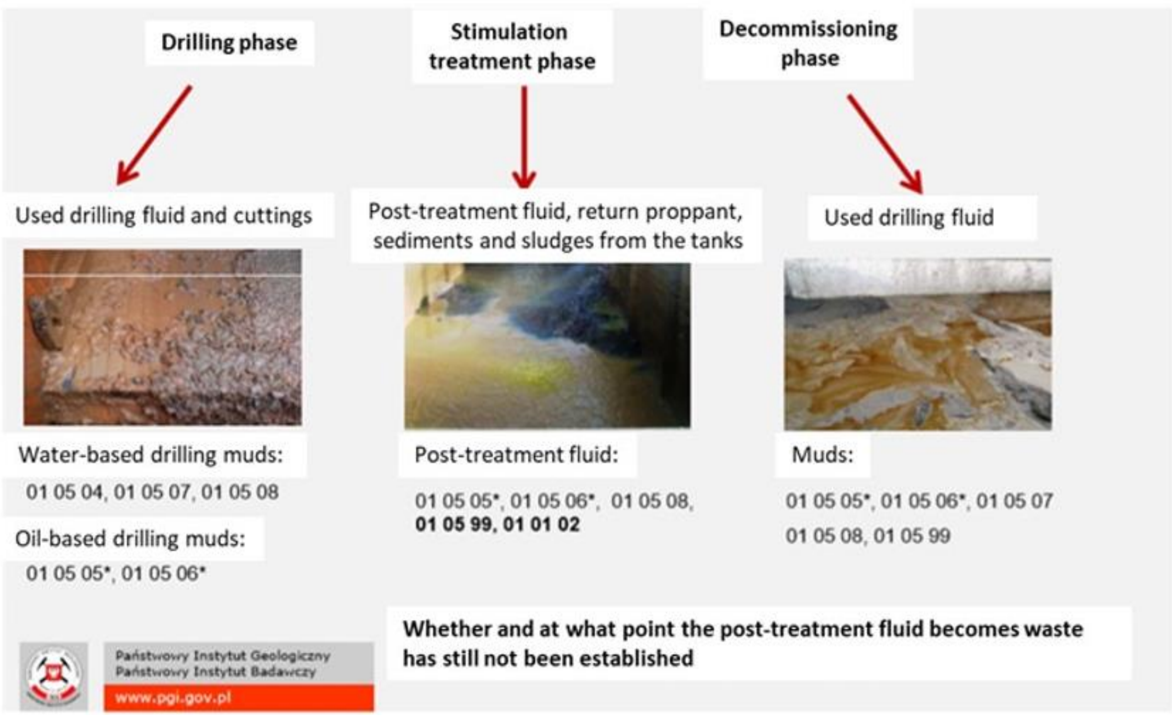

Figure K.1: Extractive waste from exploration drilling

Waste from shale gas exploration . The amount of waste (drilling muds and other drilling wastes) per drilling, generated in the 01 05 subgroup in 2010-2012, is shown in Figure K.2 (Starzycka, 2014). According to Macuda and Starzycka (2013) there were 2442 tons of extractive waste per 1 whole in Poland in 2010-2012, and about 0,65 tons per 1 m of drilling.

Figure K.2: Overview of the amount of waste generated in the 01 05 subgroup in 2010-2012 per dilling (drilling muds and other drilling wastes)

ANNEX L: ESTIMATED AMOUNTS OF MINE WASTE FROM METALLIC MINERAL PRODUCTION

The following table presents the results of the calculations for the amounts and the categories of extractive waste for each active mine in EU-27 and which category of the extractive waste facility would typically be expected to accommodate these wastes. The table is structured by MS and identifies each active metal mine by name, mine layout (U for underground and O for open-pit), and main commodity product. The material streams that are presented are the following:

1. The *Total excavated material :* that is the volume generated in order to access and extract valuable mineral resources, which was assumed to equal the sum of the streams *Rock* and *Ore* (see below)
2. The *Rock* stream: This term is used for the purposes of the current study as an "umbrella" to cover three material streams:

   (a) Overburden: this is (according to Garbarino et al., 2018) "The material that extractive operations move during the process of accessing an ore or mineral body, including during the pre-production development stage: layer of natural soil or massive rock on top of an orebody"
   (b) Waste-rock: this is (according to Garbarino et al., 2018) "The material that extractive operations move during the process of accessing an ore or mineral body, including during the pre-production development stage: part of the orebody, without or with low grades of ore, which cannot be mined and processed profitably"
   (c) Gangue: this is (according to Garbarino et al., 2018) "The part of an ore that is not economically desirable but cannot be avoided in mining"

   The *Rock stream* is the amount of excavated material that are left over after accessing and extracting the *Ore* stream from the *Total excavated material*. This stream in some cases is not considered as a waste stream but as a material which partly or total may by utilised by the sector for (a) filling the excavation voids for rehabilitation and construction purposes, (b) construction purposes outside the mine, and (c) landscaping use. It is unclear which percentage of rock may be fed to EWFs and which is utilised for the aforementioned uses. For this reason the Rock stream is presented as the amount that was initially intended to be mined, without characterizing it as waste or non-waste.
3. The *Ore stream*: this is (according to Garbarino et al., 2018) "Mineral or variety of accumulated minerals of sufficient value as to quality and quantity that it/they may be mined at a profit. Most ores are mixtures of extractable minerals and extraneous rocky material described as gangue". For the purposes of the present study it is assumed that the ore stream is equal to the sum of the streams Concentrate, By-product and Tailings (see below)
4. The *Concentrate* stream : this is (according to Garbarino et al., 2018) "Marketable product after separation in a mineral processing plant with an increased grade of the valuable mineral."
5. The secondary concentrate stream: there are cases such as in the mixed sulfide oxide ores, which are treated using two or more distinct circuits and produced a corresponding number of concentrates. So this stream presents the secondary commodity of marketable products including concentrates of additional valuable minerals
6. The *Tailings*: this is (according to Garbarino et al., 2018) "The waste solids or slurries that remain after the treatment of minerals by separation processes (e.g. crushing, grinding, size-sorting, flotation, and other physicochemical techniques) to remove the valuable minerals

from the less valuable rock. For the purposes of the present study, it is assumed that the tailings are the remaining material after the beneficiation process that leads to the production of *Concentrate* and *By-product* from *Ore stream*.

As it is explained in Chapter 3.2.5 the rock stream in some cases is not considered as a waste stream but as a material which partly or totaly may be utilized by the sector for (a) filling the excavation voids for rehabilitation and construction purposes, (b) construction purposes outside the mine and (c) landscaping use. It is unclear which percentage of rock may be led to EWFs as waste and which is utilized for the aforementioned uses. For this reason the *Rock stream* is presented as the amount that was initially intended to be mined, without characterizing it as waste or non-waste.

On the other hand, the Decision 2014/955/EU (List of Waste; EC, 2014a) considers the stream from mineral excavation as non-hazardous waste. Therefore, if hypothetically the *Rock stream* was considered as waste, then it would be assigned to the non-hazardous waste code. As far as the tailings stream is considered they are assigned with waste codes taking into consideration bibliographic data which may render the tailings stream (according to data related to the main commodity) as hazardous.

The investigation continues, by presenting the expected extractive waste facilities (EWF) in operation per mine specified in Category A facilities (CAF) and non-Category A facilities (non-CAF). Data were prepared based on the assumption that a given waste facility receives only waste from one mine. Assessment of the potential failure of existing EWFs due to loss of structural integrity or incorrect operation could not be performed by desk research alone, because no centralized database describing the structural stability of each and every EWF could be made available to this study. As a consequence, this study is focusing on the second criterion of the Decision 2009/337/EC (EC, 2009c), which concerns if the EWF contains waste classified as hazardous under Directive 91/689/EEC (EC, 1991) above a certain threshold

Table L.1: Presentation of the data collection results for the ore production and the concentrate production and the calculations for the production of the Rock stream, the Tailings stream, the classification of the tailings according to the List of Waste and the possible EWF that may accommodate these tailings

MS	Mine Name	Primary Commodity	Mine Type	From the Data Collection Process						Average Ore production 2015-2017 (t)	Estimates (based on operators information, experience of the consulting team and literature review) Rock = Stripping Ratio * Average Ore Production Total Excavated Material = Rock + Average Ore Production Tailings = Average Ore Production – Concentrate – By-Products (process)					
				Ore (t) 2015	Ore (t) 2016	Ore (t) 2017	Concentrate Average 2015-2017 (t)	Secondary Concentrate	Secondary Concentrate (t)		Stripping Ratio	Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings Waste code	EWF
AT	Erzberg36	Fe	O	3,844,900	3,616,800	3,772,400	2,840,933	Aggregates	26,166	3,744,700	2.0	7,688,548	11,433,248	877,601	010306	Non CAF
AT	Mittersill37	W	U	535,762	515,172	526,512	4,113	Aggregates	335,515	525,815	0.01	6,620	525,815	381,702	010306	Non CAF
BG	Assarel Panagyurishte Mining and Processing Complex38	Cu	O	13,000,000	13,000,000	13,000,000	4,405,633	Cu	5,742	13,000,000	3.0	39,000,000	52,000,000	8,588,625	01 03 04*	CAF
BG	Chelopech39	Cu	U	2,052,138	2,200,000	2,000,000	20,825	Au, Ag	27	2,084,046	0.5	1,042,023	3,126,069	2,063,194	01 03 04*	CAF
BG	Ellatzite40	Cu	O	10,800,000	10,800,000	10,800,000	178,000	Cu	232	10,800,000	3.0	33,200,000	44,000,000	10,621,768	01 03 04*	CAF
BG	Obrochishte41	Mn	U	n.d.	n.d.	n.d.	30,284	-	0	82,200	0.5	41,100	123,300	51,916	01 03 06	Non CAF
BG	Sedefche42	Au	U	n.d.	n.d.	n.d.	7	Au, Ag	25	1,908,214	0.5	954,107	2,862,321	1,908,182	01 03 04*	CAF
BG	Assarel Milin Kamak	Au	U	n.d.	n.d.	n.d.	7	Au, Ag	25	1,908,214	0.5	954,107	2,862,321	1,908,182	01 03 04*	CAF
BG	Yuzna Petrovitsa	Zn	U												01 03 04*	CAF
BG	Shumacheski Dol-Androu	Zn	U	346,750	346,750	346,750	9,412	Pb, Zn	9,788	346,750	0.5	173,375	520,125	327,550	01 03 04*	CAF
BG	Marzyan North	Zn	U												01 03 04*	CAF
BG	Dimov Dol	Zn	U	n.d.	n.d.	n.d.	3,725	Pb, Zn	5,588	117,592	0.5	58,796	176,388	108,278	01 03 04*	CAF
BG	Petrovitsa43	Zn	U												01 03 04*	CAF
BG	Crushev Dol	Zn	U	358,800	358,800	358,800	12,941	Pb, Zn	13,459	358,800	0.5	179,400	538,200	332,400	01 03 04*	CAF
BG	Varba-Batantsi	Zn	U												01 03 04*	CAF
BG	Chala	Zn	U	n.d.	n.d.	n.d.	10,784	Pb, Au	11,216	340,397	0.5	170,198	510,595	318,397	01 03 04*	CAF
CY	Skouriotissa44	Cu	-	1,133,059	791,332	778,572	493,333	-	0	900,988	-	456,023	1,357,011	407,654	01 03 04*	CAF
DE	Stade[45]	Al	-	-	-	-	1,000,000	-	-	2,100,000	-	-	2,100,000	1,100,000	01 03 09	Non CAF
EL	Mount Oiti region (1 site) 46	Al	U	0	0	0	0	-	0	0	0.5	0	0	0	n.a.	n.a.
EL	Gkiona (13 sites)47	Al	U	1,217,953	1,277,616	1,080,250	1,191,940	-	0	1,191,940	0.5	595,970	1,787,910	0	n.a.	n.a.
EL	Mount Parnassos region 48	Al	I	649,365	629,742	630,093	636,400	-	0	636,400	0.5	318,200	954,600	0	n.a.	n.a.
EL	Olympias 49	Pb	U	0	0	69,633	12,938	As-Au	4,733	69,633	0.5	34,817	104,450	51,962	01 03 06	CAF
EL	Greece Mavres – Petres (Stratoni)50	Pb	U	161,048	202,314	157,425	13,090	Zn	29,110	173,596	0.5	86,798	260,394	131,396	01 03 06	CAF
EL	Greece Evoia island (4 sites)	Ni	O	n.d.	n.d.	1,100,000	1,100,000	-	0	1,100,000	1.3	1,399,200	2,499,200	0	n.a.	n.a.
EL	Agios Ioannis (4 sites)	Ni	O	n.d.	n.d.	n.d.	89,115	-	0	104,277	0.1	15,162	119,439	15,162	n.a.	n.a.
EL	Kastoria (3 sites)51	Ni	O	n.d.	n.d.	430,000	430,000	-	0	430,000	13.1	5,618,000	6,048,000	0	n.a.	n.a.
EL	Mytilineos S.A. (Aluminium of Greece)52	Al	-	0	0	0	687,759	-	0	1,444,295	-	-	1,444,295	756,535	010309	Non CAF
ES	Las Cruces53	Cu	O	1,499,956	1,538,226	1,618,634	72,445	Zn,Pb,Ag,Au	58,142	1,552,272	3.0	4,656,816	6,209,088	1,421,685	010304*	CAF
ES	Los Santos54	W	O	525,000	519,803	522,402	99,603	-	0	522,402	3.0	1,567,206	2,089,608	422,799	010306	Non CAF
ES	MATSA Aguas Tenidas, Magdalena, Sotiel55	Cu	U	4,000,000	4,370,000	4,540,000	289,000	Zn, Pb	161,333	4,303,333	0.5	2,151,667	6,455,000	3,853,000	010304*	CAF

36 The data for the rock and tailings are calculated according to data, which are provided by the company

37 The data for the rock and tailings are calculated according to data, which are provided by the company

38 According to available data the Assarel-Medet processes about 13 million tons of ore per year An average stripping ratio was used for the calculations 3:1.

39 For Chelopech Mine the ore production, the copper head grade (0.91 to 1.1%) and the silver head grade (7.52g/t to 10.7g/t) were available through the desk search (link). Taking into consideration the Ore amount and the head grades the concentrate streams were calculated. The stripping ratio 0.5:1 is selected since underground mining technique is used.

40 In Bulgaria there are three active copper mines (Assarel Panagyurishte, Chelopech and Ellatzite) and according to available data *"Assarel-Medet JSC processes approximately 13 million tons of ore per year, providing around 50% of the national production of copper"*. Taking into consideration that the national copper production is near to 26 million tons as well as the total *Ore production of* Assarel Panagyurishte and Chelopech, the Ellatzite *Ore* production was estimated. The concentrate production was estimated based on published available data. An average stripping ratio 3:1 was decided for the calculation of the *Rock stream.*

41 The Obrochishte mine is the only extractive industry in Bulgaria that produces Manganese ore. So, it was assumed that the *Average Ore Production* is close to the national Manganese ore production (available tables from USGS). The stripping ratio was used 0.5:1 since the mine is developed underground.

42 For the Bulgarian Gold Mines the calculations were based on the following approach taking into consideration the available information: The Ore stream is divided into the following materials: (a) 0.0003% is the Gold metal, (b) 0.0009% by-product (silver metal) and the rest is the waste stream.

43 The estimates for the mining areas Krushev Dol, Petrovitsa and Varba - Batantsi were based on available data from the official website of the company. The Rock stream was calculated taking into account that the mine is developed underground so a stripping ratio 0.5:1 was used.

44 The estimates were based on available data from the National Annual Reports

45 The estimates were based on the capacity production of the plant according to the official website "production capacity of 600,000 to over 1 million metric tons of alumina per year". Taking into consideration the bibliographic ratio ore to alumina 2.1:1 the Ore stream and Tailings were estimated.

46 The Mount Oiti has not produced the period 2015-2017 significant amount of ore production

47 The estimates were based according to data provided by the company

48 The estimates were based according to data provided by the company

49 The estimates were based according to data provided by the company

50 The estimates were based according to data provided by the company

51 The estimates were based according to data provided by the company

52 Mytilineos S.A. (Aluminium of Greece) is a processing plant for the production of metal aluminium, for this reason the Rock stream and the Total Excavated Material were not calculated. The production activity is not under the EWD, but it is covered by this study for reasons of completeness. According to available data from Hellenic Ministry of Environment and Energy website the alumina (concentrate stream) amount was defined. Taking into consideration the bibliographic ratio ore to alumina 2.1:1 the *Ore* stream and *Tailings* were estimated.

53 The estimates were based according to data provided by the company

54 The data for the estimates were based on the available data. An average stripping ratio was used for the calculations 3:1.

55 The data for the estimation were based on the available data from a corporate presentation and the environmental report for 2015 published by Minas de Aguas Teñidas S.A.U. Taking into consideration that the mine layout is underground the stripping ratio 0.5:1 was used.

MS	Mine Name	Primary Commodity	Mine Type	From the Data Collection Process						Average Ore production 2015-2017 (t)	Estimates (based on operators information, experience of the consulting team and literature review) Rock = Stripping Ratio * Average Ore Production Total Excavated Material = Rock + Average Ore Production Tailings = Average Ore Production – Concentrate – By-Products (process)					
				Ore (t) 2015	Ore (t) 2016	Ore (t) 2017	Concentrate Average 2015-2017 (t)	Secondary Concentrate	Secondary Concentrate (t)		Stripping Ratio	Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings Waste code	EWF
ES	Minera del Duero (Barruecopardo)56	W	O	n.d.	n.d.	n.d.	260,000	-	0	1,363,635	3.0	4,090,905	5,454,541	1,103,635	010306	Non CAF
ES	Orovalle (El Valle-Boinás/Carlés ("EVBC") and former Kinbauri mine)57	Au	U	n.d.	n.d.	n.d.	2	(Ag, Mb)	54	504,451	0.5	252,226	756,677	504,395	010304*	CAF
ES	Penouta zone B (reprocessing old tailings) 58	Sn	-	n.d.	n.d.	n.d.	31	(Tn+Nb)	20	40,000	-	0	40,000	39,949	010306	Non CAF
ES	Rio Tinto59	Cu	O	n.d.	6,500,000	9,300,000	21,055	Cu, Ag	135,386	5,266,667	3.0	15,800,000	21,066,667	5,110,226	010304*	CAF
ES	San Cipria60	Al	-	n.d.	n.d.	n.d.	1,500,000	-	0	2,500,000	-	0	2,500,000	1,000,000	010309	Non CAF
FI	Kittila61	Au	U	1,484,655	1,652,974	1,563,612	6	Au, Ag	20	1,567,080	0.9	1,347,030	2,967,327	1,620,270	010304*	CAF
FI	Jokisivu62	Au	O&U	160,090	232,870	244,383	-	-	0	212,448	1.5	318,672	531,119	0	n.a.	n.a.
FI	Orivesi63	Au	U	125,707	81,305	72,792		-	0	93,268	0.5	46,634	139,902	0	n.a.	n.a.
FI	Pampalo[64]	Au	O&U	239,000	147,625	170,389	4,783	-	0	185,671	0.5	92,836	278,507	180,888	010304*	CAF
FI	Pyhasalmi65	Cu	O&U	1,378,554	1,379,546	1,259,632	13,400	Zn+Au	690,851	1,339,244	0.5	634,993	1,974,237	634,993	010304*	CAF
FI	Kemi	Cr	O&U	1,951,799	2,105,338	1,954,282	1,040,719	-	0	2,003,806	0.0	97,995	2,101,801	963,087	010304	CAF
FI	Pahtavaara66	Au	O&U	n.d.	n.d.	n.d.	2,477	Gold,Copper	128,273	247,990	0.5	123,995	371,985	117,240	010304*	CAF
FI	Talvivaara, sotkamo, kajaani67	Ni	O	4,107,344	14,209,539	17,465,197	22,575	Zn, Ni	15,209	11,927,360	1.1	13,472,428	25,399,788	11,889,576	010304*	CAF
FI	Kevitsa68	Cu	O	0	4,518,000	7,911,000	83,500	Cu, Ni	109,500	6,214,500	3.0	18,643,500	24,858,000	6,021,500	010304*	CAF
FI	Kylylahti (Luikonlahti TMF)69	Cu	U	733,000	797,000	809,000	58,246	Cu, Zn	4,753	779,667	0.5	389,833	1,169,500	716,667	010304*	CAF
FI	Vammala plant70	Au	-	285,797	314,175	317,175	183,429	-	0	305,716				122,286	010304*	CAF
FI	Laiva (Raahe region)	Au	O	n.d.	n.d.	n.d.	659,830	-	0	1,805,605	0.2	319,261	2,124,866	1,145,775	010304*	CAF
FR	Gardanne plant71	Al	-	n.d.	n.d.	n.d.	350,000	-	0	927,500	-	0	927,500	577,500	010309	Non CAF
HU	Nyirád Mine	Al	O	n.d.	n.d.	n.d.	0	-	0	0	0	0	0	0	n.a.	n.a.
HU	Fenyőfő I	Al	O	n.d.	n.d.	n.d.	0	-	0	0	0	0	0	0	n.a.	n.a.
HU	Fenyőfõ II	Al	O	n.d.	n.d.	n.d.	0	-	0	0	0	0	0	0	n.a.	n.a.
HU	Bokonyoszlop72	Al	U	n.d.	n.d.	n.d.	n.d.	n.d.	0	25,000	0.5	12,500	37,500	0	n.a.	n.a.
IE	Aughinish alumina refinery73	Al	-	n.d.	n.d.	n.d.	1,392,019	-	0	2,923,240	-	0	2,923,240	1,531,221	010309	Non CAF
IE	Navan Tara Mines74	Zn	U	2,197,000	2,603,000	2,311,000	250,000	Pb	34,000	2,370,333	0.5	1,185,167	3,555,500	2,086,333	01 03 06	Non CAF
PL	Lubin-Malomice[75]	Cu	U	7,500,000	7,500,000	7,533,000	69,000	Ag+Au	354	7,511,000	0.5	3,755,500	11,266,500	7,441,646	01 03 81 [76]	Non CAF
PL	Polkowice-Sieroszowice	Cu	U	12,000,000	12,000,000	12,000,000	200,000	Ag+Au Salt	91 234,000	12,000,000	0.5	6,000,000	18,000,000	11,566,000	01 03 81	Non CAF
PL	Rudna	Cu	U	10,232,000	10,232,000	10,232,000	167,000	Ag+Au	633	10,232,000	0.5	5,116,000	15,348,000	10,064,367	01 03 81	Non CAF
PL	Olkusz-Pomorzany	Zn	U	1,710,000	1,710,000	1,710,000	51,000	Pb	13,000	1,710,000	0.5	855,000	2,565,000	1,646,000	01 03 81	Non CAF
PT	Aljustrel	Cu	U	n.d.	n.d.	n.d.	70,000	Pb, Zn	0	1,800,000	0.5	900,000	2,700,000	1,730,000	010304*	CAF
PT	Neves-Corvo77	Cu	U	3,556,202	3,425,309	3,122,131	149,043	Zn, Pb	205,909	3,367,881	0.5	1,683,940	5,051,821	3,012,929	010304*	CAF
PT	Panasqueira	W	U	517,505	601,596	n.d.	111,910	-	0	559,551	0.5	279,775	839,326	447,640	010306	Non CAF

56 The estimation was based on information published in the company's website that "*The process plant design allows for the production of ~260,000 mtus of WO_3 per annum (at steady state operation)*." Taking into consideration the ratio *Concentrate to Ore* from the other Spanish tungsten mine (Los Santos mine) the stream Ore was calculated. An average stripping ratio was used for the calculations 3:1 was used for the calculation of the *Rock* stream.

57 The estimates were based on the data presented in the official website of the company and the data from USGS-Mineral Yearbook, 2016. The average ore production was calculated taking into consideration that the average gold mine production was near 1,700kg for the examined period and the grade for Au 3.37 g/t Au. Furthermore, according to the official website the Cu grade in near 0.42% to 0.49% (average Cu grade 0.45%).

58 The estimates were based on Strategic Minerals Spain, Mina de Penouta. http://www.strategicminerals.com/nuestro-trabajo/penouta/

59 The information was based on the official company's website.

60 The estimates were based on available data from USGS Mineral Yearbook – Spain and the calculation for the ore and the tailings are based on bibliographic ratio

61 The data are provided by the company. According to information provided by the amount of tailings generated can be higher than annual ore production, because part of the processed ore can be taken from the ore stock pile, besides the quarried one.

62 The data for the calculations were based on Mineral Deposit Report - Geological Survey of Finland - Jokisivu. The Jokisivu Gold Mine("Jokisivu") provide the ore to Vammala Production Centre, so there is no concentrate production.

63 The estimates were based on available data from the official website. According the official website Ore processed through the Vammala Plant is currently sourced from the Orivesi Gold Mine and Jokisivu Gold Mine. Therefore the result comes from the deduction of the ore milled in the plant and the ore from Jokisivu. The Orivesi Gold Mine ("Orivesi") provide the ore to Vammala Production Centre, so there is no concentrate production.

64 The data for the ore production are from the "Mineral Deposit Report" by the Geological Survey of Finland (Available here: http://tupa.gtk.fi/karttasovellus/mdae/raportti/284_Pampalo.pdf). However according to the website Kaivosvastuu " Amount of extractive waste: 1,247,596 t (waste rock 73.0%, topsoil 0.5%, tailings 26.5%)".

65 The estimates were based on available data from https://www.first-quantum.com/Our-Business/operating-mines/Pyhasalmi/

66 The estimates were based on available data from the Mineral Deposit Report - Geological Survey of Finland

67 The estimates were based on available data from the official website of the company

68 The data were available from the Boliden Annual Report (2017) "Metals for long-term value"

69 The data were available from the Boliden Annual Report (2017) "Metals for long-term value"

70 The estimates were based on the available data from the official website of the company.

71 The data were based on an average alumina production based on USGS 2016 Minerals Yearbook and the calculation for the ore and the tailings are based on bibliographic ratio

72 The data for the estimates were based on the information from the Hungarian Office for Mining and Geology report "Mineral Resources of Hungary" and the company's website http://eoszen.hu/

73 Taking into consideration the bibliographic ratio alumina to ore 2.1:1 the *Ore* stream and *Tailings* were estimated.

74 The data were available from the Boliden Annual Report (2017) "Metals for long-term value"

75 Data were collected from the official website https://kghm.com/en/our-business/mining-and-enrichment/polkowice-sieroszowice

76 According to available information from the MS, the waste code that is being used for the tailings produced from the mixed sulfide ores in Poland is the waste code 01 03 81 Wastes from flotation enrichment of non-ferrous metal ores other than those mentioned in 01 03 80. However, this waste code is not included in the List Of Waste (Decision 2014/955/EU)

77 The calculations were based on available data from the technical report for the Neves-Corvo mine

MS	Mine Name	Primary Commodity	Mine Type	From the Data Collection Process						Average Ore production 2015-2017 (t)	Estimates (based on operators information, experience of the consulting team and literature review) Rock = Stripping Ratio * Average Ore Production Total Excavated Material = Rock + Average Ore Production Tailings = Average Ore Production – Concentrate – By-Products (process)					
				Ore (t) 2015	Ore (t) 2016	Ore (t) 2017	Concentrate Average 2015-2017 (t)	Secondary Concentrate	Secondary Concentrate (t)		Stripping Ratio	Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings Waste code	EWF
RO	Rosia Poieni78	Cu	O	n.d.	n.d.	n.d.	40,000	-	209	2,750,000	0.75	2,062,500	4,800,000	2,710,785	010304*	CAF
RO	Tulcea – Alumina Refinery79	Al	-	-	-	-	448,154	-	-	941,123	-	-	941,123	492,969	010309	Non CAF
RO	Manaila Polymetallic Mine 80	Cu	O&U	n.d.	n.d.	n.d.	480	n.d.	0	12,333	1.5	18,500	18,500	11,854	010304*	CAF
SE	Aitik81	Cu	O	36,360,915	36,051,432	39,045,036	340,058	Au, Ag	372	37,152,461	0.8	28,956,420	66,108,881	36,812,031	010304*	CAF
SE	Bjorkdal82	Au	O&U	1,303,000	1,289,000	1,262,000	6	Te, Bi	13	1,284,667	1.5	1,927,001	3,211,668	1,284,648	010304*	CAF
SE	Boliden Area (4 mines)83	Zn	O&U	1,879,000	2,138,000	2,065,000	118,333	Cu, Pb	32,333	2,027,333	0.5	1,013,667	3,041,000	1,876,667	010304*	CAF
SE	Garpenberg84	Zn	U	2,367,000	2,622,000	2,634,000	199,000	Cu, Pb	61,333	2,541,000	0.5	1,270,500	3,811,500	2,280,667	010304*	CAF
SE	Lovisa85	Zn	U	n.a.	n.a.	n.a.	2,734		0	40,000	0.5	20,000	60,000	37,266	010304*	CAF
SE	Zinkgruvan86	Zn	U	1,235,191	1,119,276	1,262,519	153,490	Cu, Pb	49,944	1,205,662	0.5	602,831	1,808,493	1,002,228	010304*	CAF
SE	Kiruna87	Fe	O&U	24,100,000	26,900,000	27,500,000	-	-	0	26,166,667	1.5	39,250,001	65,416,668	2,780,208	10306	Non CAF
SE	Leveäniemi (Svappavaara)88	Fe	O	4,600,000	6,100,000	7,000,000	-	-	0	5,900,000	3.0	17,700,000	23,600,000	626,875	010306	Non CAF
SE	Malmberget89	Fe	U	16,300,000	16,400,000	13,200,000	-	-	0	15,300,000	0.5	7,650,000	22,950,000	1,625,625	010306	Non CAF
SK	Kremnica mine90	Au	U	n.a.	n.a.	n.a.	2	Ag	6	593,333	0.5	296,667	890,000	593,325	010304*	CAF

78 The estimates were based on available data after communication with the company. The EWF is not Category A Facility according to the data provided.

79 The data concerning the alumina production (conentrate stream) were available from the National Minerals Information Center of USGS- Romania. The cocnetnrate amount is near to the capacity production of 600,000 tpy (official website). Taking into consideration the bibliographic ratio alumina to ore 2.1:1 the Ore stream and Tailings were estimated.

80 For the period 2015-2017 the mine was not operating. Based on the information publicly available some estimates were made for the expected amounts of tailings. The EWF is not Category A Facility according to the data provided.

81 The data were available from the Boliden Annual Report (2017) "Metals for long-term value"

82 The data for the material streams were available from the technical report on the Björkdal Gold Mine, Sweden. The report mentions a Tailings Management Facility, however it is not presented if it operating under Directive 2006/21/EC and there are no data for the categorisation of waste facility. The Table presents the categorisation of the EWF as it was described in the chapter 2.3 of the present study.

83 The data were available from the Boliden Annual Report (2017) "Metals for long-term value"

84 The data were available from the Boliden Annual Report (2017) "Metals for long-term value"

85 For Lovisa mine limited data were available. According to the official website the current rate of mining is 40,000t per year and for the purposes of the current investigation was assumed that this number is the average ore production. The stripping ratio is 0.5 since the mining technique is underground extraction. An average ratio tailing to ore was used taking into consideration the other Swedish Zinc mines.

86 The data were available from the technical report for the Zinkgruvan mine, Sweden (2017 -Wardell Armstrong International)

87 The estimates were based on available data from the LKAB annual and sustainability report. According to the report the average ore production of the three mines (Kiruna, Malmberget, Svappavaara) is 48Mt and the amounts of tailings are on average 5.1Mt (for 2015 and 2016). Taking into consideration this ratio the tailings were estimated: 5.1Mt*26Mt/48Mt=2.7Mt

88 According to the official website "The Leveäniemi mine was first operated from 1964 to 1983. […] A production start is planned for the second quarter of 2016". So, a ratio 3:1 was used for the estimates. According to the LKAB annual and sustainability report the average ore production of the three mines (Kiruna, Malmberget, Svappavaara) is 48Mt and the amounts of tailings are on average 5.1Mt (for 2015 and 2016). The calculations for the tailings are based on the previous mentioned approach 5.1Mt*6Mt/48Mt=0.6 Mt.

89 Data for the Malberget Mine were collected from the Annual and Sustainable Report (2017) of the LKAB and the USGS 2016 Minerals Yearbook – Sweden. The available data for the assessment was the yearly ore production and the ore grade (Fe=60%). The stripping ratio is 0.5 since the mining technique is underground extraction. According to the LKAB annual and sustainability report the average ore production of the three mines (Kiruna, Malmberget, Svappavaara) is 48Mt and the amounts of tailings are on average 5.1Mt (for 2015 and 2016). The calculations for the tailings are based on the previous mentioned approach 5.1Mt*15Mt/48Mt=1.6 Mt.

90 For the Kremnica mine the yearly ore production was not found, only the final products (silver and gold). The estimation was based on the assumption that 0.0009% of the total excavated material is the final gold and silver metal. So, the total excavated material is estimated (100%*8t)/(0.0009%)~890,000t. Furthermore, taking into consideration that the mining technique is underground extraction (stripping ratio =0.5) the *Rock* and the *Ore* Stream was estimated 0.5*Ore + Ore = Total Excavated Material → Ore= 593,333t and Rock = 0.5*Ore = 296,667t

The following table presents the tailings management that has been described in Chapter 3.3.5.

Table L.2: Tailings Management: Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles of EWD

MS	Mine Name	Commodity	Estimates Rock = Stripping Ratio * Average Ore Production Total Excavated Material = Rock + Average Ore Production Tailings = Average Ore Production – Concentrate – By-Products (process)		Tailings Management: Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD		
			Tailings (t)	Tailings Waste code	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
AT	Erzberg	Fe	877,601	010306	0	877,601	According to the previous BREF "Management of tailings and waste rock in mining" the coarse tailings with the waste rock are co-deposited and the fine tailings are deposited into tailings facilities
AT	Mittersill	W	381,702	010306	229,021	152,681	According to the data sent by the company 60% of the extractive waste produced is used for filling excavation voids and 40% of the tailings are deposited
BG	Assarel Panagyurishte Mining and Processing Complex	Cu, Au, Ag	8,588,625	01 03 04*	0	8,588,625	no data available. Taking into consideration that the waste stream is estimated to be hazardous then it is estimated that no portion of tailings are returned into the excavation voids
BG	Chelopech	Cu	2,063,194	01 03 04*	0	2,063,194	no data available. Taking into consideration that the waste stream is estimated to be hazardous then it is estimated that no portion of tailings are returned into the excavation voids
BG	Ellatzite	Cu	10,621,768	01 03 04*	0	10,621,768	no data available. Taking into consideration that the waste stream is estimated to be hazardous then it is estimated that no portion of tailings are returned into the excavation voids
BG	Obrochishte	Mn	51,916	01 03 06	0	51,916	There were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.
BG	Sedefche	Au, Ag	1,908,182	01 03 04*	0	1,908,182	There were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.
BG	Assarel Milin Kamak	Au, Ag	1,908,182	01 03 04*	0	1,908,182	There were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.
BG	Yuzna Petrovitsa	Zn Pb	327,550	01 03 04*	0	327,550	no data available. Taking into consideration that the waste stream is estimated to be hazardous then it is estimated that no portion of tailings are returned into the excavation voids
BG	Shumacheski Dol-Androu						
BG	Marzyan North						
BG	Dimov Dol	Zn, Pb	108,278	01 03 04*	0	108,278	There were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.
BG	Petrovitsa	Zn, Pb	332,400	01 03 04*	0	332,400	no data available. Taking into consideration that the waste stream is estimated to be hazardous then it is estimated that no portion of tailings are returned into the excavation voids
BG	Crushev Dol				0		
BG	Varba-Batantsi				0		
BG	Chala	Zn, Pb, Au	318,397	01 03 04*	0	318,397	There were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.
CY	Skouriotissa	Cu	407,654	01 03 04*	0	407,654	According to MS all the generated amount of tailings are deposited in an CAF and only waste rock is used as material for construction works.
DE	Stade	Al	1,100,000	01 03 09	0	1,100,000	This operation is a plant for producing alumina from bauxite.
EL	Mount Oiti region (1 site)	Al	No tailings are produced.				
EL	Gkiona (13 sites)	Al	No tailings are produced. The extractive waste is inert material from the excavation process. There is no beneficiation process. Typically, the excavated material is returned back to the excavation voids, but if this is not technically feasible, some amount is deposited in the EWF Lakes Lyritses				
EL	Mount Parnassos region	Al	No tailings are produced. The extractive waste is inert material from the excavation process to access the ore. There is no beneficiation process. Typically, the excavated material is returned back to the excavation voids, but if this is not technically feasible, some amount is deposited in the EWF Rodia. For the year 2015-2017 all the excavated material was returned back to excavation voids and zero material was deposited in the EWF				
EL	Olympias	Pb, Zn, As-Au	52,000	01 03 06	41,000	11,000	According to the data sent by the company the years 2015 and 2016 the mine Olympias was in the construction phase and there were not ore production. The numbers corresponds only for 2017 (some months)
EL	Mavres – Petres (Stratoni)	Pb, Zn	131,396	01 03 06	66,220	65,176	According to the data sent by the company near 50% of the tailings produced are the coarse stream that can be used technically as material for filling excavation voids
EL	Greece Evoia island (4 sites)	Ni	No Tailings				
EL	Agios Ioannis (4 sites)	Ni	No Tailings The management of extractive waste is according to the waste hierarchy. Some amounts of the waste stream 01 01 01 will be used as a material for construction. Also, some amounts will be used as a filling of excavation voids and then the operator should cover the sterile material with soil (for rehabilitation purposes). The amounts of waste that cannot be used will be deposited into the EWFs. According to the AETC[91] the company has licensed two EWFs				
EL	Kastoria (3 sites)	Ni	No tailings The management of extractive waste is according to the waste hierarchy. Some amounts of the waste stream 01 01 01 will be used as a material for construction. Also, some amounts will be used as a filling of excavation voids and then the operator should cover the sterile material with soil (for rehabilitation purposes). The amounts of waste that cannot be used will be deposited into the EWFs. According to the AETC[92] the company has licensed two EWFs.				
EL	Mytilineos S.A. (Aluminium of Greece)	Al	756,535	010309	0	756,535	This operation is a plant for producing alumina from bauxite. There is not a mine inside the operation. All the generated amounts of tailings are deposited into a non-CAF facility.
ES	Las Cruces	Cu, Zn, Pb, Ag, Au	1,421,685	010304*	0	1,421,685	The technical report "Technical Report Las Cruces Copper Project, Southern Spain[93]" only inert waste from mining is sending back to excavation voids. So
ES	Los Santos	W	422,799	010306	422,799	0	According to "Technical Report on the Los Santos Mine Project[94]": "*There is no tailings discharge from the process and no tailings dam: all plant waste is dewatered and transported back to the mine waste dumps for disposal*." So, it is assumed that all the calculated tailings are being led back to the mine
ES	MATSA Aguas Tenidas, Magdalena, Sotiel	Cu, Zn, Pb	3,853,000	010304*	1,926,500	1,926,500	According to communication with the company MATSA´s tailings are considered as a hazardous waste due to its pyritic characteristics, so its TMF is managed as type "A" facility. The use of tailings in paste preparation allowed reducing the TMF footprint in the subsequence TMF expansions projects implemented. The tailings are processed in paste processing plants such that the resulting material has the

[91] Approval of Environmental Terms and Conditions (AETC) (ADA Ω9ΓΛ4653Π8-5ΜΠ) *ADA it is the code of the Hellenic Transparency Program, by which all the administrative acts and decisions are valid if they are published online*

[92] Approval of Environmental Terms and Conditions (AETC) (ADA ΒΕΤΟ0-ΕΞΗ)

[93] The technical report is available here: https://www.sec.gov/Archives/edgar/data/913586/000119312504123683/dex99.htm (Access 14 September 2021)

[94] The technical report is available here: https://almonty.com/wp-content/uploads/2019/06/Los_Santos_43-101_Tech_Rep_Oct15_SEDAR.pdf (Access 14 September 2021)

MS	Mine Name	Commodity	Estimates Rock = Stripping Ratio * Average Ore Production Total Excavated Material = Rock + Average Ore Production Tailings = Average Ore Production – Concentrate – By-Products (process)		Tailings Management: Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD		
			Tailings (t)	Tailings Waste code	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
							required quality to backfill the exploited stopes. Approximately 50% of the tailings, as part of the paste, are finally disposed into the mine.
ES	Minera del Duero (Barruecopardo)	W	1,103,635	010306	0	1,103,635	"The project began operations in August 2018 with the first successful trial of waste rock through the primary crusher"[95]. So during the period 2015-2017 there were no amounts of tailings that could be used for filling excavation voids
ES	Orovalle (El Valle-Boinás/Carlés ("EVBC") and former Kinbauri mine)	Au, Ag, Mb	504,395	010304*	0	504,395	According to a Orovalle Operation 2020 Technical Report[96] only waste rock is used for fillings excavation voids and the whole amount of tailings are disposed into a TSF
ES	Penouta zone B (reprocessing old tailings)	Sn, Tn+Nb	39,949	010306	39,949	0	According to the presentation "The Penouta Project: Strategic and Sustainable Mining[97]" the historical tailings will be reprocessed the extractive waste that will be generated will go for further processing in an industrial minerals plant. The stream that is not marketable will be used for restoration purposes. So it is assumed that all the generated tailings will be used as material for filling excavation voids for restoration purposes.
ES	Rio Tinto	Cu, Ag	5,110,226	010304*	2,555,112.90	2,555,113	According to the "Technical Report Update on the Mineral Resources and Reserves of the Riotinto Copper Project" published in 2018[98] "The coarse tailings (sands) are separated by cycloning and deposited as underflow to form the dam walls, while the overflow consisting of the fine tailings fraction (slimes) is deposited within the basin area. The ponded water is also located away from the dam walls." *It was estimated that 50% of total amounts of tailings are the coarse portion.*
ES	San Cipria	Al	1,000,000	010309	0	1,000,000	This operation is a plant for producing alumina from bauxite. There is not a mine inside the operation and the bauxite is imported
FI	Kittila	Au, Ag	1,620,270	010304*	252,255	1,368,015	The data are based on the exchange of information with the company
FI	Jokisivu	Au	No tailings are produced. The Jokisivu Gold Mine("Jokisivu") provide the ore to Vammala Production Centre, so there is no concentrate production.				
FI	Orivesi	Au	No tailings. The Orivesi Gold Mine ("Orivesi") provide the ore to Vammala Production Centre, so there is no concentrate production.				
FI	Pampalo	Au	180,888	010304*	0	180,888	According to available data only the 53.0% of waste rock is utilised and there are no data for the usage of tailings.[99]
FI	Pyhasalmi	Cu, Zn+Au	634,993	010304*	279,397	355,596	According to available information 44% of generated tailings are used for filling excavation voids (the information are from the site of Kaivosvastuu[100])
FI	Kemi	Cr	963,087	010304*			
FI	Pahtavaara	Au, Cu	117,240	010304*	0	117,240	no data available Taking into consideration data from different sources in the internet "*The mine's previous Swedish owners, Lappland Goldminers, declared bankruptcy in 2014 and the mine has been closed down ever since.*" So during 2015-2017 the period of investigation there were not produced amounts that could be returned into the excavation voids
FI	Talvivaara, sotkamo, kajaani	Ni, Zn	11,889,576	010304*	0	11,889,576	According to the technical report "Talvivaara Projekti oy talvivaaran kaivoshankkeen ympäristövaikutusten arviointiselostus[101]" published by LAPIN VESITUTKIMUS OY and page 33 "*The generated rock from the open pit Kolmisopen will be used for filling excavation voids. The tailings that are in a slurry form are deposited.*"
FI	Kevitsa	Cu, Ni	6,021,500	010304*	0	6,021,500	According to the presentation for Kevitsa Mine[102] (page 16) the generated tailings are divided into (a) low sulphur tailings and (b) high sulphur tailings that are deposited into two different tailings deposition
FI	Kylylahti (Luikonlahti TMF)	Cu, Zn	716,667	010304*	0	716,667	According to the technical report "Boliden Summary Report[103]" published in 2019 in Kylylahti cemented rock fill (CRF) and/or waste rock used as material for filling excavation voids
FI	Vammala plant	Au	122,286	010304*	This is a plant, and it is considered that the tailings are deposited		
FI	Laiva (Raahe region)	Au	1,145,775	010304*	0	1,145,775	There were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.
FR	Gardanne plant	Al	577,500	010309	0	577,500	This operation is a plant for producing alumina from bauxite. There is not a mine inside the operation and the bauxite is imported
HU	Nyirád Mine	Al	No tailings				
HU	Fenyőfő I	Al	No tailings				
HU	Fenyőfő II	Al	No tailings				
HU	Bokonyoszlop	Al	No tailings				
IE	Aughinish alumina refinery	Al	1,531,221	010309	0	1,531,221	This operation is a plant for producing alumina from bauxite. There is not a mine inside the operation and the bauxite is imported
IE	Navan Tara Mines	Zn, Pb	2,086,333	01 03 06	1,043,167	1,043,167	According to the report "Boliden Summary Report[104]": "The coarse fraction of the mill waste product is used for backfill while the remnant tailings are pumped 2km to a tailings management facility"
PL	Lubin-Malomice	Cu Ag+Au	7,441,646	010381	21,804,009.75	7,268,003	Taking into consideration that these mines have one EWF are evaluated together. According to the official website[105] "Annually, from 20 to 26 million tonnes of flotation waste is deposited here, out of which 75% is processed further, and only one fourth is discharged"
PL	Polkowice-Sieroszowice	Cu Ag+Au Salt	11,566,000	010381			
PL	Rudna	Cu, Ag+Au	10,064,367	010381			
PL	Olkusz-Pomorzany	Zn, Pb	1,646,000	010381	no tailings	1,646,000	no reference in articles that the operator uses tailings for filling excavation voids, the only reference is for using waste-rock

[95] According to the web-site: https://www.mining-technology.com/projects/barruecopardo-tungsten-project-castilla-y-leon/ (Access 14 September 2021)
[96] The technical report is available here: https://s2.q4cdn.com/372236871/files/doc_downloads/elvalle/RPA-Orovalle-Operation-NI-43-101-FINAL-Report-Dec-29-2020.pdf (Access 14 September 2021)
[97] The presentation is available here: https://www.phytosudoe.eu/wp-content/uploads/2016/11/10_Strategic-Minerals_Penouta-Project_PhytoSUDOE-workshop-2017.pdf (Access 14 September 2021)
[98] The technical report is available here: https://atalayamining.com/wp-content/uploads/2018/07/RioTinto-July-2018-Complete-Report-Rev-6.pdf (Access 14 September 2021)
[99] The information is available from the official web-site of Kaivosvastuu (Available here https://www.kaivosvastuu.fi/en/yrityskortti/endomines-oy/) (Access 14 September 2021)
[100] Available here: https://www.kaivosvastuu.fi/en/yrityskortti/pyhasalmi-mine-oy/) (Access 14 September 2021)
[101] The technical report is available here: https://www.ymparisto.fi/download/noname/%7B8832D3F7-69FA-4C99-8AF4-5738AF22C691%7D/43141 (Access 14 September 2021)
[102] The presentation is available here Mine https://www.boliden.com/globalassets/investor-relations/reports-and-presentations/capital-markets-day/2017/cmd/7-kevitsa---expansion-to-9-mtonnes.pdf (Access 14 September 2021)
[103] Available here https://www.boliden.com/globalassets/operations/exploration/mineral-resources-and-mineral-reserves-pdf/2019/resources_and_reserves_kylylahti_2019-12-31.pdf (Access 14 September 2021)

[104] The report is available here: https://www.boliden.com/globalassets/operations/exploration/mineral-resources-and-mineral-reserves-pdf/2020/resources-and-reserves-tara-2020-12-31.pdf (Access 14 September 2021)
[105] Tailings management | KGHM Corporate Website

MS	Mine Name	Commodity	Estimates Rock = Stripping Ratio * Average Ore Production Total Excavated Material = Rock + Average Ore Production Tailings = Average Ore Production – Concentrate – By-Products (process)		Tailings Management: Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD		
			Tailings (t)	Tailings Waste code	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
PT	Aljustrel	Cu, Pb, Zn	1,684,600	010304*	no tailings	1,684,600	According to the "Technical Report on the Aljustrel Mine, Southern Portugal"[106] only material from the quarry are used for filling excavation voids.
PT	Neves-Corvo	Cu, Zn, Pb	3,012,929	010304*	1,506,464	1,506,464	According to the technical report "Technical report for the Neves-Corvo mine" published in 2017 "The backfill types used in the new production area, LP2, are: Paste fill (PF)made fromcycloned process tailings; cemented rock fill (CRF); and rock fill (RF) produced from underground development waste." *It was estimated that 50% of total amounts of tailings are the coarse portion.*
PT	Panasqueira	W	447,640	010306	0	447,640	Grangeia et al (2011) "Mine tailings integrated investigations: The case of Rio tailings (Panasqueira Mine, Central Portugal)" Engineering Geology Volume 123, Issue 4, 21 November 2011, Pages 359-372
RO	Rosia Poieni	Cu	2,710,785	010307*	no operation		
RO	Manaila Polymetallic Mine	Cu	11,854	010304*	no operation		
RO	Tulcea – Alumina Refinery	Al	492,969	10309	0	492,969	This operation is a plant for producing alumina from bauxite. There is not a mine inside the operation and the bauxite is imported
SE	Aitik	Cu, Au, Ag	36,812,031	010304*	0	36,812,031	According to available data only the waste rock is recovered/recycled.
SE	Bjorkdal	Au, Te, Bi	1,284,648	010304*	0	1,284,648	According to a report[107] "There are currently two active waste areas; the North and South. In the new operating permit application received in 2018, the capacity of the waste rock facility has been expanded to over 53 million t. This capacity is sufficient to cover the needs of the current mine life. The TMF is located in an area of gently undulating relief approximately 1.5 km north of the processing plant. Approximately 31 million t of tailings have been deposited since mining began at Björkdal in 1988." No reference for using tailings as material for filling excavation voids
SE	Boliden Area (4 mines)	Zn, Cu, Pb	1,876,667	010304*	0	1,876,667	According to a report published by the company[108] the Boliden Area has the Hötjärn TMFclassified as CAF (Boliden Area) that is active, the Gillervattnet TMF (Boliden Area) which now is closed and the Kristineberg TMF (Boliden Area) is in care and maintenance). The tailings are deposited in the CAF
SE	Garpenberg	Zn, Cu, Pb	2,280,667	01 03 05*	752,620	1,528,047	According to the available Extractive Waste Management Plan: The EWF Ryllshyttemagasinet accepts the tailings from the enrichment plant in Garpenberg which is asseigned under the waste code 01 03 05* (hazardous waste). It is estimated that about 25-35% of the tailings are used for the refilling of broken excavation rooms in the mine (chapter 8.1)
SE	Kiruna	Fe	12,716,667	010306	0	12,716,667	According to the official website of LKAB[109] "All mining and processing generates waste products in the form of waste rock and tailings that have to be sent to landfill and stored in as sustainable a way as possible – in accordance with the laws and guidelines contained in the Swedish Environmental Code. Tailings from LKAB's activities are disposed of, together with water, in what are known as tailings dams. These contain large quantities of water and tailings that have to be stored over a prolonged period and so dam safety is a priority issue in terms of sustainability."
SE	Leveäniemi (Svappavaara)	Fe	2,400,000	010306	0	2,400,000	According to the official website of LKAB "All mining and processing generates waste products in the form of waste rock and tailings that have to be sent to landfill and stored in as sustainable a way as possible – in accordance with the laws and guidelines contained in the Swedish Environmental Code. Tailings from LKAB's activities are disposed of, together with water, in what are known as tailings dams. These contain large quantities of water and tailings that have to be stored over a prolonged period and so dam safety is a priority issue in terms of sustainability."
SE	Lovisa	Zn	37,266	010304*	0	37,266	There were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.
SE	Zinkgruvan	Cu, Pb	1,002,228	010304*	350,780	651,448	According to technical report [110]"The annual production of tailings is approximately 1.1Mtpa with 35% used as mine backfill and 65% disposed at the Enemossen Tailings Storage Facility (TSF)"
SE	Malmberget	Fe	6,120,000	010306	0	6,120,000	According to the official website of LKAB[111] "All mining and processing generates waste products in the form of waste rock and tailings that have to be sent to landfill and stored in as sustainable a way as possible – in accordance with the laws and guidelines contained in the Swedish Environmental Code. Tailings from LKAB's activities are disposed of, together with water, in what are known as tailings dams. These contain large quantities of water and tailings that have to be stored over a prolonged period and so dam safety is a priority issue in terms of sustainability."
SK	Kremnica mine	Au, Ag	593,325	010304*	0	593,325	According to pre-feasibility study (Available here: https://www.sec.gov/Archives/edgar/data/1271199/000120445907001067/exh991.htm) "The principal objectives of the pre-feasibility design for the tailings storage facility (TSF) are to provide storage for all tailings, PR rock, and site water, while ensuring the protection of the regional groundwater and surface waters both during operations and in the long-term (after closure), and to achieve effective reclamation at mine closure." So all the amount of waste will be deposited. Non-reactive (NR) mine waste rock will be used to construct the TSF embankment

[106] Available here: https://www.sec.gov/Archives/edgar/data/1377085/000120445907001644/lundin103107exh9912.htm (Access 14 September 2021)
[107] Available here: : https://minedocs.com/20/Mandalay_AIF_2019.pdf (Access 14 September 2021)
[108] Available here: https://www.boliden.com/globalassets/sustainability/our-responsibilities/in-focus/tailings_safety_disclosure_response_boliden.pdf (Access 14 September 2021)
[109] Available here: https://www.lkab.com/en/sustainability/environment/waste-and-landfill/ (Access 14 September 2021)
[110] The technical report is available here: https://www.lundinmining.com/site/assets/files/3642/zm-techreport-113017-sedar.pdf (Access 14 September 2021)
[111] Available here: https://www.lkab.com/en/sustainability/environment/waste-and-landfill/ (Access 14 September 2021)

The following table presents an attempt to compare the amounts of Rock stream (excavated material minus ore) and tailings that are produced from the active metal mines in EU-27 with the figures reported by Member States as part of the 3 yearly reporting on the implementation of the Directive for 2014-2017 and with the amounts of hazardous and, where informative, the amounts of non-hazardous extractive waste generated from quarrying and mining reported to Eurostat. However, this attempt may be misleading because it is unclear which portion of the Rock Stream is classified as extractive waste and secondly because ESTAT presents the total amount of waste from mining and quarrying (corresponds to all the extractive sectors) and the comparison is with the findings from the metal mines.

Table L.3: The aggregated figures for the estimates of Rock Stream and tailings from the active metal mines compared with the total amounts of Mining and quarrying waste reported to Eurostat

MS	Data from the Commission's Report on the implementation of the Directive based on the information provided by Member States[112]	Data from ESTAT Generation of waste by waste category, hazardousness and NACE Rev. 2 activity [ENV_WASGEN__custom_710584] Mining and quarrying TOTAL			Sum of the Rock stream[113] and the tailings stream for the metal sector
	Total waste from quarrying and mining activities 2012	2014	2016	Average for 2014-2016	
AT	51.339	43,232	39,305	41,269	8,954,471
BG	141.082.596	159,280,382	98,716,372	128,998,377	102,060,393
CY	217.888	155,399	131,244	143,322	407,654
DE	8.625.187	12,067	15,648	13,858	1,100,000
EL	47.831.627	47,356,920	56,717,060	52,036,990	8,251,504
ES	22.509.144	18,640,873	20,299,473	19,470,173	41,974,509
FI	52.880.000	62,775,117	93,661,383	78,218,250	56,390,162
FR	2.477.408	2,345,765	1,408,895	1,877,330	577,500
HU	91.218	82,576	147,534	115,055	12,500
IE	2.024.984	2,706,594	2,398,489	2,552,542	4,802,720
PL	68.035.432	75,736,488	70,667,483	73,201,986	46,444,513
PT	242.598	921,523	408,888	665,206	8,008,884
RO	223.292.741	152,783,566	153,917,821	153,350,694	492,969
SE	129.480.919	138,898,168	109,720,077	124,309,123	126,108,562
SK	310.580	289,110	316,625	302,868	889,992

[112] EUR-Lex - 52016DC0553 - EN - EUR-Lex (europa.eu)

[113] The Rock stream is the amount of excavated material that are left over after accessing and extracting the Ore stream from the Total excavated material. This stream in some cases is not considered as a waste stream but as a material which partly or total may be utilised by the sector for (a) filling the excavation voids for rehabilitation and construction purposes, (b) construction purposes outside the mine, and (c) landscaping use. It is unclear which percentage of rock may be fed to EWFs and which is utilised for the aforementioned uses. For the comparison of the results of ESTAT it is assumed that also the Rock stream is waste, even if it is not known which amounts are classified as waste and which as secondary raw materials.

Annex M: Estimates of the CAF facilities for Metallic mineral ores per MS

Annex M: Estimates of the CAF facilities for Metallic mineral ores per MS

MS	Mine	Primary Commodity	Estimation for the classification of EWF as CAF or non-CAF based on the characterisation of the tailings as hazardous or non-hazardous		Classification of EWF as CAF or Non-CAF based on information provided by MS, EC list and operators
			Tailings Waste code	Classification of EWF receiving tailings[114]	
AT	Erzberg	Fe	01 03 06	Non CAF	Non CAF
AT	Mittersill	W	01 03 06	Non CAF	Non CAF
BG	Assarel Panagyurishte Mining and Processing Complex	Cu	01 03 04*	CAF	no data available
BG	Chelopech	Cu	01 03 04*	CAF	*Chelopech Tailing Dam (CAF)*
BG	Ellatzite	Cu	01 03 04*	CAF	*1. Benkovski 2 Tailing Dam (CAF)* *2. Mining Waste Heaps (CAF)*
BG	Obrochishte	Mn	01 03 06	Non CAF	no data available
BG	Sedefche	Au	01 03 04*	CAF	no data available
BG	Assarel Milin Kamak	Au	01 03 04*	CAF	no data available
BG	Yuzna Petrovitsa	Zn	01 03 04*	CAF	no data available
	Shumacheski Dol-Androu	Zn	01 03 04*		no data available
	Marzyan North	Zn	01 03 04*		no data available
BG	Dimov Dol	Zn	01 03 04*	CAF	no data available
BG	Petrovitsa	Zn	01 03 04*	CAF	no data available
	Crushev Dol	Zn	01 03 04*		no data available
	Varba-Batantsi	Zn	01 03 04*		no data available
BG	Chala	Zn	01 03 04*	CAF	no data available
CY	Skouriotissa	Cu	01 03 04*	CAF	CAF
DE	Stade	Al	01 03 09	Non CAF	Non CAF
EL	Mount Oiti region	Al	no tailings	Not applicable	Non category A Facility
EL	Gkiona (13 sites)	Al	no tailings	Not applicable	Non Category A Facility Lakkes Liritsas
EL	Mount Parnassos region	Al	no tailings	Not applicable	Non Category A Facility Rodia
EL	Olympias	Pb	01 03 06	Non-CAF	Category A Facility Kokkinolakkas

114 CAF= Category A Facility, Non CAF= Non Category A Facility

EL	Mavres – Petres	Pb	01 03 06	Non-CAF	
EL	Greece Evoia island	Ni	no tailings	Not applicable	non CAF
EL	Agios Ioannis	Ni	no tailings	Not applicable	Non category A Facility Tsouka
EL	Kastoria (3 sites)	Ni	no tailings	Not applicable	Non Category A Facility Kolokotroni area in Kastoria
EL	Aluminium of Greece	Al	01 03 09	Non CAF	Non Category A Facility (not licenced under EWD)
ES	Las Cruces	Cu	01 03 04*	CAF	*1.Escombrera (Waste Code 01 01 01) (CAF)* *2. Balsa (Waste Code 01 03 07*) (non CAF)* *3. Presa (Waste Code 01 03 07*) (non CAF)* *4. Balsa (Waste Code 01 03 07*) (non CAF)* *5. Balsa (Waste Code 01 03 07*) (non CAF)* *6. Balsa (Waste Code 01 03 07*) (non CAF)* *7. Balsa (Waste Code 01 03 07*) (non CAF)* *8. Balsa (Waste Code 01 03 04) (CAF)*
ES	Los Santos	W	010306	Non CAF	*1. Escombrera (Waste Code 01 01 01) (Non CAF)* *2. Escombrera (Waste Code 01 01 01) (Non CAF)* *3. Escombrera (Waste Code 01 05 99) (Non CAF)*
ES	MATSA Aguas Tenidas, Magdalena, Sotiel	Cu	010304*	CAF	*1. Presa (Waste Code 01 03 04*) (CAF)* *2. Escombrera (Waste Code 01 01 01) (CAF)* *3. Escombrera (Waste Code 01 01 01) (CAF)*
ES	Minera del Duero (Barruecopardo)	W	010306	Non CAF	non CAF
ES	Orovalle (El Valle-Boinás/Carlés (“EVBC”) and former Kinbauri mine)	Au	010304*	CAF	*1.Balsa (Waste Code 01 03 05*) (CAF)* *2. Escombrera(Waste Code 01 01 01) (Non CAF)* *3. Escombrera (Waste Code 01 01 01) (Non CAF)* *4. Escombrera (Waste Code 01 01 01) (Non CAF)* *5. Escombrera (Waste Code 01 01 01) (Non CAF)* *6. Balsa (Waste Code 01 03 05*) (CAF*
ES	Penouta zone B (reprocessing old tailings)	Sn	010306	Non CAF	Non CAF
ES	Rio Tinto	Cu	010304*	CAF	*1.Presa (Waste Code 01 03 04*) (CAF)* *2. Escombrera (Waste Code 01 01 01) (CAF)* *3. Escombrera (Waste Code 01 01 01) (CAF)*
ES	San Cipria	Al	010309	Non CAF	*No data available*
FI	Kittila	Au	010304*	CAF	*1. Kittilä mine, Suurikuusikko, CIL-pond 2 (Waste Code 01 03 05*) (CAF)* *2. Kittilä mine, Suurikuusikko, CIL-pond 1 (Waste Code 01 03 05*) (CAF)* *3. Kittilä mine, Suurikuusikko, mine waste management facility of soil material (Non CAF)* *4. Kittilä mine, Suurikuusikko, NP-3 pond (Waste Code 01 03 05*) (CAF)* *5. Kittilä mine, Suurikuusikko, waste rock management facility (Non CAF)*

FI	Jokisivu	Au	no tailings	Not applicable	*1. Jokisivu mine, area 1, waste rock and soil management facility (Non CAF)* *2. Jokisivu mine, area 3, waste rock and soil management facility (Non CAF)*
FI	Orivesi	Au	no tailings	Not applicable	*1. Orivesi Mine, waste rock management facility (Non CAF)* *2. Orivesi Mine, waste rock management facility (vulcanizate) (Non CAF)*
FI	Pampalo	Au	010304*	CAF	*1. Pampalo mine and concentration plant, tailings management facility (Non CAF)* *2. Pampalo mine and concentration plant, waste facility of soil material (Non CAF)* *3. Pampalo mine and concentration plant, waste rock management facility (Non CAF)*
FI	Pyhasalmi	Cu	010304*	CAF	CAF
FI	Kemi	Cr	01 03 06	Non CAF	*1. Kemi mine, tailings management facility 1 (CAF)* *2. Kemi mine, tailings management facility 2 (Non CAF)* *3. Kemi mine, tailings management facility 3 (Non CAF)* *4. Kemi mine, waste rock management facility 1 (Non CAF)* *5. Kemi mine, waste rock management facility 2 (Non CAF)* *6. Kemi mine, waste rock management facility 3 (Non CAF)* *7. Kemi mine, waste rock management facility 4 (Non CAF)* *8. Kemi mine, waste rock management facility 5(Non CAF)*
FI	Pahtavaara	Au	010304*	CAF	*1. Pahtavaara mine, tailings management facility 1 (Waste Code 01 03 06) (Non CAF)* *2. Pahtavaara mine, waste rock management facility 1* *3. Pahtavaara mine, waste rock management facility 2*
FI	Talvivaara, sotkamo, kajaani	Ni	010304*	CAF	No data available
FI	Kevitsa	Cu	010304*	CAF	*1. Kevitsa mine, tailings management facility A (CAF)* *2. Kevitsa mine, tailings management facility B (CAF)* *3. Kevitsa mine, waste rock management facility (Non CAF)* *4. Kevitsa mine, mine waste management facility of soil material (inert waste) (Non CAF)* *5. Kevitsa mine, mine waste management facility of soil material (Non CAF)*
FI	Kylylahti (Luikonlahti TMF)	Cu	010304*	CAF	*1. Kylylahti mine, NAF waste rock and soil material management facility (NAF = non-acid forming) (Non CAF)* *2. Kylylahti mine, PAF waste rock management facility (PAF = potential acid forming) (Non CAF)*
FI	Vammala plant	Au	010304*	CAF	*1. Concentration plant of Vammala, tailings management facility (Non CAF)*
FI	Laiva (Raahe region)	Au	010304*	CAF	
FR	Gardanne plant	Al	010309	Non CAF	*Site MangeGarri (non CAF)*
IE	Aughinish alumina refinery	Al	01 03 09	Non CAF	*CAF*
IE	Navan Tara Mines	Zn	01 03 06	Non CAF	*CAF*

PL	Lubin-Malomice	Cu	010381[115]	Non CAF	
PL	Polkowice-Sieroszowice	Cu	010381	Non CAF	EWF "Żelazny Most" waste facility - category A
PL	Rudna	Cu	010381	Non CAF	
PL	Olkusz-Pomorzany	Zn	010381	Non CAF	Non CAF
PT	Aljustrel	Cu	010304*	CAF	*Aljustrel - IR "Aterro Temporário de Feitais (non CAF)*
PT	Neves-Corvo	Cu	010304*	CAF	Tailings management facility (TMF) Category A facility
PT	Panasqueira	W	010306	Non CAF	CAF
RO	Rosia Poieni	Cu	010307*	CAF	*Tailings management facility (TMF) Category A facility*
RO	Manaila Polymetallic Mine	Cu	010304*	CAF	Category A Facility
RO	Tulcea – Alumina Refinery	Al	10309	Non CAF	*non CAF*
SE	Aitik	Cu	010304*	CAF	*CAF*
SE	Bjorkdal	Au	010304*	CAF	
SE	Boliden Area (4 mines)	Zn	010304*	CAF	*Kankberg (non CAF),Maurlidengruvan (non CAF),Renström (CAF), Kristineberg (CAF)*
SE	Garpenberg	Zn	01 03 05*	CAF	*CAF*
SE	Kiruna	Fe	01 03 06	Non CAF	*Kiirunavaara (CAF)*
SE	Leveäniemi (Svappavaara)	Fe	010306	Non CAF	*Gruvberget (Svappavaara) (CAF)* *Leveäniemi (Svappavaara) (CAF)*
SE	Lovisa	Zn	010304*	CAF	*Lovisagruvan (Non CAF)*
SE	Zinkgruvan	Cu	010304*	CAF	*Zinkgruvan (CAF)*
SE	Malmberget	Fe	010306	Non CAF	*CAF*
SK	Kremnica mine	Au	010304*	CAF	*Horná Ves (non CAF)*

[115] According to available information from the MS, the waste code that is being used for the tailings produced from the mixed sulfide ores in Poland is the waste code 01 03 81 Wastes from flotation enrichment of non-ferrous metal ores other than those mentioned in 01 03 80. However, this waste code is not included in the List Of Waste (Decision 2014/955/EU)

ANNEX N: RESPONSES TO 'LEGACY' QUESTIONNAIRE

(1) Austria

The Austrian Ministry for Sustainability and Tourisms has published its assessment of closed and abandoned EWF according to Article 20 EWD (https://www.bmlrt.gv.at/bergbau/Ver-ffentlichung-Bestandsaufnahme.html). This covered all EWFs that are not part of a currently licensed extractive operation. The assessment concluded that only one site, the milling residues deposit at the former copper mine Tessenberg (Tyrolia) will have to be further investigated. These investigations were on-going as per 29.10.18 (the date of the last revision of above Web-site).

Austria had established a register on heaps and tailings between the years 1993-2007 ("mining dumps register"). Using this inventory as starting point, a methodology taking the 'Guidance' document into account was set up. The respective work was carried out by the Austrian Federal Geological Survey in close cooperation with the Ministry for Sustainability and Tourism. Using its own methodology, Austria did not comment on chapter 1 of the questionnaire.

Concerning chapter 2 of the questionnaire on long term safety and the design base, the sites were reviewed from two perspectives:

- Backward oriented according to Article 20: the authorities tried to identify failures of the physical integrity of the installation detectable in the aerial photograph and took simple design parameters into account, such as slope angles in case of heaps, or capping/sealing in the case of tailing ponds.
- Forward oriented: According to the Austrian mining legislation, emissions have to be eliminated that can be avoided in accordance with the best available technologies. During the closure phase, installations have to be rehabilitated, when they do not fulfil the necessary technical requirements, e.g. as set out in Garbarino et al. (2018). The acceptance criteria are checked during the approval phase. For example, a proof of stability of dams is checked for the scenario of a 300-year flood, if this is relevant.

It may be noted that the criterion of a 300-year flood event appears to be protective, even for a significant climate change over the coming decades.

(2) Belgium

Responses from both regions, Flanders and Walloon have been received, which have different mining and regulatory histories.

Flanders did not use the 'Guidance', but had developed their own strategy for identifying relevant sites. However, in Flanders only industrial minerals in addition to clays, sands, and gravel are extracted.

Wallon, however, used the 'Guidance' as direct guidance. Walloon had a long tradition of metal and coal mining. It was noted, that the metal mines left little residues of concern behind and there have been no tailings ponds. Hence, no Article 20 sites were to be listed. The region compiled an extensive GIS-supported database on mine sites, which includes a categorisation according environmental risk (three categories) and a description of the site:
http://geoportail.wallonie.be/catalogue/63a32b78-6260-4646-8705-8b1e9e3392c5.html.

(3) Bulgaria

Bulgaria did not respond to the questionnaire on the 'Guidance'.

The Environmental Agency of Bulgaria publishes a simple list of sites, but with no details (http://eea.government.bg/bg/nsmos/soil/opis-na-zakriti-saorazheniya-za-minni-otpadatsi). It is not clear, whether this list contains all known closed and abandoned mine sites or only those according to Article 20 EWD. Closed uranium mining EWFs are not listed on the Web-site, though certain EWFs (e.g. the Buhovo uranium tailings pond) would perhaps fulfil the relevant criteria. Their legal status with respect to the EWD is not known.

None of the sites listed in the above link were covered by Cherrier et al. (2017). The link reported by these authors as being non-functional (http://eea.government.bg/bg/ nsmos/soil/opisminob.doc) does not point to a document on extractive waste (anymore).

(4) Croatia

The country joined the EU only after the 2012 deadline for the first submissions under Article 20, i.e. in July 2013. Croatian mining authorities stated in the workshop on the implementation of the Directive (March 2017) that there was no inventory yet and that they were working on it. In further communication, Croatia stated that they had not yet identified any sites to which Article 20 was applicable (Cherrier et al., 2017).

Croatia did not respond to the questionnaire on the 'Guidance'.

(5) Cyprus

Cyprus provides a list of 38 sites that would be classified into Category A according to Cyprus Law 82 (I)/2009. A further four sites were found, but they do not fall into the Cyprus category A. A simple justification is given, but no further details or co-ordinates: http://www.moa.gov.cy/moa/environment/environmentnew.nsf/All/3FC88CAC22E5817AC225814C003CF79C?OpenDocument

Cyprus did not use the 'Guidance' (pers. Comm. Emorfia Constantinidi, Department of Environment), but rather the evaluation was based on the Water Framework Directive and on a 'source – pathway – receptor'-model.

(6) Czech Republic

The Czech authorities did not respond to the questionnaire on the 'Guidance'.

However, the Czech Republic reports 21 sites in form of a list and an interactive map supported by a database (http://www.geology.cz/extranet/sgs/ulozna-mista-tezebniho-odpadu/registr-rizikovych-uloznych-mist). This database contains a large amount of detail on each site, albeit, of course, in the Czech language. The interactive map shows risk classifications for geological, hydrogeological and engineering geological risk as well as an overall hazard index.

The classification is based on a comprehensive risk assessment. The method is described in detail in Čížek et al. (2011). As most of the actual assessment of the Czech sites took place between 2009 and 2011, the 'Guidance' was not used as a screening tool *per se*, but as a tool to aid in the decision, whether a site should be included in the register (Čížek et al., 2011, p. 9/10). The criteria selected were similar to those proposed in the 'Guidance' (Čížek et al., 2011, p. 13) and a conceptual risk-pathway-receptor model was used. The risk assessments were based on extensive field work. This included engineering geological works as well as radiometric surveys. Cumulative risk quotients are calculated from these data using different exposure models for different media (Čížek et al., 2011, p. 68ff) and given for each site in the database.

None of the extensive uranium mining sites in Bohemia and Southern Moravia appear to be listed. It would need to be ascertained, whether the related EWFs are considered closed or still operational.

(7) Denmark

Denmark stated that there are no sites to which Article 20 is applicable and, hence, no inventory is required (Cherrier et al., 2017).

(8) Estonia

The Estonian authorities were not invited to comment on the 'Guidance' given the limited extractive activities in the country. The major EWF of relevance to this study in Estonia is the Sillamäe tailings pond. Due to its precarious location at the Baltic coast it has been the subject of various rehabilitation projects after 1990. However, it is classified as a 'nuclear' site and, therefore, not covered by Article 20.

The country undertook an extensive survey of the relevant EWFs in order to prepare the inventory required under Article 20 EWD (Tamm & Ideon, 2011). An overview and general information (location, size, etc.) of the closed waste facilities, including abandoned waste facilities, from extractive industries, such as oil shale, dolomite and limestone, phosphate and Cambrian clay mines and open pits are given in this report on the first phase of the project. The data for overview was gathered from existing investigation reports and during visual inspections of some waste facilities. EWFs that did not pose risks to the environment or human health were excluded from further investigation. The categorisation of the EWFs was undertaken according to the Commission Decision 2009/337/EC (EC, 2009c). All potential Category A facilities were waste rock piles from the processing of oil shales. A total of 32 such EWFs were listed in the inventory, with another five from mining other non-metallic minerals.

In the second phase, the risk assessments were deepened by detailed field investigations. These investigation comprised:

- Thermal imaging of burning waste rock heaps;
- Direct measuring of soil temperature in the surface layer of oil shale waste rock heaps;
- Determination of the environmental impacts of burnt or still burning waste rock heaps to the soil and groundwater. The concentrations of dangerous substances in the soils and water were compared with the applicable environmental regulations;
- Air emissions were measured at the burnt oil shale waste rock heaps.

As a the result of these investigations and subsequent detailed risk assessment only one oil shale waste rock heap (Kukruse) was classified as a Category A. In the short to medium term, the Kukruse

waste rock heap has the potential of becoming a serious threat and the cause of a major accident by spontaneous combustion. Air emissions (H_2S, CO, VOC) from this EWF could pose a threat to human health. There is also the risk of dangerous substances leaching to the groundwater. Studies to determine rehabilitation options are being undertaken.
While the remaining nine oil-shale EWF were classed into Category B, a more detailed monitoring across their depth might be warranted to better understand the potential combustion processes in such heaps (Tamm & Ideon, 2012).

The ‘Guidance’ was not cited in the above the reports, so it must be concluded, that it was not used in developing the inventory.

The country currently reviews the sites in question with a view to update the inventory.

(9) Finland

The investigations into closed and abandoned EW sites were carried out by the Geological Survey of Finland (GTK), Kainuu Business, Transport and Environment Center (ELY Center) and the Finnish Environment Institute (SYKE), commissioned by the Ministry of the Environment. The risk assessment procedure outlined in the EU Commission’s guidance (Stanley et al., 2011) has been used to categorise the areas, and the review was supplemented by factors relevant to the Finnish circumstances (Räisänen et al., 2013). The material used in the report consisted of the Geological Survey’s databases, publications, reports, environmental management documents and environmental management geographic information. The survey identified a total of 53 mining waste areas from 37 mines that could cause serious environmental pollution or potential environmental hazard. In addition to the location of the waste sites, the published list includes information on waste volumes and needs for further research in 30 areas. None of the areas assessed, as they stand, present a major-accident risk. Recommendations for follow-up are given at the end of the report. The Finnish authorities have published a two-page PDF with a list of the sites and what was mined, but no further details are given and no information on rehabilitation state (http://www.ymparisto.fi/download/noname/%7B338BC4F5-62BF-4C76-A755-A6F1CB06E2E0%7D/44798).

(10) France

France has not been able to respond to the questionnaire on the ‘Guidance’ before the deadline.

In France the last iron-ore mine was closed in 1995 and the last uranium-mine in 2001. The potassium-mining in Alsace stopped in 2003 and coal-mining in 2004. Apart from geothermal water extraction, extractive activities are limited to underground salt mining (by solution mining), bauxite and hydrocarbons. Other industrial minerals are extracted in mainly open-cast mines. The closure of a mining operation and its EWFs does not result in the definitive disappearance of the risks and nuisances that may result. While mining in France has a very long history, post-mining management was put in place only at the end of the 1990s as a result of subsidence in the Lorraine iron ore basin that destroyed dozens of homes.

As part of residual mine risk management, the current Ministry of Ecological and Solidary Transition (Ministère de la Transition Ecologique et Solidaire, https://www.ecologique-solidaire.gouv.fr/) is responsible:

- to draw up the technical rules to be applied when the mining works are closed;
- manage and monitor post-mine work (waiver of concessions, safety work, monitoring).

In these missions, it is supported by:

1. GEODERIS, national experts of the post-mine management, who gather competences of the National Institute of the Industrial Environment and Risks (INERIS) and the Bureau of Geological and Mining Research (BRGM);
2. the Department of Prevention and Mining Safety within the BRGM, whose main missions, defined in le décret n°59-1205 du 23 octobre 1959 relatif à l'organisation administrative et financière du BRGM and includes:
    - works to make sites safe, as delegated by State contracting authority;
    - monitoring of mine site works under the Environment and/or the Mining Code;
    - management of the mining technical archives.

Current risks from closed EWFs are managed by assessing the hazards and their levels. On this basis a decision is made on the adequate route of actions, including:

- site monitoring;
- rehabilitation to render EWFs safe;
- expropriation, if the site poses a serious threat to the environment or humans.

Potential future risks are addressed by appropriate land-use management, in particular with respect to residential development. Hazard maps have been developed and, where needed, a mine risk prevention plan (MRPP) put in place. In case the soil is already contaminated, the respective information is published.

The legal basis for the MRPPs is the circular of 6 January 2012, repealed and replaced the circular of 3 March 2008 on the "objectives, content and elaboration of the MRPPs". Its purpose is to provide methodological elements for the management of residual after-closure mining risks, and to specify and update the procedures for developing and / or revising the MRPPs.

Inventory of sites under Article 20 of the EWD (Directive 2006/21/EC)
GEODERIS built between 2009 and 2012 an inventory of EWFs by grouping them into classes. This inventory includes 28 sites across France, most of them metal mines.
https://www.ecologique-solidaire.gouv.fr/sites/default/files/2017%2003%2017%20Tableau_Mise_en_ligne%20Inventaire%20DDIE%20pour%20site%20internet.pdf

The approach to post-mining risk management has been outlined in Salmon et a. (2017). In the case of metal mining, the EWFs have been defined and prioritized into six classes, from the least to the most impacting public health and / or the environment: A, B, C-, C+, D and E). For classes C, D and E, additional studies are to be conducted. Note that unlike in the EWD, 'class A' is the 'best', with the least impact. Areas with a class D or E pose a significant risk to the environment and human health and require a thorough assessment, if this has not already been done. The studies consist of a detailed assessment of the environmental impacts and health risks for the entire area. It is also based on the tools defined by the national methodology for the management of polluted sites and soils, revised in April 2017, and in particular on the IEM (Interpretation of the State of the Environment) approach. Since 2012, GEODERIS has carried out studies on about twenty sites classified into E, D or

C+. However, the published list of 28 sites does not give any details on the sites and their actual classification.

The former uranium mining sites are presented in great detail in an interactive map: https://mimausabdd.irsn.fr/. Details of the amount of material extracted, the amount of uranium and the rehabilitation undertaken are given for many sites.

(11) Germany

In a communication from 25.04.12 the German government notified the European Commission that there are no sites according to Article 20 of the EWD on the territory of the Federal Republic of Germany.
The status and responsibilities of submissions according to Article 20 EWD in Germany are not very transparent, which is due to the federal structure with distributed responsibilities. Collection and assessment of data falls within the remit of the Länder authorities. This distribution of responsibilities made it impossible to obtain information on, whether and how the 'Guidance' on screening for Article 20 was used. The submission to the European Commission being a Federal prerogative, the mining authorities in the Länder, who are in charge of collating the information are in general not prepared to discuss the issues.

The Federal Ministry for Research and Technology (BMFT) is well aware of the circular economy needs and has funded from 2013 to 2016 a programme to investigate *inter alia* the possibility of mineral raw materials extraction from old mine waste (r^3 – Strategische Metalle und Mineralien / Innovative Technologien für Ressourceneffizienz, http://www.r3-innovation.de). In this context three projects were concerned with the mapping of old mine waste sites (REStrateGIS), the utilization of materials contained in old mine waste in the West-Harz area (ROBEHA) and in Saxony (SMSB) (see https://www.fona.de/mediathek/r3/pdf/r3_kickoff/8_Gutzmer_Haldencluster.pdf). The cadaster of old mine sites that was compiled by REStrateGIS (https://www.ressourcenkataster.de/) is currently off-line.

The BMFT continues to fund projects that address the recovery of mineral raw materials from closed and abandoned EWF through a follow-on programme: These approaches are also integrated into regional development projects: http://www.recomine.net/vision/.

The German environment agency (Umweltbundesamt) is engaged in research on tailings pond safety and contributes to the UNECE Convention on Tailings Management Facility Safety (UNECE, 2014). The aim is to have a fast and reliable method to estimate risks (VIJGEN & NIKOLAIEVA, 2016). In this context also a Tailing Hazard Index was developed and tested on examples in the Ukraine (https://www.umweltbundesamt.de/en/publikationen/improving-the-safety-of-industrial-tailings).

On the territory of the former GDR many mine sites and EWFs existed that had not been properly closed by 1990 and that required rehabilitation. All sites and facilities that either were in public ownership or for which no rightful owner could be established immediately were transferred after 1990 to a state-owned trust organisation (Treuhandanstalt, THA). THA set up two organisations that dealt with the mining legacies, the Lausitzer und Mitteldeutsche Bergbau-Verwaltungsgesellschaft (LMBV) and the Gesellschaft zur Verwahrung und Verwertung von stillgelegten Bergwerksbetrieben (GVV). LMBV mainly dealt with the lignite mining legacies, while GVV's remit were all other types of mining activities, except uranium (which is the remit of WISMUT GmbH). GVV and LMBV are now merged. These organisations owned and assessed for environmental relevance all mining sites on the territory of the former GDR, so that there are no 'abandoned' EWFs. Similarly, there are no 'abandoned' sites in the former West Germany that need to be considered under Article 20 EWD and all 'closed' EWFs had been made safe.

It seems that the submission of the Federal Government to the Commission in 2012 was strictly based on the criteria of 'closed' and 'abandoned'. There are publications at Länder-level (e.g. SMUL, 2014) that indicate that EWFs still existed that may have posed a significant threat to the environment. However, these where in the process of rehabilitation at the time and their rehabilitation has been completed since:

- Lautawerk, Saxony. Red mud has been deposited in a former open-cast (lignite?) mine. A separation dam was considered unsafe (SMUL, 2014).
- Freital-Saugrund. Complex mining and industrial site, including coal-mine waste and uranium mining tailings dams (not part of WISMUT anymore). The latter are currently rehabilitated or have already been rehabilitated (SMUL, 2014).
- Zinnerz Ehrenfriedersdorf GmbH. Mining and milling wastes in dumps are currently rehabilitated in order to prevent infiltration and, hence, migration of heavy metals (SMUL, 2014).

(12) Greece

In 2012 the Directorate of Environmental Licensing (Ministry of Environment and Energy) published a Study for Inventory of closed waste facilities. Article 21 of the Joint Ministerial Decision 39624/2209/E103/2009 states:

"*The Ministry of Environment and Energy in cooperation with the Ministry of Development and Investments set up an inventory of closed waste facilities, including abandoned facilities, which cause serious adverse environmental impacts or have the potential of becoming in the medium or short term a serious threat to human health or the environment is drawn up. This inventory is updated every three years and the updates will accessible to the public. The methods set out in Article 21 of Directive 2006/21/EC shall be taken into account for carrying out the above inventory, which shall be conducted until 1 May 2012*."

The study is based on the investigation of the Hellenic Survey of Geology & Mineral Exploration (HSGME), which took place in closed/abandoned mines all over the Greek territory. It is noted that the remit of the HSGME investigation did not include quarries, bauxite mines and lignite fields and neither areas of known mine ownership.

Principles and methodology of HSGME investigation:

- Bibliographic research in order to collect information on the type of mine, its historical route, the waste that were produced and the geological conditions;
- Selection of the mines with the following characteristics:
    - Unknown owner of the site
    - The site is or has been returned to public ownership
    - No maintenance/rehabilitation has been undertaken
    - The extractive activity has ceased without rehabilitation

For the risk analysis of the abandoned/closed facilities the main groups of classification criteria examined are:

1. Disposal characteristics: type, composition, volume of waste, extractability of contaminants
2. Water body characteristics
3. Distance of water body from the facility
4. Distance of human settlements

5. Distance from ecosystems – archaeological sites
6. Special local features

In 2012 a total of 19 abandoned EWFs were investigated. At some sites rehabilitation is being undertaken none has been completed as of today.

The obstacles to rehabilitation are the costs of such works, problems with the ownership and regulatory issue. There are some examples were the rehabilitation process is already licencesed and today some areas are already rehabilitated (e.g. Mines of Laurion). There is also another case, where the rehabilitation of some closed extractive waste faclitities were licenced under the Approval of Environmental Terms of a company. Specififcally, the ministry report mentions that the approval was for the transferring of the old tailings to a Category A EWF, in order to assist the rehabilitation process. However, today this activity is seaced because the materials underneath the actual tailings are considered as "soil (including excavated soil from contaminated sites), stones and dredging spoil" and not 'extractive' waste from a regulatory perspective and, therefore, could not be deposited into an EWF. Currently, there is no standard licensing procedure that will resolve this regulatory issue.

Reference
http://www.ypeka.gr/Portals/0/Files/Perivallon/Diaxeirisi%20Apovlitwn/Eksoriktika/09.pdf

(13) Hungary

The Geological Survey of Hungary used the 'Guidance' as direct guidance for identifying relevant sites (Kiss et al., 2012). In some cases the criteria were adapted in order to account for the absence of relevant data (e.g. the heavy metals present at the sites). As the 'Guidance' did not make an explicit reference to Cat. A site, being meant for sites that were closed and abandoned before the EWD came into force, such sites were not re-classified.

The site identification proceeded in steps, starting from desk-top studies. Some of the criteria for preliminary risk-ranking, such as the size of the EWFs, were difficult to apply in practice: due to changes in the landscape and overgrowth, the boundaries were difficult to establish using satellite images. Cross-checking with archival sources did not necessarily help, as often there has not been a clear distinction between waste heaps and installations such as tailings ponds. Given the difficulty of delineating heaps or tailings ponds in satellite images, rather than the elevation above the average ground, the steepness of slopes based on a digital elevation model (DEM) was used as a criterion.

The potential heavy metal content is a useful criterion, but at the beginning of the assessment very little was known, so it was assumed that all former metal mines were potentially relevant. Whether any potentially dangerous chemicals were used could only be answered for those EWFs with historical records. In the case of bauxite processing, the tailings ('red mud') would be highly alkaline. Whether a high-permeability layer was potentially underneath an EWF was decided on the basis of a national surface permeability map that has three classes of permeability. The criterion of proximity of water courses with a guidance value of 1 km distance was only partially useful, as it does not relate the EWF to the relevant catchment area. Thus a close surface water course may belong to a different catchment area with little chance of contamination, while a water body further away, but in the same catchment area as the EWF may be exposed to a risk of contamination. GIS data on the quality of surface waters are available and can be related to the hydrogeological situation of an EWF.

The effect of natural vegetation or re-vegetation against wind erosion can only be assessed for sure in the field. Conversely, the question, whether an EWF had been covered cannot be decided in most cases on the basis of aerial photography or satellite imagery alone due to the natural development of vegetation.

The proximity to human settlements and protected areas (such as Natura 2000 sites) can be evaluated in the respective GIS databases using filtering. The proximity to agricultural land and livestock also can be evaluated based on CORINE land-use maps.

No information was given on the design criteria applied to closed and abandoned EWFs as presumably the relevant information was not reviewed or available, when the inventory was drawn up.

(14) Ireland

Ireland did not use the ‘Guidance’, as the Historic Mine Sites Inventory and Risk Classification had already been published in 2009. This included field work and so there was no need to carry out a desk based study which the Guidance Document, Stanley (2011) provided for. Not surprisingly the Irish authorities agree in principle with the concepts and criteria put forward in the ‘Guidance’, as it was partially developed by them. It was questioned, however, whether the size criterion of 10,000 m^2 for an EWF might not be too stringent and putting many small facilities onto the list.

A historic or closed mine site can be defined as one, where minerals are not being worked, the mine site is not in the process of rehabilitation and is not under active management (addressing health and safety, and environmental issues) by a competent person. A competent person is a person who has the technical knowledge and experience to manage the site.
http://watermaps.wfdireland.ie/ExtractiveFacilities/SearchResults.aspx?entrymode=SiteStatus&querytext=Closed

Registry of closed sites, but none is abandoned, none ‘Regulation 20’ (= Category A)
The report by Stanley et la. (2009) on “Historic Mine Sites – Inventory and Risk Classification (HMS-IRC)” identified 82 sites based on a risk classification similar to the ‘Guidance’, for which Ireland was the lead author. It does not cover gravel pit and quarry wastes. Volume I of the study focuses mainly on the contamination aspects. Volume II of this study, that concerns inter alia the geotechnical aspects does not seem to be available as yet.
“*In recent years, detailed investigations have been carried out at a number of the larger abandoned/closed base-metal mine sites, namely Silvermines, Co. Tipperary, Tynagh Mines, Co. Galway, and Avoca Mines, Co. Wicklow. The DCENR with Tipperary North Riding County Council (TNRCC) is currently carrying out large-scale remediation works at Silvermines. A detailed feasibility study for the remediation and long-term management at Avoca managed by the GSI has been completed (Camp, Dresser and McKee (CDM), 2008) and the EPA carried out investigations at Tynagh*.” (Stanley et al., 2009).

There is a database downloadable from http://www.epa.ie/pubs/reports/land/mines/, but seems to require a specific kind of software to read that was not available to the authors.

(15) Italy

Italy used the ‘Guidance’ to develop their inventory. The country developed its own set of guidance documents on this basis and on methods for risk calculation (A.R.G.I.A., Analisi relativa di Rischio per la Gerarchizzazione dei siti Inquinati registrati in Anagrafe, ISPRA, 2004). Initially data on the heavy metal content of mining residues were not available, so that the relevant criterion was only partially useful for a desk study. Likewise, data on the mining and milling processes and, hence, on any dangerous substances used were not available or required extensive archival research. Area, height of heaps and basins, and angles of slopes on which EWFs were constructed, together with other parameters, such as the volumes, were parameters used in calculating the structural risk index. It was noted that the criterion of the distance to surface water courses must be related to the geological and hydrological context (surface and subsurface catchment area) and cannot be a fixed threshold number. Also, a priori no information on the permeability of the layers underneath the EWFs were available. Italy, being a Mediterranean country, has areas with only scattered vegetation. Such areas exposed to potential wind erosion can be identified on satellite imagery. It appeared that in most cases mining residues remained uncovered and there were only some archival references to covers being constructed.

In some cases the respondents to the questionnaire on the ‚Guidance' seems to have misunderstood its purpose. Rather than commenting on the usefulness of the criteria, they reported on the presence of sites in Italy corresponding to such criteria.

The country compiled a detailed database of sites and their status, organised by provinces, plus supporting reports (APAT, 2006). The 650 identified sites (Summary: http://www.isprambiente.gov.it/it/banche-dati/strutture-di-deposito-di-tipo-a) are grouped into three risk classes (medium, medium-to-high, high) and structural risks are distinguished from other types of risks. Only 20 sites, however, are considered structurally unsafe, while 108 further sites pose other types of risks. Most of the sites are located in Sardinia, Tuscany and Lombardy.

Provincial maps and details on sites and their status in XLS-format can be downloaded at http://www.isprambiente.gov.it/it/banche-dati/strutture-di-deposito-di-tipo-a.

(16) Latvia

Lithuania stated that there are no sites to which Article 20 is applicable and, hence, no inventory is required (Cherrier et al., 2017).

(17) Lithuania

Lithuania stated that there are no sites to which Article 20 is applicable and, hence, no inventory is required (Cherrier et al., 2017).

(18) Luxemburg

Luxemburg stated that there are no sites to which Article 20 is applicable and, hence, no inventory is required (Cherrier et al., 2017).

(19) Malta

Malta stated that there are no sites to which Article 20 is applicable and, hence, no inventory is required (Cherrier et al., 2017).

(20) Netherlands

The Netherlands stated that there are no sites to which Article 20 is applicable and, hence, no inventory is required (Cherrier et al., 2017).

(21) Poland

Poland did not use the 'Guidance', instead they used their own Methodology (Faijfer et al., 2010). The Polish authorities commented on the 'Guidance' and pointed out that some of the screening criteria would require contextualisation and may need to be related to the actual surroundings of the EWF:

- The height criterion (Q9 of the questionnaire) should be connected to spatial planning scheme of the surroundings and take into consideration additional factors, such as terrain inclination, etc. Particularly in areas with a pronounced topography this criterion as such may not mean much.
- The proximity of a water course (Q10) alone is not very meaningful without information on its size and flow velocity/rate; most importantly an absolute distance criterion is meaningless, if the respective water course belongs to a different catchment area, which may well be the case in mountainous areas.
- Q13 and Q14 are usually related, i.e. when the EWF is covered, there would be no exposure to wind.
- Also, the distance to settlements (Q15) is not really very meaningful without taking into consideration the topography and perhaps the climatology.

The country appears to have a comprehensive programme of assessment, but it is done on the basis of provinces (Voivodships) and finding the information is tedious, i.e. *https://www.slaskie.pl/download/content/66534*, or https://www.malopolska.pl/_userfiles/uploads/PGOWM_zalaczniki_02_07_2012_1.pdf

There does not appear to be a central database. However, a database of various mine waste deposits is available under https://cbdgportal.pgi.gov.pl/haldy/. These EWFs are all aligned along the border to the Czech Republic, so that this is probably not a comprehensive list. There is also a document by GIOS (Inspectorate of the Environment), that lists 17 EWFs with a negative impact on the environment. It is not clear, however, whether these are Article 20 sites (http://www.gios.gov.pl/bip/zalaczniki/spis_zouow_wrzesien_2012.pdf).

(22) Portugal

The Direção-Geral de Energia e Geologia (DGEG) did not respond to several attempts to contact them for the purpose of this study. They have a link (http://www.dgeg.gov.pt/?cr=13014) to a MS EXCEL-Table with EWF information dated to 2012. Some sites are marked as 'rehabilitated'. This inventory lists 26 'Category A' EWFs and includes some of the uranium mining sites. This is at odds with the inventory supplied to the EU, which lists in total 175 EWFs. The latter may include also sites that would not qualify under Article 20 EWD.

(23) Romania

Romania did not respond to the questionnaire.

It appears that the assessment of the respective mining legacies was undertaken in several iterations since 1999. Lists of heaps and tailings ponds were published in 2012, but the links on https://ec.europa.eu/environment/waste/mining/implementation.htm are non-functional.

In 2017 an 'Interministerial Commission for the National Inventory of Waste Dumps and Tailings' was set up, that reviewed the current situation (Ministry of the Economy, 2017). Regional authorities were instructed to undertake visual inspections. On this basis a number of problematic cases were identified and recommendations for action made. It was also recommended that the list of Article 20 sites be revised.

It was noted that none of the uranium mining sites were found on these lists and their status would need to be verified.

(24) Slovakia

Slovakia used the 'Guidance' to develop their own guidance document. The respondent however also misinterpreted the questionnaire on the 'Guidance', commenting on the occurrence of sites with qualifying according to the criteria set out, rather than commenting on the usefulness and applicability of the criteria. On the basis of some of the responses to the questionnaire, one may conclude that the way in which some criteria have been phrased in the 'Guidance' may be confusing to non-english speakers.

It appears that the assessment was not only based on desk-top studies, but involved also field inspections. The off-site contamination criteria were replaced by actual data.

An inventory of EWFs in Slovakia is available on the interactive Web-site: http://charon.sazp.sk/Odpady_tp/Ulozisko.aspx

Of the 338 EWFs listed, 28 are considered as qualifying under Article 20. A further 33 are considered as potentially posing a risk, and 277 as not posing a risk. To the contrary, the list supplied by DG ENVI contains all 338 EWFs. No information on possible actions on the sites considered to pose a risk is given. This inventory is only available in the Slovak language.

(25) Slovenia

Slovenia used the 'Guidance' to develop their own guidance document. The inventorisation of closed mine waste facilities was carried out in three phases comprising 1) selection of closed mines, 2) pre-selection of closed and abandoned mine waste facilities, and 3) risk-based classification of closed and abandoned mine waste facilities. The question whether there has been a known incident with the EWF was used as the first and most important criterion in Phase 2. Some of the criteria were slightly modified. Thus all metal mines were considered for further investigation, when no data on the ore assembly and processing were available. The surface area criterion was augmented by including also the total volume of material deposited, which may be more adequate in mountainous terrain, namely 50,000 m^3 for metal mines and 200,000 m^3 for coal mines. It was noted that a criterion of a height of 20 m might not be conservative, as the stability strongly depends on the grain-size distribution and type of material deposited. Conversely, it was noted that the slope angle for the foundation is set quite conservatively, as many spoil heaps can be found deposited on much steeper slopes, but are still stable and pose no threat. A useful additional criterion would be the drainage conditions within in spoil heaps and in their foundation, which strongly affects stability of spoil heaps. However, this will require a more detailed understanding of the underlying geology or site investigations, so for a screen the conservative value for the slope angle would be adequate. It was further noted that the criterion concerning the permeability of the underlying geology would be useful in principle, but that there usually is an a priori lack of information during a desk-top screening process. Also the criterion re. exposure to wind erosion has to be relativised, as it depends on the type of waste on the surface of the heap and not only on the presence or absence of a cover. In mountainous territory the distance of 1 km to settlements may not be conservative, as erosion event could spread material rapidly much further.

Stream waters and solids are monitored to detect releases from EWFs.

Overall the assessment resulted in a comprehensive, but static report (Gosar et al., 2014).

This list is being reviewed in three-year intervals, the next review is to be undertaken this year (2020). None of the mine sites listed in the report has been remediated.

(26) Spain

Spain did not respond the questionnaire.

However, Spain has developed a guidance document for screening of sites according to Article 20 EWD (Alberruche del Campo et al., 2016). This document observes that “the [EWD] does not provide an express definition of what is considered an abandoned mining waste facility, leaving the interpretation open for the member countries of the European Union (EU). In this Guide, only closed and abandoned waste storage facilities associated with mining activity which has ceased, with or without a responsible body or person identified, which might represent a risk to the health and safety of human beings and the environment are considered, according to the concept of ‘pasivo ambiental minero’ (Arranz and Alberruche, 2008; Moreno and Chaparro, 2008; Guzmán Martinez et al., 2020) or that accepted by the Association of Ibero-American Mining and Geology Services (ASGMI, 2010).” This guide is based on a comprehensive review of EU and international practices in screening for and assessing such sites. Alberruche Del Campo et al. (2016) noted that the ‘Guidance’ (Stanley et al., 2011) requires *a priori* documentary knowledge of the sites, which in many cases is not available, particularly for abandoned sites. Therefore, a simplified risk assessment procedure was developed for Spain. The method is based on developing risk scenarios and with a prioritisation of the sites in mind already. Unlike the ‘Guidance’ these risk scenarios also consider (qualitatively) the stability of retaining structures (dams), the effects of erosion on retaining structures, seismicity, and the effects of ‘human intrusion’. In many parts of Spain there is little connected vegetation on the ground, so that erosion is a more serious problem than in area with a more temperate climate and denser vegetation. Overall, the method developed for Spain goes far beyond what was attempted in the ‘Guidance’, being more based on real site assessment, requiring a considerable amount of site data. This has the potential for a quite realistic assessment of the situation with respect to closed or abandoned EWFs in Spain. A risk matrix is used to calculate what would be considered a serious threat as per Article 20 EWD.

Unfortunately, the Spanish authorities did not respond to the questionnaire on the ‘Guidelines’, so that it is not known, whether the list of sites submitted to the Commission was actually drawn up on the method described by Alberruche Del Campo et al. (2016).

(27) Sweden

The 'Guidance' has not been used in the Swedish inventory of closed and abandoned extractive waste facilities because another method was already in use at the time, when it was published. As there is a national inventory of contaminated sites, Sweden chose to continue with its method, so that all types of site were assessed with uniform criteria, allowing comparisons.

The Swedish inventory was built using the 'MIFO' method (SEPA, 2002) and the work was undertaken between 1999 and 2015. A wide range of industries were identified that could be responsible for ground contamination. The purpose was to identify those sites with the most urgent need of attention. The method was developed for an assessment of risk on an uniform basis and with a reasonable degree of reliability. By applying a uniform method, sites can be compared in order to set priorities for further investigation and rehabilitation, and to make decisions about hazardous and suspected hazardous sites. The method consists of three parts: The first part is concerned with environmental quality criteria for contaminated areas, including a method for risk classification, the second part provides guidance for the collection of data required for risk classification; the third part, describes the analytical procedures that form part of the method.

This inventory is not specific for closed and abandoned extractive waste facilities and has been used for a wide range of other industries. The inventory lists about 85000 potentially contaminated sites, of which around 24000 have been classified into risk classes 1 to 4, were 1 is the highest risk and 4 the lowest. All of this collected information is stored in a database, that contains further information on the sites.

The inventory did identify most of Sweden's abandoned extractive waste facilities and prioritises those that constitute the highest risk to their surrounding areas. While the same method to identify and risk-classify was applied to all contaminated land in Sweden, it was slightly modified for the specific risk evaluation for the abandoned extractive waste facilities.
As the Swedish MIFO method is more general then the 'Guidance' and, in consequence, does not focus on the same mining specific questions. However do the MIFO-method has the aim of identify and prioritise the objects that constitute the highest risk for humans and the environment, which is a similar objective to that of the 'Guidance'.

The county administrative boards do have more detailed information on abandoned extractive waste facilities in their databases, where most of the information on Sweden's contaminated land is stored. A list of abandoned extractive waste facilities in risk classes 1-2 is available at:
https://www.naturvardsverket.se/upload/sa-mar-miljon/mark/avfall/Inventering-av-gruvor/forteckning-nedlagda-gruvor-2019-06-26.pdf,
http://www.naturvardsverket.se/upload/sa-mar-miljon/mark/avfall/Inventering-av-gruvor/forteckning-nedlagda-anlaggningar-12-04-27.pdf
but there are no details on these sites in this list. The list contains of both sulfide ore mines, iron ore mines, quarries, gravel and peat pits, if they are of the highest risk classes 1 and 2.

ANNEX O: EXAMPLES OF GOOD PRACTICE FOR REHABILITATION

Good practice concepts

For the reasons discussed in Section 3.3.5, it has not been possible to identify potential 'best practice' cases among specific examples listed in the MSs' inventories of closed and abandoned EWFs. Therefore, the rich guidance developed in the international context (e.g. EU, ICMM, UNEP, IAEA) and at national level in countries with a long mining tradition, namely Canada, South Africa and Australia has been reviewed.

The MWEI BREF (Garbarino et al., 2018) was developed for extractive operations under planning, in operation or under preparation for closure. As the environmental objectives for the post-closure phase under the EWD (2006) and the post-rehabilitation phase of a previously abandoned site are very similar, many of the BAT for closure described in Garbarino et al. (2018) will be applicable as rehabilitation solution.refer to a post-closure stage in their 'Best Available Technologies' (BAT) for rehabilitation, but it is not possible to give universally applicable 'good' or let alone 'best' practice examples of rehabilitation for a variety of reasons. One is, that the setting and initial situation for each EWF is different. Another reason is that the real long-term efficacy and stability of rehabilitation solutions will only be known by future generations. Our practical experience with mine and extractive waste rehabilitation dates back a few decades only (to about the 1960s) and largely concerns geotechnical aspects, where one can also build on the experience with civil engineering projects, extending perhaps the time-frame by another 100 years. There is comparatively little long-term experience with the geochemical evolution of EWFs. On the other hand, there are many industrial revolution, medieval or older extractive waste dumps that do not seem to cause significant environmental impacts (c.f. the geochemical study by Potter & Johnston, 2014). We can, therefore, only extrapolate our current geological, mineralogical, geochemical, and climatological knowledge to predict future system behaviour. Unlike for deep repositories for hazardous and radioactive wastes, the conditions at the surface of the Earth can change rapidly over the timescale of centuries. Particularly also in the context of climate-change, many climate-related parameters may change in a way that is difficult to predict. Our models for flooding frequencies and intensities are calibrated against measurements taken over the past 150 years or so, but the underlying conditions seem to change significantly. Still, such parameters are relied upon for the design of covers and drainage systems for rehabilitated EWFs.

Rehabilitation of previously closed and abandoned EWFs can aim to either remove the source or to cut the pathways by which impacts can occur. Source removal could include measures to transform non-inert extractive wastes into inert forms. Cutting of the pathways can be affected by either encapsulation or by removing the vector, particularly infiltrating surface waters. In the following several technical options for such actions are discussed. Some of the techniques discussed leave the extractive waste as such undisturbed and only improve its isolation, while other techniques require to dig up the material. Which technique is suitable depends not only on expected efficacy, but also on the total volumes to be managed and potential collateral impacts.

While most of the techniques discussed in MWEI BREF (Garbarino et al., 2018) are aimed atoperating mines, many can be employed analogously for rehabilitation of previously closed and abandoned EWFs. However, the term 'rehabilitation' as used in the MWEI-BREF can give rise to confusion, because it not only encompasses 'techniques' (or rather technologies) s.s., but also strategies, such as for instance '4.3.1.3.1 Progressive rehabilitation', which of course is effected by employing various techniques. Rehabilitation in reality is a process that should result in a state, in which a given site does not pose a threat to the environment or the health and safety of the communities living nearby or downstream.

The following overview focuses on long-term, final and stable solutions. During the implementation phase of rehabilitation, a variety of treatment techniques, such as for the treatment of contaminated effluents and seepage, as described e.g. in Garbarino et al. (2018) may be required. However, any process and technique that requires an industrial type plant with continuous attendance and maintenance is not ultimately a long-term solution.

The EWD implicitly refers to the long-term stability of the wastes to be deposited by distinguishing between ‚inert' and ‚non-inert' wastes. According to the relevant definitions in the EWD, inert wastes do not require significant measures to isolate them from the surrounding environment. In contrast, non-inert wastes need to be isolated from their surroundings by engineering measures. The level to which this needs to be done depends on the degree of hazardousness and the projected time evolution of the associated risk.

Previously closed and abandoned EWFs, i.e. their retaining structures, cappings or liners, are subject to change, alterations, or degradation, such as erosion. In the following paragraphs the processes and forces that may have altered EWFs over time and may compromise their function are discussed together with strategies to counteract and delay these alterations.

Rehabilitation of previously closed and abandoned EWFs may be undertaken years or decades after they originally fell into disuse. It is not unusual that in the meantime new ecosystems have developed on and around the EWF. Such sites have been left undisturbed and may have developed into safe havens for threatened flora and fauna.

As *inter alia* IAEA (2006), DHI et al. (2012), and ICMM (2019) note, orderly closure of EWFs is often integrated with closure of the mine. In the case of previously closed or abandoned EWFs, such an integrated approach is most often not possible anymore. A comprehensive risk assessment should be undertaken to weigh all benefits and costs of the envisaged rehabilitation solutions.

Source removal

(1) Potentials and exergy

Geological structures, including mineralisations, are in secular (dynamic) equilibrium with their surrounding environment. Exceptions are high-energy environments, such as coastal zones or alpine-style mountains for example. Excavating rocks or the construction of engineered structures, such as EWFs, disturbs the respective equilibria and increases the exergy of the materials. Translated into more practical terms, this means that while engineered structures may be stable over a human timescale, this is not likely to remain so over the extended timescales we expect EWFs to function. Due to natural weathering and related processes man-made slopes, dams, and similar features or retaining structures will slowly erode and collapse. This is generally due to high relief energy or chemical potentials stored within and that have the tendency to dissipate according to the 2nd Law of Thermodynamics. Rehabilitation of previously closed and abandoned EWFs and preparations for long-term safety, therefore, must aim to minimize these potentials with respect to the surrounding environment, in other words to reduce the exergy.

As part of the rehabilitation of a previously closed and abandoned EWF, it is therefore beneficial to investigate whether and how the re-equilibration processes can be enhanced so that the EWs become (more) inert. It is important to understand the natural processes that control the evolution of EWs after rehabilitation.

(2) Enhancing diagenetic evolution

An understanding of the natural processes of weathering and diagenesis for the given landscape helps to predict the geochemical and mineralogical evolution of the disposed wastes over long timescales. This in turn will help to understand, for instance, the acid rock drainage (ARD) generation potential and to design measures to combat it within the EWF, rather than to collect and treat the ARD downstream. A possible strategy is to blend or interlayer EWs with acid generation potential with EWs that have an acidity or redox buffering capacity (analogous to co-disposal in Garbarino et al., 2018, p. 320 and p. 326). Secondary mineral formation can encapsulate problematic minerals (source removal), clog existing pore-spaces (forming an ‘engineered’ hard-pan), and in this way reduce the action of the vector porewater (pathway reduction). As assessments and predictive modelling of such processes are complex undertakings, they would only be warranted (and affordable) for the higher risk EWFs appearing in MSs’ inventories.

Injection of solidifying agents, e.g. phosphate solutions, into tailings to form precipitates that effect both, encapsulation of problematic minerals (source removal) and clogging the pore space (pathway reduction) has been investigated (see e.g. IAEA, 2004b, for a review of relevant techniques). However, at present these must be considered as emerging techniques.

(3) Acceleration of alteration processes

A number of minerals, notably sulfidic ones, are unstable under atmospheric conditions. The presence of such minerals can lead to a prolonged emission of reaction products, for instance ARD, requiring the waste to be classified as ‚non-inert’. For such wastes it may be worthwhile to investigate the artificial acceleration of these alteration processes as part of the rehabilitation (analogous to Garbarino et al., 2018, p. 324). This can include the forced (*in situ*) oxidation of acid-generating sulfidic minerals under controlled conditions. The feasibility of such measures must be carefully studied and balanced against the costs/impacts of materials handling. They require sufficient permeability of the EWs and a natural or engineered liner of the area, where the wastes are deposited to allow the collection of the leachates (e.g. Westerstrand, 2009). The leachates must be neutralised in a treatment plant. Neutralisation residues may then returned to the EWF or another suitable disposal site. Under such a strategy, the final capping of the waste may be delayed until the acid generation potential has been largely exhausted.

(4) Reworking to extract ‚problematic’ or valuable components as by-products

Some components of previously closed and abandoned EWFs can actually be extracted for sale. Smaller quantities of EWs may be treated on specially prepared ‘heap-leaching’ pads (Figure O.1). This process may offer the opportunity to recover residual original ores or to extract other minerals previously not of interest.

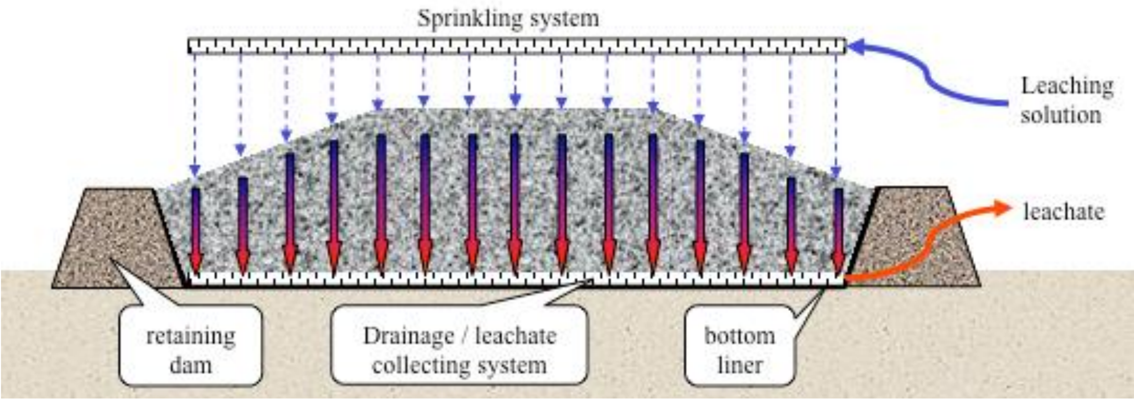

Figure O.1: The principle of heap-leaching (Source: IAEA, with permission)

Certain plant species have the ability to take up large quantities of metals, which can be used to extract these metals from contaminated material (see IAEA, 2004a, for an overview). The plants are harvested at the end of the vegetative period, incinerated, and the resulting ash is deposited in an appropriated EWF or may be processed into a by-product. The process is slow, and requires considerable maintenance (Garbarino et al., 2018, p. 383ff.), but may be cost-effective when metals levels are low. This is not a long-term solution but can help to reduce contamination levels at a site with a view to allow its return to a beneficial use.

Over the past 15 years or so a variety of EU (e.g. the SULTAN European Training Network, https://etn-sultan.eu/) and nationally funded (e.g. http://www.recomine.net/vision/) projects have been exploring the added value of reworking extractive residues with a view to generate the dual benefit of rehabilitating an EWF and extracting marketable materials. A practical challenge arises from the unknown and uncertain distribution of valuable components in the extractive wastes. Different types of extractive waste may have been deposited randomly in spoil heaps without records, so that the usual exploration methods are difficult to apply.

Although such reworking would be desirable from the circular economy perspective, the energetics (CO_2-footprint) and market conditions must be investigated carefully (see also Garbarino et al., 2018, p. 212). It needs to be assessed, whether such approach would be economically viable and would provide a net environmental benefit for the given circumstances. The viability may depend on the energy source available.

(5) Removal / Relocation

Managing a multitude of small previously closed and abandoned EWFs at one mining site can be a technical and organisational challenge. It may be worthwhile to investigate, whether the concentration of all extractive waste in one location, which then can be properly engineered, is technically and financially feasible. This then will result in the majority of locations qualifying for free release and beneficial after-use without any restrictions. It may also satisfy certain stakeholders concerns.

Reworking the extractive waste during relocation can have the added benefit of allowing segregation and possibly the extraction of marketable constituents that previously had not been of interest. It is important to undertake a comprehensive risk and environmental impact assessment before undertaking any such step. These assessments should include an energy balance and the assessment of off-site risks, such as traffic accidents, accident at work risks, and additional impacts from the relocation operation itself. Only when the benefits of improved manageability outweigh the sum of these risks, will such relocation have a net benefit. Notwithstanding such cost-benefit evaluation, removal/relocation can have a significant external societal benefit and may be the preferred option of nearby stakeholders. Apart from NIMBY-syndrome related motivations, the community might benefit from the availability of de-contaminated land. In the interaction with the stakeholders they must be made aware of possible costs and risk of removal/relocation – especially if a net benefit is not objectively identified.

(6) Segregation

A reworking the contents of a previously closed and abandeoned EWF requiring rehabilitation can give the *a posteriori* opportunity to segregate out 'problematic' components as well as those that may be marketable. Segregated re-emplacement of different materials, including overburden, allows for instance to put acid-generating materials below the future water table, or to mix materials with a view to utilise their buffering capacities or potential to form stable secondary minerals. Segregated emplacement of acid-generating overburden is common practice e.g. in lignite mining (Jolas, 2012). Whether reworking and retrospective segregation are economically viable depends on the risk and impact reduction potential and needs to be carefully evaluated.

(7) Removal of residual process chemicals

Removal of process chemical residues during rehabilitation of previously closed and abandoned EWFs may help if such residues can be better managed or destroyed outside the EWF. An adequate disposal route for chemicals that cannot be destroyed needs to be found, of course. A net benefit may be obtained, if the reactive chemicals can be sent to a hazardous waste facility despite significant disposal fees, because a possibly large EWF can then be more safely rehabilitated. The remaining material can perhaps also be used in other beneficial applications.

(8) Treatment of acid rock and contaminated other drainage

If contaminated drainage cannot be prevented at source and *in situ*, it will have to be collected and sent through a treatment plant (see Garbarino et al., 2018, p. 88 for a list of active treatment options). Active treatment is effective (more than 99% removal of sulfate and neutralisation, Garbarino et al., 2018), but is a less desirable option in the closure and rehabilitation phase, as the treatment may have to be run for extended periods of time, if not forever. It is difficult to conceive that treatment plants could be run for hundreds of years or longer. Thus, acid rock and mine drainage are best treated at root by suppressing the vector, i.e. preventing water percolation through rocks containing sulfidic minerals. Water treatment plants require a considerable infrastructure, energy expenditure, and are expensive to run. Therefore, more 'passive' alternatives should be favoured (INAP, 2008; PAT-ESPADAS et al., 2018).

Acid rock and mine drainage is a world-wide problem and dedicated associations, such as the International Network for Acid Prevention (www.inap.com.au) an the International Mine Water Association (https://www.imwa.info/) aim to foster research and guidance into its treatment and prevention.

Vector removal

The measures described above concerned mainly source removal. In the following measures to remove the vector (path) water are discussed. These measures often act in conjunction with measures to increase the physical long-term stability of the EWF by reducing the physical potentials.

(1) Accelerated dewatering of tailings

Owing to the fine-grained nature of tailings, the natural dewatering process is often slow and can take years. While modern tailings disposal systems dewater the tailings to a significant degree before disposal (see EUROPEAN COMMISSION, 2019), rehabilitation of previously closed and abandoned EWFs may require accelerated dewatering of already deposited tailings. Dewatering is needed to enable the following steps of rehabilitation, including capping. Drainage ditches can be dug into the surface of the ponds to accelerate drainage, but amphibious machines may be needed due to the thixotropic behaviour of the tailings. Another option are wick drains that are inserted from above and connected to surface drainage mats (Figure O.2).

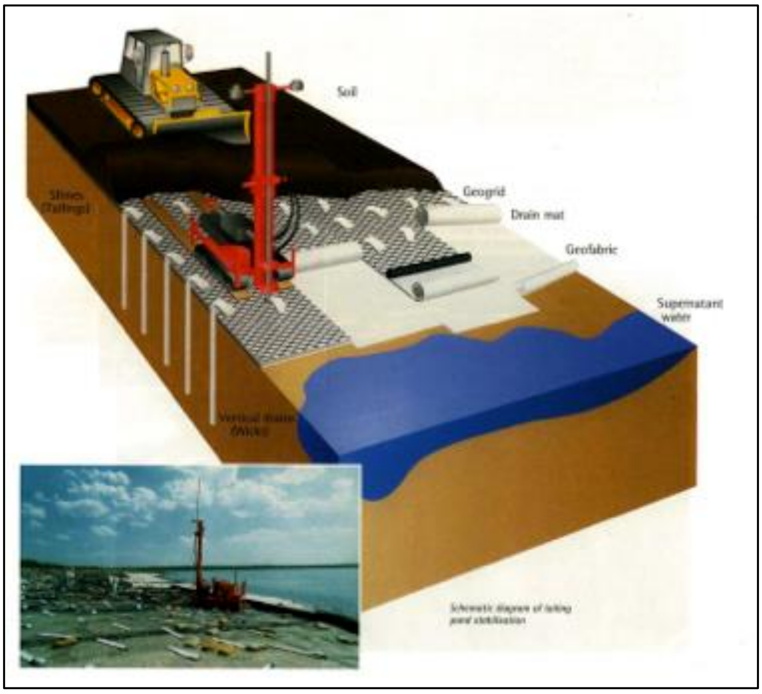

Figure O.2: Wick drainage system employed on uranium mining tailings ponds (Source: WISMUT GmbH, with permission)

In principle, bottom drainages can be installed *a posteriori*, but the necessary technology, horizontal drilling, is costly, so that other options are preferred. The same technique can also be used to construct bottom liners *a posteriori*, e.g. by injecting clay suspensions, but due to the size of tailings ponds, this too is rarely practical.

(2) Re-contouring

Features and shapes of mines and EWFs were typically designed with operational convenience in mind. This means for instance, that quarry faces are designed as steep as the material properties and the geology permits, or that the slopes of residue dumps are made as steep as possible to reduce the footprint of the dump. While such designs might find favour with regulators and other stakeholders alike due to the apparently small impacted area, they will not be stable in the long-term without maintenance.

It is obvious from Figure O.3 one must also consider the overall relief energy in the surrounding environment when seeking to rehabilitate a previously closed and abandoned EWF. Steep slopes and high surface run-off may compromise the long-term safety of a dump even though it has been put below the average surface elevation of the surrounding landscape.

High relief energy can not only compromise the geotechnical stability of slopes, but also enhances the action of erosional forces, namely that of surface run-off. To minimise the relief energy with respect to the surroundings, the rehabilitated EWF should mimic the surrounding topography. It is important to understand the function and evolution of the surrounding landscape and to integrate the man-made features into them (e.g. Zapico et al., 2017; Zhang et al., 2018). Modern surveying (e.g. air-borne photogrammetry, LIDAR) and modelling techniques allow to develop a detailed geomorphological analysis of the surrounding landscape. This in turn allows to analyse the surface drainage patterns. These analyses can then form the basis for developing a model of a most stable contour of the rehabilitated waste heaps, including the small-scale drainage patterns that mimic the adjacent landscape. Together with re-vegetation (where appropriate) this can lead to a stable, erosion-resistant geomorphology of the rehabilitated EWF (e.g. Zapico et al., 2017).

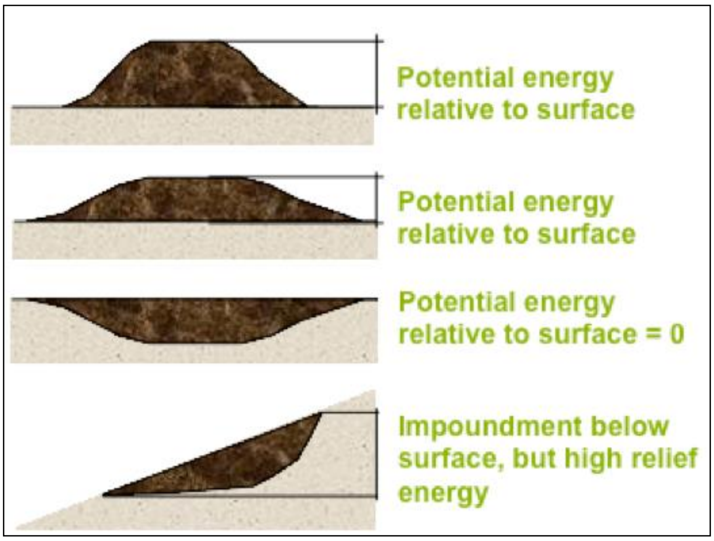

Figure O.3: Strategies to reduce the potential (or relief) energy in waste dumps (Source: IAEA with permission)

To ensure their long-term geotechnical stability, previously closed and abandoned tailings dams may also need to be re-contoured. This may involve in particular the re-enforcement of the toe- or starter dams (analogous to Garbarino et al., 2018, p. 266) with integrated drainage to prevent the build-up of phreatic surfaces within the dam. As part of dam rehabilitation, earthquake resilience may also need to be revisited. The recommendation of Garbarino et al. (2018, p. 275ff.) and of ICOLD (2016) should guide the respective actions.
Any re-contouring will also take into consideration future uses of the site, e.g. the need for access roads or flat areas for buildings, if such use is foreseen. The designs of re-contouring and capping, if needed, will also include re-vegetation in a systemic design. The aim is to create a feature that resembles the functional capabilities of the surrounding landscape as far as possible.

Some historical waste-heaps may not conform to these recommendations but have been stable without signs of erosion or emissions. In such a case, it will be better to not disturb them, but to confirm their continuing performance by monitoring.

(3) Capping

The capping of previously closed and abandoned EWFs has the purpose to prevent dust generation, provide an erosion barrier for the impounded wastes, and to keep the phreatic surface in the wastes low by preventing the infiltration of meteoric waters (analogous to Garbarino et al., 2018, p. 265; Zhang et al. 2018).

The concept of ‚engineering with nature' must be extended also to the cover design for rehabilitation of previously closed and abandoned EWFs (IAEA, 2006; DeJong et al., 2015). The profile and slope angle must mimic the local (top)soil profile to have comparable infiltration and run-off properties, which will counteract the erosive forces of surface precipitation. Sharp concave (in plain view) angles are to be avoided, as these will focus surface run-off and may give rise to gully erosion that penetrates into the waste.

Depending on the type of extractive waste, particularly its acid generation potential, and the local soil profile, a capping consists of one or more layers (Figure O.4). Often, a drainage layer (gravel or geotextiles) will be required above the waste to divert infiltrating water sideways away from the waste. Under natural conditions this water would eventually reach the groundwater table. Such a layer of coarser material also acts as root barrier, as the roots preferentially follow higher humidity zones. In certain instances, it may need to be designed to discourage the growth of larger trees. The coarse layer also acts as capillary break, preventing contaminated porewaters from rising into the capping (see also Garbarino et al., 2018, p. 363ff.).

During rehabilitation of previously closed and abandoned EWFs, a temporary cover or surface consolidation may be required to prevent wind-blown dust and erosion. In addition to the materials mentioned in Garbarino et al. (2018, p. 357), acrylic emulsions have been successfully applied for this purpose (IAEA, 2004).

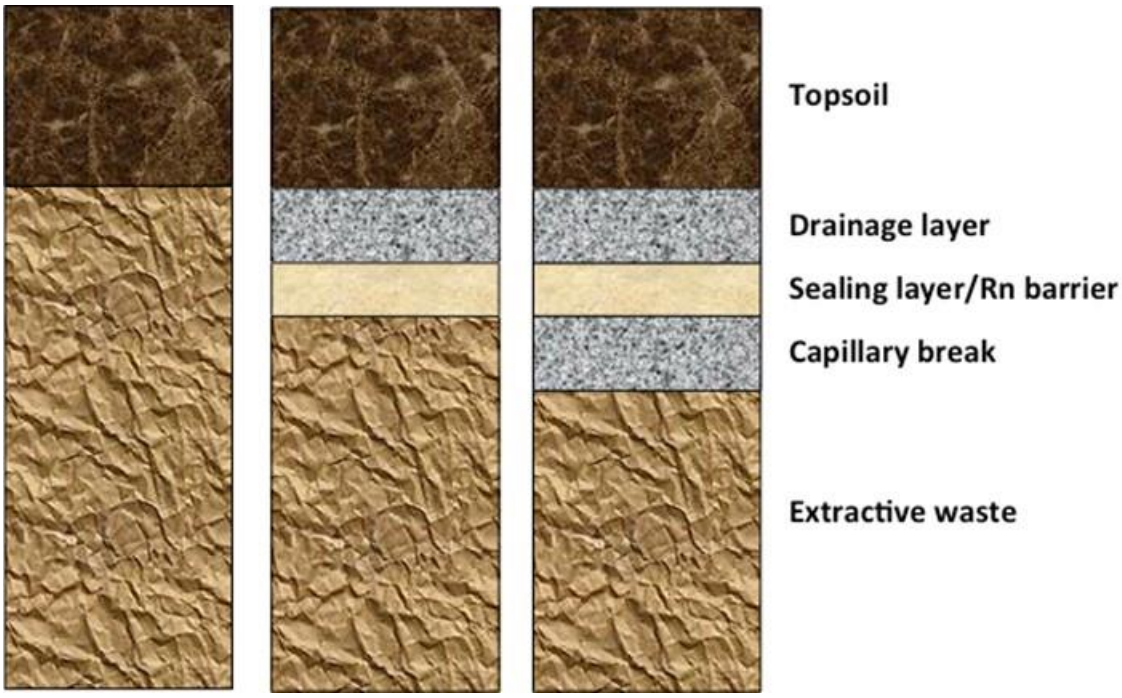

Figure O.4: Examples of multi-layer cappings (after Garbarino et al., 2018)

(4) Wet covers

In regions with a positive climatologic water balance, where perennial ponds and lakes exist, extractive wastes can be covered by a perennial layer of water. A typical situation is, where extractive wastes have been deposited back into an excavated pit, but also artificial lakes can be created on top of e.g. tailings dams (see Garbarino et al., 2018, p. 373ff. for a more detailed discussion of the latter situation). The water must be deep enough to prevent freezing of the whole water column and ideally should be deeper than the thermocline (the seasonal mixing depth) for the region to prevent the access of oxygenated surface waters. It would be also possible to establish a permanent wetland on top of an EWF (Garbarino et al., 2018, p. 378).

(5) Diversion of surface water inflow

Tailings dams and mine waste dumps are often constructed by (partially) infilling of valleys. This means that all the waters collecting in the catchment area upstream from the EWF will enter the EWF unless diversion channels are constructed. Such diversion channels must have sufficient capacity to be able to discharge the worst assumed rainfall per reference period (typically a 500- or 1000-year rainfall event). These channels will need to be kept clear and may still require periodic cleaning and maintenance. Diverting water from upstream has the added benefit, that less drainage water needs to be treated, as the diverted water will have the natural background composition of the respective catchment area.

(6) Seepage barriers

In cases where seepage from an EWF contaminates downstream shallow aquifers, it may become necessary to hydraulically isolate these aquifers. Different techniques exist for that purpose and are summarized in Garbarino et al. (2018, p. 350). Materials ensuring low permeability include clay slurries, concrete, plastic foils, or steel sheets. Such hydraulic barriers will have to be keyed into underlying less permeable layers. It is also possible to combine a hydraulic barrier with a permeable reactive barrier in a so-called ‘funnel-and-gate’ system (Garbarino et al., 2018, p. 380).

(7) Re-vegetation

Vegetation, through its root system, will stabilise the soil on slopes. The plants further re-circulate and return to the atmosphere some of the precipitation, that otherwise would infiltrate into deeper layers or lead to erosion through surface run-off. Part of the precipitation will be caught by the leaf surfaces and evaporates from there, while another part will be taken up by the roots and returned to the atmosphere as vapour by transpiration. A plant cover significantly reduces the amount of infiltration through a capping and thus reduces the water vector in EWFs. A plant cover also speeds up the dewatering of at least the surface layers of tailings due to the root uptake of water.

Temporary re-vegetation by pioneer species might be encouraged by seeding to reduce dusting and erosion while rehabilitation works, such as re-contouring, are on-going. Geotextiles that can be penetrated by plants also serve as temporary dust suppression and prevent erosion.

Re-vegetation efforts will be more successful in the long-term, if modelled after the natural vegetation of the surrounding landscape. There are significant differences in the vegetation covers across Europe. While in Central and Northern Europe in most cases a continuous plant cover is found, the Mediterranean landscape is characterised by a sparser vegetation with bare soil in between. In Europe, most landscapes have been significantly altered by human activities, in particular turning forests into agricultural land. Nevertheless, one should strive to establish a biodiversity appropriate for the prevailing soil and climatic conditions. This indicates that the design of an adequate capping and plant cover system is a multidisciplinary effort, involving biologists, climatologist, soil scientists, geographers, and geologists, and is not just an engineering project.

While reforestation with local tree species is a viable strategy for previously closed and abandoned EWFs containing inert wastes, this can be problematic for other wastes due to the deep roots of some tree species that can penetrate cappings and liners and in this way may compromise the isolation of these wastes. As noted above, the layered capping layer design must take account of this.

Post-rehabilitation monitoring

Monitoring has the purpose of assuring that the chosen rehabilitation solution performs as planned, to give early warning signs so that remedial action can be taken timely, and, if monitoring results are shared, to re-assure the public. Monitoring concerns the stability of slopes and other engineered structures (see Garbarino et al., 2018, p. 283ff.), the erosion resistance of covers, the dispersal of contaminated leachates, and the re-vegetation success. Surveys of rehabilitated EWFs are normally undertaken at considerably longer intervals than during the operational phase. When no changes are observed, intervals can be extended with time. These intervals can range from once a year to several years.

Remote sensing techniques permit more frequent surveys at relatively low cost compared to on-site inspections and physical sampling. Instrumented monitoring (e.g. moisture measurements in dams, piezometer pipes, sediment traps, etc.) may be feasible in the early years after the rehabilitation is completed but are unlikely to be maintained over longer time horizons. Satellite-based positioning systems today have sufficient resolution to allow for rapid on-site monitoring of markers to survey ground movements. Airborne LIDAR surveys also have sufficient 3D spatial resolution to permit periodic checking of the integrity of the shape of slopes and dams, at least, when there is not too much vegetation on them. Satellite imagery using different spectral bands permits visual inspections of the sites (e.g. plant coverage, human intrusion by digging or building activities), but also to monitor soil moisture development, vegetation cover, vegetation health and others.

Intrusion by burrowing animals usually can only be detected by ground surveys. Similarly, the actual vegetation cover may need to be inspected on the ground to assure that covers are not breached by deep-rooting species or trees uprooted by storm events.

Many natural systems have a certain buffering and retention capacity for contaminants, such as those arising from acid drainage. This buffering and retention capacity means that no immediate serious environmental or human health impacts may arise from a previously closed, abandoned or rehabilitated EWF. The development of the site and its surroundings, however, should be monitored to be able to intervene, if necessary (USEPA, 2015). Effective natural attenuation of contaminants will depend on the persistence of the prevailing environmental conditions. Monitoring has to assure, that if these conditions change or the buffering and retention capacity is exhausted, rehabilitation action can be triggered in a timely fashion (Figure O.5). In fact, monitored natural attenuation will often be a baseline option against which the costs and benefits of other rehabilitation options need be evaluated (IAEA, 2006).

Being able to rely on natural attenuation or on the slow evolution of a site depends to a large degree on predictive modelling of the site evolution. It is always advisable to develop a good conceptual understanding of the site, i.e. an understanding of the source(s) and the pathway(s).

All rehabilitation solutions will enter a stage in which monitoring is required to assure that they function as designed. Monitoring is an essential element of long-term management and helps to reassure stakeholders of the efficacy of the chosen solution (IAEA, 2002).

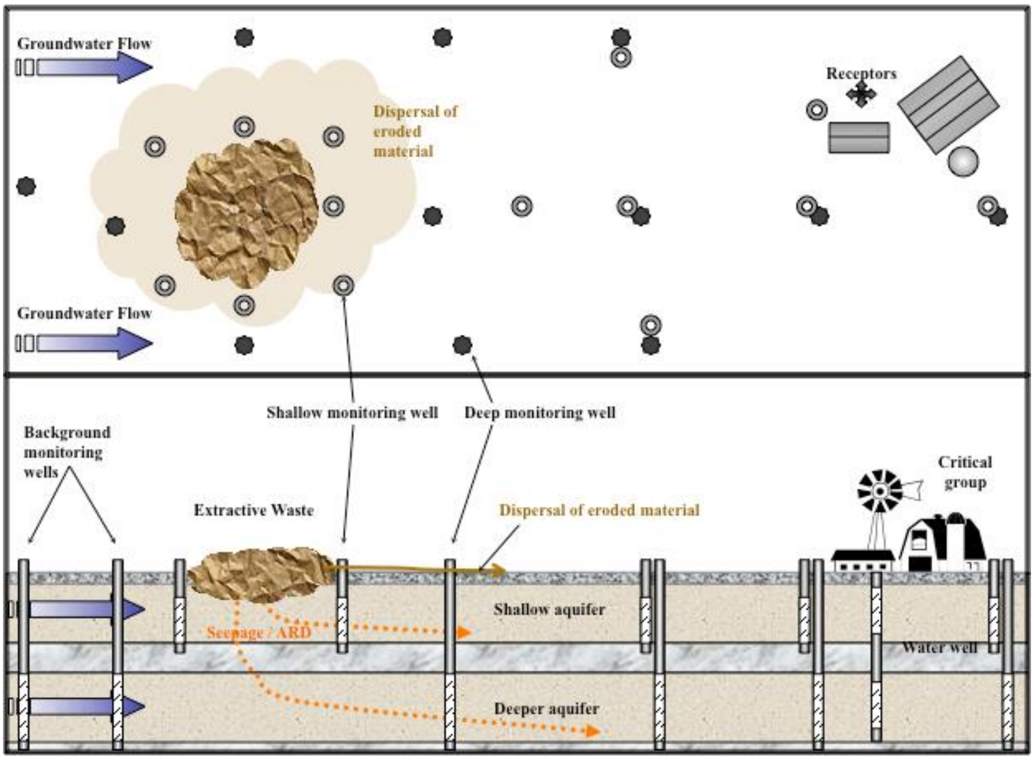

Figure O.5: Monitored natural attenuation for contaminant dispersal (From IAEA with permission)

Post-rehabilitation land-use

Previously closed and abandoned EWFs will remain features in the landscape forever. Their rehabilitation should be such that maintenance needs are minimized as far as possible, mimicking the geomorphology and vegetation of the surrounding landscape.

However, there may be an interest in using waste heaps for other purposes than just forest- or woodland. These uses must be compatible with the integrity of the covers, which means that certain use restrictions may need to be put into place. For example, excavations for building foundations may have to be prohibited or restricted to a certain depth. These restrictions must be laid down in the land-use planning and building permitting instruments. Instruments and procedures to enforce the restrictions must also be established.

Finding a beneficial and compatible after-use for previously closed and abandoned EWFs is likely to foster the long-term maintenance of retaining structures and covers (e.g. IAEA, 2006). Such use needs to be found during the rehabilitation phase or ideally even before, so that rehabilitation options can be tailored to this use and *vice versa* (EC, 2019). The envisaged after-use should keep the community visions for a sustainable development of the region in mind. This planning should concern realistic time horizons (see discussion of stepwise approaches above) to be implementable.

As noted in EC – DG ENV et al. (2019), long-term management and stewardship planning will have to make provisions for monitoring the rehabilitation solution with respect to their integrity and functionality. The challenge is to identify an organization that can be charged with this part of the rehabilitation. Again, one must be realistic concerning the time horizons (IAEA, 2006). If there is a beneficial after-use, the new owners of the site may be charged with the monitoring, as it is likely also in their own interest.

Integration of the rehabilitation planning into the long-term regional planning is likely to reduce societal impacts as well as fostering a compatible after-use of the sites of EWFs. This land-use planning will indicate possible pressures on the land or conflicting interest that could lead to inappropriate site use. The consideration of previously closed, abandoned and rehabilitated EWFs in such plans also makes sure that the sites are not forgotten over time.

Some resilience needs to be designed into the technical rehabilitation solutions, as the envisaged after-use of a site may turn out to be not economically sustainable or the needs of the host community may evolve over time. For instance, even when the popular after-uses for housing development, golf-courses, or managed parks do not materialise, cappings, slopes, etc. must remain stable and the conditions for establishing an adequate vegetation cover must be met.

Finding a suitable and likely economically sustainable after-use is not an easy task and the process has to be undertaken in close co-operation with the host community. Only a use that meets the needs and expectations of the host community is likely to be viable in the long(er) term. At the same time, it is important to undertake realistic economic analyses as not all options that are desirable from the host community's point of view are really viable in each wider socio-economic context. Several very successful after-uses of former mines sites and EWFs are showcased in the publication "101 Things to Do with a Hole in the Ground" published by the Eden Project (Pearman, 2009).

Annex P: Questionnaire for the report by Member States on the ongoing implementation of Directive 2006/21/EC

Questionnaire for the report by Member States on the ongoing implementation of Directive 2006/21/EC
Please provide the following contact information and complete the text boxes:

Institution/Organisation you are representing:	
Country your Organisation is representing:	
Your Name (Family Name, Surname): Example: Einstein, Albert	
Your email address:	
Your Phone Number: (+International Dialling Code - Local Number) Example: +352 9876 12345	

Please fill in the relevant parts of the form, • "Part A" on applicability & changes must be filled by all countries • If yes to Part A, then "Part B" must be filled in.
You can use your national language to fill in the questionnaire.
Questions below use the same text as Annex III of Commission Decision 20xx/xxx/EC. For clarification of some of the questions featured in part B, please refer to the separate letter sent by the Commission.
Deadline for the submission: 1 February 20xx [2024, 2027, 2030,…]

Part A. Questions to be answered by all MS to update the information on applicability in Member States

(1) Administrative arrangements and general information:

Do you have EWFs on your territory falling under Article 7 of the Directive 2006/21/EC (Mining Waste Directive). the directive?

Yes/No

Have new Extractive Waste Facilities falling under Article 7 of the Directive 2006/21/EC (Mining Waste Directive). come into operation since the last reporting period?

Yes/No

Have there been any changes to the inventory of closed/abandoned EWFs since the last reporting period?

Yes/No

(2) Please indicate the competent authority in charge of reporting to the EC Questionnaire:

……………………………….

Part B. Questions to be answered by those MS that have reported changes under Part A.

If possible, using the table provided in Annex, please provide an estimate of the number of extractive waste facilities on the territory of the Member State:

	In Operation	In Transition	In Closure phase	Closed or Abandoned
- Category A that are also "Seveso" installations - Category A that contain hazardous waste but are not "Seveso" installations - Category A installations containing non-hazardous non- inert waste - Category A installations containing inert waste Total Category A Not Category A - Inert waste[116] -Non-hazardous non-inert waste Total				

Please indicate the number of cases of waste facilities of Category "A" in operation on your territory having a potential environmental or human health impact on another Member State:

(2) Waste Management Plans and Permits

(a) Please indicate the competent authority(ies) in charge of verifying and approving the waste management plans proposed by the operators:

(b) Please indicate the competent authority(ies) in charge of issuing the Article 7 permits

(c) Have there been any changes made in national legislation since the last reporting period? Which ones?

[116] Installations treating exclusively inert waste as defined in the Directive

(d) How many Waste Management Plans referred to in Article 5(6) of the Directive are currently in place?
(e) What percentage of Waste Management Plans take the latest EC Guidance into account?
(f) How many permits have been updated since the last BAT note on the Management of the Extractive Wastes has been finalised?

(g) Have you or the operator applied the CEN standards[117] for characterisation of the expected waste?
(h) Have there been any issues with the implementation of the guidance or the BAT note?
(i) Has there been any change in national legislation, or any guidance been issued in relation to the classification of wastes going beyond the EC waste codes and guidance on classification of wastes? If so, please explain.

(3) Financial guarantees

(a) Please indicate the competent authority(ies) in charge of approving and managing the financial guarantee?
(b) Does your national legislation earmark and preserve the guaranteed finances as laid down in Art. 14 of the Directive for the EWFs?
(c) How many Financial Guarantees are currently approved and in place?
(d) How many Financial Guarantees had to be released due to unforeseen or planned closure since the last triennial reporting?
(e) Have you taken into account the new EC guidance on Financial Guarantees?
(f) Have there been any issues with this guidance?
(maybe some more questions after the C&E consultant's report)

(4) Major-accident prevention plans and information

(a) Please indicate the competent authority(ies) in charge of approving and managing the major-accident prevention and information plans and information
(b) Have you encountered any specific problems?
(c) Please provide a comprehensive list of the external emergency plans referred to in Article 6(3) of the Directive:

(5) Inspections

(a) Please indicate the competent authority(ies) in charge of the inspections:

(b) Have there been any issues with implementation of the 2020 technical guidelines?

(c) What percentage of the installations is covered by regular inspections since the last reporting period? Please specify?

[117] CEN/TR 16365:2013
CEN/TS 16229:2011
CEN/TR 16376:2012
CEN/EN 15875:2011
CEN/TR 16363:2012

(6) Public Participation, Transboundary effects

(a) Please indicate the competent authority(ies) in charge of organising the public and the consultation with neighbouring MS?

(b) Which Member States have you consulted as per Article 16 of the Directive, and in relation to how many of your EWFs in total?

(c) Which Member States have consulted you as per Article 16 of the Directive, and in relation to how many of their EWFs in total?

(7) Closure and after closure procedures

(a) Please indicate the competent authority(ies) in charge supervising the sites during and after closure?

(b) How many closures have been started/completed since the last reporting period?

(8) Inventory of closed and abandoned mines

(a) Please indicate the competent authority(ies) in charge of compiling the inventory:

(b) Has there been an update of the inventory of closed and abandoned facilities?

(c) Has there been any new assessment been carried out? Were the criteria changed? In which way?

(d) Are there any improvements/safety measures/rehabilitations achieved since the last reporting period?

(9) Other relevant information

Have you encountered any particular problems with the implementation of the Directive and its provisions**?**

ANNEX Q: COUNTRY FACT SHEETS

Austria – Country Fact Sheet

Austria and its minerals industry

Background

Austria´s mineral extraction sector is dominated by the production of industrial minerals (graphite, talc, salt, and magnesite) and construction minerals (limestone, dolomite stone, aggregates, etc.). Most metal mines in the country have been closed, except for a large iron ore (Styrian Erzberg) and a tungsten mine.

Mineral ownership

State-owned minerals are rock salt, oil, gas and uranium. 'Free for mining' minerals in Austria include all metallic ores and numerous industrial minerals. Landowner minerals are all the remaining minerals such as dolomite, quartzite, bentonite, diatomite, asbestos, mica, feldspar, marl, granite clay and glass sand.

Production and Waste generation

Production data

The tables below present the annual production of main commodities and number of extraction sites in Austria.

Table 1: Austria, Annual mineral production per main commodity (t)

Commodity	2015	2016	2017	Average	Reference
Metals					
Iron (t)	2783327	2777260	2981737	2847441	BGS
Wolfram (t)	870	950	975	932	BGS
Industrial minerals					
Graphite (production at Grafitbau Kaisersberg) (Mt)	0,022	0,023	0,024	0,023	BGS
Gypsum (incl. anhydrite) (Mt)	0,715	0,674	0,712	0,701	BGS , BMLRT (2020), USGS (2021), WMD
Kaolin (Mt)	0,013	0,014	0,014	0,013	BGS, WMD
Magnesite (Mt)	0,703	0,646	0,73	0,693	BGS , BMLRT (2020), USGS (2021), WMD
Salt (rock salt) (t)	248	255	388	297	BMLRT (2020)
Talc (Mt)	0,122	0,123	0,124	0,123	BGS , BMLRT (2020), USGS (2021), WMD
Aggregates					
Sand&Gravel (Mt)	63	63	63	63	UEPG
Crushed rock (Mt)	33	33	33	33	UEPG
Energy					
Shale oil (t)	68	55	55	59	USGS (2021)
Dimension stone (Mt)	1,46	1,51	1,42	1,46	Eurostat Prodcom
Clay, incl. bentonite (Mt)	1,891	1,728	1,893	1,837	BMWFW (2016,2017)

Table 2: Austria, Total number of extraction sites per main commodity

Commodity	Number of extraction sites				Reference
	2015	2016	2017	other	
Metals					
Iron	1	1	1		Euromines
Wolfram	1	1	1		Euromines
Industrial minerals					
Graphite (production at Grafitbau Kaisersberg)	1	1	1		BMWFW (2016, 2017), BMLRT (2020)
Gypsum (incl. anhydrite)	8	7	8		BMWFW (2016, 2017), BMLRT (2020)
Kaolin	2	2	ND*		BMWFW (2016, 2017)
Magnesite	8	10	10		MHB (2016, 2017), BMLRT (2020)
Salt (rock salt)	6	4	1		BMWFW (2016, 2017), BMNT (2019)
Talc	1	3	3		MHB (2016, 2017), BMLRT (2020)
Aggregates	1363	1363	1363		UEPG
Energy					
Shale oil	ND	ND	ND		
Dimension stone	ND	ND	ND		
Clay, incl. bentonite	55	47	ND		BMWFW (2016,2017)

*ND No data available or provided

More information on individual production data of the principal mines and quarries in Austria is provided in Annexes C to I.

Extractive waste generation 2015-2017

The following tables present the total estimated average annual generation of extractive waste in Austria per commodity. The estimations are derived from production data and generic material flows per commodity produced (according to the methodology described in the report, §2.2).

Table 3: Austria, Estimated extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217	Rock[b](t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Erzberg	Fe	O	2.840.933	Aggregates	26.166	3.744.700	7.688.548	11.433.248	877.601
Mittersill	W	U	4.113	Aggregates	335.515	525.815	6.620	525.815	381.702

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4. Estimation of total industrial minerals excavation and waste in Austria (Mt)

Austria (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Graphite	0,0220	0,0230	0,0240	0,0230	0,0460	N/A	0,0690
Gypsum[a]	0,715	0,674	0,712	0,701	0,490	0,000	1,191
Kaolin	0,013	0,014	0,014	0,013	0,094	0,054	0,162
Magnesite	0,703	0,646	0,730	0,693	0,693	0,416	1,801
Salt	0,0002	0,0002	0,0004	0,000	N/A	0,000	0,000
Talc	0,122	0,123	0,124	0,123	0,123	0,000	0,246

a incl. Anhydrite

b Rock = Average Stripping Ratio * Average Production

c Total Excavated Material = Rock + Average Production + Tailings

d Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Austria the waste legislation is based on EU legislation. Extractive waste in national legislation is defined as in the EU Waste Directive. In Austria 'treatment' of mineral resources does not include the combustion of energy minerals for the production of electricity/heat/energy.

Classification of Extractive Waste

Austria does not have a list of waste materials to be regarded as inert according to EWD criteria. Individual testing of waste materials is required. Clay (construction material) is classified as inert waste.

Extractive waste is classified in Austria according to the Austrian Standard Norm 2088 (which includes limit values). There are different additional codes in the Austrian Waste catalogue.

Classification of Chemical Reagents applied in extractive sector

In Austria risks arising from the processing of minerals with chemical agents are not evaluated in the EIA. There are no generic restrictions to use a specific chemical agent according to the Austrian legislative framework. The thresholds are adapted according to EU legislation.

Re-use and placing back of extractive waste material

Available information and estimations of the re-use of extractive waste is provided in following tables.

Table 5: Austria, Reuse of tailings for filling excavation voids (t)

Property Name	Primary Commodity	Mine Type	Average Ore production 2015-2017 (t)	Estimates			Tailings Management[d]:		
				Rock[a] (t)	Total Excavated Material[b] (t)	Tailings [c] (t)	Tailings for filling excavation voids or other uses in the mine (t)	Tailings for deposit (t)	Source
Erzberg	Fe	O	3.744.700	7.688.548	11.433.248	877.601	0	877.601	According to the the previous BREF "Management of tailings and waste rock in mining" the coarse tailings with the waste rock are co-deposited and the fine tailings are deposited into tailings facilities
Mittersill	W	U	525.815	6.620	532.435	381.702	229.021	152.681	According to the data sent by the company 60% of the extractive waste produced is used for filling excavation voids and 40% of the tailings are deposited

a Rock = Stripping Ratio * Average Ore Production
b Total Excavated Material = Rock + Average Ore Production
c Tailings = Average Ore Production – Concentrate – By-Products (process)
d Tailing management: Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been made according to the principles EWD

Table 6: Austria, reused aggregates at quarries

Reused aggregates “waste” at site (Mt)	2015	2016	2017	Reference
	0	0	4	UEPG

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

According to the Austrian Mineral Raw Materials Act (“MinroG”) the holder of the mining permit has to prepare a waste management plan for the minimization, treatment, recovery and disposal of extractive waste (= “waste rock and tailings”) and notify it to the authority. The operating plan for waste management must be reviewed every five years and adapted, if necessary.
The EWMPs are included in the permits and are reviewed every 1 - 5 years depending on the defined need. In the reporting period 2014-2017 48 plans were submitted and approved.

Financial guarantees

The usual instrument for financial security under the Mineral Raw Materials Act for extractive waste facilities in Austria is a bank guarantee followed by a deposit, an insurance policy, a frozen bank account, and a registration in the Land-Registry. In addition, a governmental authority may issue a

declaration of liability. There are no stated provisions of financial security instruments and mechanisms that are not acceptable.
Further information concerning financial security is provided in Guidance on Extractive Waste https://www.wko.at/branchen/gewerbe-handwerk/bauhilfsgewerbe/Leitfaden-Bergbauabfallrecht.pdf (in German). The Guidance states, among other things, that financial security shall be provided for measures to carry out conditions in the license, and decommissioning and rehabilitationstorat of the land used by the waste disposal facility.

Emergency preparedness

Emergency preparedness is laid down in the General Austrian Mineral Resources Act (MinroG). No further information was provided.

Reporting

The reporting requirements are regulated by the permit and are governed by the prioritisation of risks. Specific extractive waste reporting in Austria is not compulsory, only when requested by the Ministry.

Extractive waste facilities

Category A and non-Category A facilities

Table 7 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Austria. Austria has no Cat A facilities.

Table 7: Austria, Overview EWF from 2015 to 2017

EWF Austria	Number of EWF					Reference
	In operation	In operation with permit	In Transition	In closure phase	closed or abandoned	
Category A	0	0	0	0	0	BMNT
Non-Cat A	30	6	24	3	1	BMNT

Closed and abandoned extractive waste facilities

Austria had established a register on heaps and tailings between the years 1993-2007 (the location of the register was not provided). On the basis of the existing information (abandoned mine site register in combination with existing geotechnical/geochemical/hydrochemical and mineralogical data) a desk based preliminary risk assessment project was started in 2009.

The Austrian Ministry for Sustainability and Tourisms has published its assessment of closed and abandoned EWF according to Article 20 EWD. This covered all EWFs that are not part of a currently licensed extractive operation. The assessment concluded that only one site, the milling residues dump at the former copper mine Tessenberg (Tyrolia) will have to be further investigated

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

Mining in Austria is mainly governed by the Mineral Raw Materials Act (MinroG Act No. 38/1999, amended), which regulates the exploration and extraction of all mineral raw materials. Other laws of relevance for permitting procedures are the Commercial Code 1994 (BGBl. Nr. 194), Federal Acts on

Environmental Impact Assessment (UVP-G 2000), Water Management (215/1959) and Construction Coordination (BauKG 37/20099), Acts on Nature Protection and Acts on Land Use Planning (each Federal State has its own), the Work Inspection Act 1993 (ArbIG), among others.
For prospecting/exploration and for extraction activities two authorities issue the corresponding permits: Districts (Bezirkshauptmannschaft) for construction minerals, and the national mining authority (Montanbehörde) for 'free for mining' minerals and state-owned minerals. While the federal state is exclusively responsible for certain environmental issues (e.g. construction of waterways), other issues (e.g. nature conservation) rest entirely with the provinces (Länder). General water management permits are usually dealt by the national mining authority, except in cases of water protection areas, where the responsible authorities are the Districts. Other co-authorities may also be involved, e.g. in the case of archaeologically relevant sites the Federal Monuments Office (BDA) should be involved.

With regards to prospecting and exploration, for 'free for mining minerals' an exploration licence is required (not required for prospecting) which is usually granted in one month and is valid for 5 years with the possibility for extension; for land-owner minerals the preparation and approval of an exploitation plan is required (instead of a license). The exploration of state-owned raw materials is for legal reasons reserved to the State (Article 68 ML); the authority must approve exploration activities.

Concerning extraction, for construction minerals the main permitting authority is the District authority (for areas < 5 ha a maximum of 6 permits may be required, all granted by the District, which acts as a one-stop shop); if the area is >10 ha an EIA is normally required. All required permitting procedures are in the hands of one authority (District) but not always in the hand of one chief negotiator. Several negotiators act for the authority; often MinroG and nature conservation laws are taken over by one negotiator, water permission by another negotiator.

The exploitation of 'free for mining' minerals requires a mining license granted by the Montanbehörde subject to an exploitation plan for five years. The operator also needs to obtain a nature conservation and (if needed) a water permit from the District Authority. In Natura 2000 sites there is de facto no mining; only mining in existing sites is allowed. Extraction of state-owned raw materials requires the approval of an exploitation field for five years. An exploitation field is a space which is not limited in depth and whose cut surface in the projection level of the national surveying system is a flat polygon. The Mineral Raw Materials Act (MinroG) states that when considering an application for an extraction license (free for mining or land-owned minerals), the owner of the land must be involved in the process. The average time for the granting of permits (granted parallel) takes 6 months for nature conservation, for water permits between 6 months and 2 years, for MinroG approvals an average of 1 to 2 years.

Legislation for extractive waste management

The Austrian extractive waste legislation is based on the European EWD.

The competent authority for the Extractive Waste Directive (2006/21/EC), which is implemented in Austria at the federal level by the Mineral Raw Materials Act (Mineralrohstoffgesetz, MinroG), is the Ministry of Economics and Labour (Bundesministerium für Wirtschaft und Arbeit). The competent authorities at regional level are the Governors of the Bundesländer (Landeshauptmann) and the relevant District Administrative Authority (Bezirksverwaltungsbehörde).

Austrian guidance on Extractive Waste (Leitfaden, Bergbauabfall) is provided at (in German) https://www.wko.at/branchen/gewerbe-handwerk/bauhilfsgewerbe/Leitfaden-Bergbauabfallrecht.pdf.

Authorities governing extractive waste

The Federal Ministry and District Mining authorities of the counties are the competent authorities in charge of:

- verifying and approving the extractive waste management plans proposed by the operators
- issuing and updating EWM permits
- Location of list of permits
- Establishing and updating the financial guarantee (other ministries are to be consulted as well)
- Making inspection of the waste facilities.

The competent authority in charge of establishing an inventory of closed and abandoned waste facilities is the Federal Ministry for Sustainability and Tourism (Bundesministerium für Nachhaltigkeit und Tourismus).

Belgium – Country Fact Sheet

Belgium and its minerals industry

Background

Belgium is a federal state comprising three Regions: Flanders, Wallonia, and the Brussels Capital region. Extraction activities are located in the first two. In Flanders, since the discontinuation of coal-mining operations, clay, loam, sand and gravel have now become the only extracted and commercialised mineral resources. In Wallonia the main extracted minerals include chalk and dolomite used for the construction sector. Another mineral extraction area in Belgium is the continental shelf on the North Sea, where sand is extracted.

Mineral ownership

Since the passing of the Special Institutional Reform Act of 8 August 1980, onshore industrial minerals and building materials belong to the landowner and minerals in the continental shelf to the federal government. According to the Act, also legislation and permitting have become the responsibility of the three Regions, whereas offshore remains under the control of the federal government.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Belgium are presented.

Table 1: Belgium, Annual mineral production per main commodity (Mt)

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	13,4	13,0	13,0	13,1	UEPG 2020
Crushed Rock	45,5	46,0	46,0	45,8	UEPG 2020
Industrial Minerals					
Quartz	2,2	3,0	2,5	2,6	Info for MS
Clay and loam	active excavation, no data* reported (cf. confidentiality)				Eurostat Prodcom; USGS (2020)

Table 2: Belgium, Total number of extraction sites per main commodity

Commodity	Total Number of Extraction Sites			
	2015	2016	2017	Reference
Aggregates	112	112	112	UEPG
Clay and loam	ND	ND	ND	

ND: no data available / provided

Belgium does not have metal mining.

Extractive waste generation 2015-2017
No data were available to estimate the generation of extractive waste.

Waste designation and classification

Re-use and placing back of extractive waste

No data about reuse of "extractive waste" for filling up excavation voids was available or was provided.

Extractive waste facilities

Table 3 provides an overview of the extractive waste facilities in Belgium.

Table 3: Belgium, Overview EWF

EWF information	Number of EWF	Reference
Nr. EWF construction minerals	3	Walloon Government order of 14 June 2001
Nr. EWF metallic minerals	0	Walloon Government order of 14 June 2001
Nr. EWF industrial minerals	1	Walloon Government order of 14 June 2001
Nr. EWF energy minerals	0	Walloon Government order of 14 June 2001

In the 2017 EU study "Assessment of Member States' performance regarding the implementation of the Extractive Waste Directive; appraisal of implementation gaps and their root causes; identification of proposals to improve the implementation of the Directive" (Ref 38054 - Amec Foster Wheeler, 2017) one Cat A Facility was identified in Wallonia (Limestone and Dolomite -Carrières et Fours à Chaux Dumont-Wautier S.A.). However, according to communication with Belgian authorities, this EWF has most probably been erroneously labeled as Category A facility. In Belgium a quarry can only obtain an operational permit when it can proof that any extractive "waste" does not leave the extraction site to another location but is reused for filling up voids. Besides that, Carrières et Fours à Chaux Dumont-Wautier S.A is extracting chalkstone and dolomite and is not expected to generate any hazardous substances from that activity.

Legislation for exploration, extraction and waste generation

Authorities governing mineral exploration and extraction

Directions extérieures des Permis et des Autorisations. Service Public de Wallonie Agriculture, Ressources naturelles et Environnement

Legislation for mineral exploration and extraction

Implementation of the European directive Mining Waste (2006/21/EC) in the Decree of the 18th of December 2008 about mining industry's waste management implies the listing of all mining sites (disused, potential or in activity) and the reporting of their condition and evolution. In addition, the drawing up of individual mining waste management plans is obligatory (other wastes are already treated by the waste management plan imposed by the Permis d'environnement.) It is, however, not applied to companies using back-filling technics. The reporting to the European Commission must be done every 5 years.

Decree about quarries (surface ground exploitation) of the 4th of July 2002 modified by the Decree of 31st of May 2008 about the involvement of the public concerning environmental matters. This decree establishes the obligation for mining companies to obtain an environmental permit (Permis d'environnement, see below).

Plans de secteur: the Walloon Region is divided in 23 Plans de secteur (Territorial management plans) which were drawn up to regulate land use according to predetermined allocations, specifically to manage building development. They affect, indeed, the mining sector and have a legal standing but may undergo modifications according to governmental initiatives1. Since 2005, any new zone to be urbanized must be compensated either by a modification going in the other direction, for a similar-sized area not to be urbanised (agricultural, forest, natural, etc.) or by any "alternative compensation defined by the Gorvernment".

Permis d'environnement (Environmental Permit): the administrative licence necessary before being allowed to start and run a business or an industry2. It was established according to the Decree of the 11th of March 19993 and is delivered if the project complies with territorial management plans and the legislation on waste and water (pumping and disposal) management. An impact study is thus always carried out before any permit issue. Furthermore, to receive the permit, mining companies must submit anticipatory upgrading project for the mining area they are planning to work. Due to the high traffic of trucks generated by mining activities, obligatory routes can be imposed on trucks by the Permis d'environnement to reduce nuisance.

Conditions sectorielles (Sectoral terms): after the obtention of the Permis d'environnement, the company still must comply with a set of criteria which are related to the specific activities carried out by a given sector4. For example, in mining's case, specific regulations exist regarding temporary stocking of used oil and lubricants. These conditions are meant to prevent accidental pollutions. But, more specifically regarding mining, CS also impose noise level limitations according to the localization of the mining site, measures to reduce dust emission, vibrations (due to explosives use level) limitations, etc. The CS were established by the Decree of the 17th July 20035.

- In Flanders, both exploration and extraction permitting procedures are subject to the Flemish Spatial Structure Plans, which recognise 19 regions as extraction areas. Special Surface Mineral Resource Plans are drafted for all regions recognised as extraction areas related to the current and future needs for the considered mineral resource. The Flemish Regulations for Environmental Permits – abbreviated as VLAREM – use an official classification list of nuisance activities in order to determine a company’s category (from less polluting (3) to strongly polluting (1)). Mines and quarries extracting non-energy minerals belong to Category 1 and the environmental permit has a maximum duration of 20 years. For Category 1 companies for which an environmental impact report or a safety report is required, the Board of the Mayor and Aldermen must organise at least one (officially announced) public information meeting during the public consultation phase. In a number of cases, a joint application for an environmental permit and an urban planning permission can be submitted to a unique municipal one-stop shop. For the first instance, the procedure takes 105 days at most, starting on the date on which the dossier is declared admissible and complete. A declaration regarding the admissibility and completeness is sent usually within 14 days or a maximum of 30 days after submission. The dossier is disclosed for public opinions and an opinion is necessary from the Provincial Environmental Permit Committee comprising the Mayor, VLAREM officers and a public consultation or inquiry. A public consultation is always part of the procedure. The average time to obtain an extraction permit is between 4 and 6 months if no appeals are claimed; if appeals are claimed 5 extra months must be added, which totals an average of between 9 and 11 months (if just 1 appeal is lodged).The extraction permitting success rate in Flanders in the period 2013-2015 was high (11 permits approved, 1 refused), with a success rate of 92%.
  In Flanders the Environment, Nature and Energy Department (LNE) is the environment regional governmental administration which acts as a one-stop shop in charge of preparing, following up and evaluating the Flemish environmental policy and of awarding all permits for

exploration and extraction in the Flemish region. In Flanders, when processing environmental permits, the authorities work in a coordinated way. The general and sectoral conditions of Title II of the Vlarem that are applicable to all installations or sectors of installations are discussed in advance in working groups in which all the government departments concerned are represented.

In Flanders the Environment, Nature and Energy Department (LNE) is the environmental administration of the Flemish government which acts as a one-stop shop in charge of preparing, following up and evaluating the Flemish environmental policy and of awarding all permits for exploration and extraction in the Flemish region.
In the Flemish region the main laws relevant to non-energy minerals permitting are the Flemish Parliament Act on Surface Mineral Resources (4 April 2003) and the Flemish Parliament Act on Gravel (9 April 2009, as amended 15 July 2015) for the province of Limburg; this Act on Gravel allocated a fixed quota of gravel to the different extractors and introduced a levy on the production of the gravel, in order to secure the realisation of the rehabilitation and social consequences of the future reorganisation of the sector. For environmental issues the Flemish Environmental Permitting Regulations (VLAREM) is the relevant law.

- In Wallonia, when a project requires a planning permit and an environmental permit, the legislation has provided for a single permit that pools together the two procedures. Wallonia has set up a Single Permit scheme that has been in effect since 2002 as part of an approach to simplify administrative procedures. To speed up the process for getting authorisations, strict deadlines have been set for each step in the process. All applicants can thus determine at any point the maximum deadline within which the permit will be issued and thus plan investments accordingly.

  In Wallonia, it is the Permits and Authorisations Department (DPA), under jurisdiction of the Operational Directorate-General for Agriculture, Natural Resources, and the Environment (DGARNE), who is in charge of the issuance of permits and authorisations. When a project requires a planning permit and an environmental permit, the legislation has provided for a single permit that pools together the two procedures. Wallonia has set up a Single Permit scheme that has been in effect since 2002. This system is part of an approach to simplify administrative procedures.

  The Walloon Region counts some 160 mineral extraction sites which produce an amount of almost 70 million tons per annum.
  Wallonia is quite a small territory but with intensive quarrying activities. They provide raw materials, mainly for construction (production of aggregates, cement, concrete) and industrial applications (production of lime and dolomite for chemicals. The activity has thus been concentrated around bigger stone quarries and the level of production is steady. Two main types of rock are worked: chalk and dolomite which are used for industrial (cement works, lime) and civil engineering (gravels, granulate). Beside it, some smaller quarries exploit ornamental stones (black marble…) which represent 1,5% of the production.

  In Wallonia, it is the Permits and Authorisations Department (DPA), under jurisdiction of the Operational Directorate-General for Agriculture, Natural Resources, and the Environment (DGARNE), who is in charge of the issuance of permits and authorisations. In Flanders, when processing environmental permits, the authorities work in a coordinated way. The general and sectoral conditions of Title II of the Vlarem that are applicable to all installations or sectors of installations are discussed in advance in working groups in which all the government departments concerned are represented.

In Wallonia the main law is the Decree “Carrières” of July 4th 2002 as amended by Decree of May 31 2008; for environmental regulations the Decree of 11th March 1999 governing environmental permits and the Walloon Code of Territorial Planning, Urbanism, Patrimony and of the Energy (CWATUPE) of 1984, amended last by Decree of April 24 2014, applying to quarry products, and regulating about the involvement of the public concerning environmental matters. This decree establishes the obligation for mining companies to obtain an environmental permit (Permis d'environnement, see below).

Plans de secteur: the Walloon Region is divided in 23 Plans de secteur (Territorial management plans) which were drawn up to regulate land use according to predetermined allocations, specifically to manage building development. They affect, indeed, the mining sector and have a legal standing but may undergo modifications according to governmental initiatives1. Since 2005, any new zone to be urbanized must be compensated either by a modification going in the other direction, for a similar-sized area not to be urbanised (agricultural, forest, natural, etc.) or by any "alternative compensation defined by the Government".

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Conditions sectorielles (Sectoral terms): after the obtention of the Permis d'environnement, the company still must comply with a set of criteria which are related to the specific activities carried out by a given sector4. For example, in mining's case, specific regulations exist regarding temporary stocking of used oil and lubricants. These conditions are meant to prevent accidental pollutions. But, more specifically regarding mining, CS also impose noise level limitations according to the localization of the mining site, measures to reduce dust emission, vibrations (due to explosives use level) limitations, etc. The CS were established by the Decree of the 17th July 2035.

Description of the permitting procedures

The steps in the permitting process are the following:

- Introduction of an application file containing:
  - the applicant's details
  - the nature of the substances that are the subject of the application;
  - the duration of the permit requested
  - the general program and the planning of the work that the applicant plans to carry out during the term of the permit;
  - the minimum financial investment that the applicant undertakes to devote to research
- The Direction extérieure des Permis et des Autorisations concerned checks to see if the request is compliant
- Transmission of the application file to the governor of the province concerned
- Public inquiry
- Opinion of the state council

- Decision of the government

Administrative arrangements for waste management

Every 3 year a waste management report has been submitted by the "Institut Scientifique de Service Public" (ISSeP) to the EU Commission (2008-2011, 2012-2014, 2015-2017).

Extractive waste management plans and environmental permits

In Belgium, the Département des Permis et Autorisations – DPA is the competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators and in charge of issuing and updating EWM permits.

Financial guarantee

The competent authority in charge of establishing and updating the financial guarantee is the Département des Permis et Autorisations – DPA.

Inspection of waste facilities

The competent authority in charge of making inspection of the waste facilities is the Département des Permis et Autorisations – DPA.

Emergency plans

The competent authority in charge of establishing the external emergency plans for Category "A" installations are the Direction des Risques industriels, géologiques et miniers of Belgium. The location of the list with the external emergency plans is at Direction des Risques industriels, géologiques et miniers. Avenue Prince de Liège 15, 5100 Namur (Jambes).

Closed and abandoned waste facilities

The competent authority in charge of establishing an inventory of closed and abandoned waste facilities is the Direction des Risques industriels, géologiques et miniers. As Belgium does and did not have extractive waste facilities relevant under EWD, no EWF inspections and closing procedures took place.

Legislation extractive waste

According to the Walloon Government order of 14 June 2001 allowing the valorisation of some wastes (M.B. 10/07/2001, p. 23.859à, unpolluted soil (rubric 170.504) and no metalliferous rock materials generated by mine/quarry exploitations (rubric 010102) are automatically considered as inert materials.

Closed and abandoned waste facilities

In Belgium up to now not any facility to which a EWM permit has been granted has been closed.
Belgium has no case where the competent authority is the 'operator'.
Up to now no facility has required a post exploitation management/monitoring programme.

An inventory of abandoned facilities took place in the past. A risk assessment study on those 32 abandoned facilities with a potential risks is still in progress.

Bulgaria – Country Fact Sheet

Bulgaria and its minerals industry

Background

Bulgaria's mineral industry is small and mainly of regional importance, with a mine output of metal ores (copper, gold, iron, lead and zinc), coal, fluorspar and cement raw materials. The statistics on permit applications in the last sixteen years show that construction minerals, followed by industrial minerals and facing stones, are the main interests for exploration and production.

Subsurface resources under this Act are the mineral resources and mining waste resulting from extraction and primary processing. They are defined as:
1. metalliferous mineral resources;
2. non-metal mineral resources - industrial minerals;
3. oil and gas;
4. solid fuels;
5. building materials;
6. facing-stone materials;
7. mining waste.

The subsurface resources are nominated as "wide-spread mineral resources". With a view to limit the intensity on the territory of the country of mining activities, the Council of Ministers can adopt a decision to limit the granting of licenses for prospecting for the most widely spread mineral resources for a certain period. The decision of the Council of Ministers shall serve as grounds to deny granting of licenses.

Mineral ownership

As stated by the Constitution of the Republic of Bulgaria and the "Subsurface Resources Act" (Mining Law) the subsurface mineral resources are exclusive state property. All kind of activities related to the extractive industry are regulated by the State. Production of minerals can be performed only under concession provided by the State for a period up to 35 years.

Underground mineral resources in Bulgaria are owned exclusively by the state.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Bulgaria are presented.

Table 1: Bulgaria, Annual mineral production per main commodity (kg, t or Mt)

Production, Bulgaria	2015	2016	2017	Average	Reference
Metals					
Manganese (t)	46500	41700	2000	30067	BGS
Cadmium (t)	344	362	333	346	BGS
Copper (t)	71748	70573	73003	71775	BGS
Lead (t)	16456	19688	16099	17414	BGS
Zinc (t)	10783	11415	10886	11028	BGS
Gold (kg)	7914	7918	8682	8171	BGS
Silver (kg)	37955	52526	53053	47845	BGS

Industrial Minerals					
Baryte (Mt)	0,060	0,070	0,080	0,070	BGS
Bentonite (Mt)	0,062	0,037	0,054	0,051	BGS, WMD
Chalk (Mt)	0,149	0,074	0,236	0,153	USGS (2021)
Fluorspar (Mt)	0,147	0,004	0	0,050	BGS
Gypsum (incl. anhydrite) (Mt)	0,109	0,061	0,088	0,086	BGS, WMD
Kaoline (Mt)	0,334	0,330	0,322	0,329	BGS
Lime (Mt)	1,474	1,518	1,503	1,498	USGS (2021)
Perlite (Mt)	0	0	0,005	0,002	BGS
Sulphur (Mt)	0,439	0,396	0,501	0,445	WMD
Aggregates					
crushed rock (Mt)	19,80	20,00	20,60	20,13	UEPG
sand & gravel (Mt)	11,30	11,50	11,80	11,53	UEPG
Dimension stone (Mt)	4,32	2,47	1,87	2,89	Eurostat Prodcom
Energy minerals					
Coal (Mt)	2,407	2,581	2,720	2,569	BMGK
Lignite (Mt)	35,900	31,200	34,400	33,833	Euracoal, USGS (2021)
Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic) clays); (Mt)	0,815	1,118	0,837	0,923	Eurostat Prodcom

Table 2: Bulgaria, Total number of extraction sites per main commodity

Number extraction sites	2015	2016	2017	Reference
Metals				
Manganese (t)			1	Euromines
Cadmium (t)	*Byproduct*			Euromines
Copper (t)			4	Euromines
Lead (t)			7	Euromines
Zinc (t)				Euromines
Gold (kg)			2	Euromines
Silver (kg)	*Byproduct*			Euromines
Ind.Minerals				
Baryte	ND	ND	ND	
Bentonite	ND	ND	ND	
Chalk	ND	ND	ND	
Fluorspar	ND	ND	ND	
Gypsum (incl. anhydrite)	ND	ND	ND	
Kaoline	ND	ND	ND	
Lime	ND	ND	ND	
Perlite	ND	ND	ND	
Sulphur	ND	ND	ND	
Aggregates Sum	295	295	295	UEPG
crushed rock				
sand & gravel				
Dimension Stones	ND	ND	ND	
Common clays and shales for construction use	ND	ND	ND	

ND: no data available / provided

More information on individual production data of the principal mines and quarries in Bulgaria is provided in Annexes C to I.

Extractive waste generation 2015-2017

In the next table the total average annual generation of extractive waste in Bulgaria is presented through estimations. Methodology is described in the report, §2.2 and Annex L.

Table 3: Bulgaria, Estimated extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Assarel Panagyurishte Mining & Processing Complex	Cu	O	4.405.633	Cu	5.742	17.645.500	39.000000	52.000.000	13.234.125
Chelopech	Cu	U	20.825	Au, Ag	27	2.084.046	1.042.023	3.126.069	2.063.194
Ellazite	Cu	U	178.000	Cu	232	10.800.000	33.200.000	44.000.000	10.62.768
Obrochishte	Mn	U	30.284	-	0	82.200	41.100	123.300	51.916
Sedefche	Au	U	7	Au, Ag	25	1.908.214	954.107	2.862.321	1.908.182
Assarel Milin Kamak	Au	U	7	Au, Ag	25	1.908.214	954.107	2.862.321	1.908.182
Yuzna Petrovitsa Shumacheski Dol-Androu Marzyan North	Zn	U	9.412	Pb, Zn	9.788	346.750	173.375	520.125	327.550
Dimov Dol	Zn	U	3.725	Pb, Zn	5.588	117.592	58.796	176.388	108.178
Petrovitsa Crushev Dol Varba-Batantsi	Zn	U	12.941	Pb, Zn	13.459	358.80	179.400	538.200	332.400
Chala	Zn	U	10.784	Pb, Au	11.216	340.397	170.198	510.595	318.397

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4: Estimation of total industrial minerals excavation and waste in Bulgaria (Mt)

Bulgaria	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Baryte	0,060	0,070	0,080	0,070	0,077	0,014	0,161
Bentonite	0,062	0,037	0,054	0,051	0,036	0,000	0,087
Fluorspar	0,147	0,004	0,000	0,050	0,151	0,101	0,303
Gypsum	0,109	0,061	0,088	0,086	0,060	0,000	0,146
Kaolin	0,334	0,330	0,322	0,329	2,301	1,315	3,944
Lime	1,474	1,518	1,503	1,498	0,749	0,000	2,248
Perlite	0,000	0,000	0,005	0,002	0,001	0,000	0,003
Sulphur	0,439	0,396	0,501	0,445	N/A	N/A	0,445

a Rock = Average Stripping Ratio * Average Production
b Total Excavated Material = Rock + Average Production + Tailings
c Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Bulgaria the definition of 'extractive waste' in the national legislation no longer includes metallurgical slag, cinder and ash from thermal power stations etc.

In Bulgaria, 'treatment' of mineral resources is not interpreted to include the combustion of energy minerals to produce electricity/heat/energy. The definition corresponds only to 'processing' of mineral resources.

Classification of Extractive Waste

In Bulgaria there is no national list of inert wastes. National threshold values for sites identified as not contaminated do exist.

Bulgarian wastes dwarfed the rest of the EU at over 13 Mt/yr in 2014. Significant amounts of hazardous waste were reported from the mining and quarrying sector (nearly 93% of the total hazardous waste produced in the EU from that sector) whereas three Category A facilities have been reported, none of which were reported as containing hazardous waste.
Different criteria for classification as "hazardous" have most likely been used by companies when submitting EWMPs and Progress Reports to the Ministry of Energy, and when submitting waste statistics to the national statistical office. Before accession to the EU, Bulgarian environmental laws automatically classified all extractive waste containing "heavy metals" as hazardous, whereas EU waste classification law allows sample analysis to prove absence of hazard. Therefore, especially the earlier waste statistics from Bulgaria most likely reflect better the total extractive waste rather than the hazardous component according to EU law. All three Category A facilities in Bulgaria have been classified as such because they contain dangerous substances (hazardous waste). Rather than reporting "zero" Category A facilities containing hazardous waste, Bulgaria has simply not reported the classification of the wastes within its EWFs. Classification and quantities of extractive wastes within extractive waste facilities are not reported to the Commission.
Rather than reporting "zero" facilities containing inert waste, Bulgaria has simply not reported the classification of the wastes within its EWFs. Classification and quantities of extractive wastes within extractive waste facilities are not reported to the Commission.

Classification of Chemical Reagents applied in extractive sector

In Bulgaria chemical reagents are used as collectors, frothers, modifiers, and depressants. In Bulgaria, any potential risks arising from the processing of minerals with chemical agents are evaluated in the EIA.

The use of POPs is forbidden and for other chemicals REACH Registration (or exemption from Registration) is required.

Re-use and placing back of extractive waste material

No data on placement of tailings into voids in Bulgaria were available. Next table gives further explanation why it is assumed that no tailings are used for back placement in voids.

Table 5: Bulgaria, Reuse of tailings for placing back into excavation voids (t)

Property Name	Primary Commodity	Mine Typea	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management[c]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source[c]
Assarel Panagyurishte Mining and Processing Complex	Cu	O	13.000.000	39.000.000	52.000.000	8.588.625	0	8.588.625	d
Chelopech	Cu	U	2.084.046	1.042.023	3.126.069	2.063.194	0	2.063.194	d
Ellatzite	Cu	O	10.800.000	33.200.000	44.000.000	10.621.768	0	10.621.768	d
Obrochishte	Mn	U	82.200	41.100	123.300	51.916	0	51.916	e
Sedefche	Au	U	1.908.214	954.107	2.862.321	1.908.182	0	1.908.182	e
Assarel Milin Kamak	Au	U	1.908.214	954.107	2.862.321	1.908.182	0	1.908.182	e
Yuzna Petrovitsa	Zn	U							
Shumacheski Dol-Androu	Zn	U	346.750	173.375	520.125	327.550	0	327.550	d
Marzyan North	Zn	U							
Dimov Dol	Zn	U	117.592	58.796	176.388	108.278	0	108.278	e
Petrovitsa	Zn	U							
Crushev Dol	Zn	U	358.800	179.400	538.200	332.400	0	332.400	d
Varba-Batantsi	Zn	U							
Chala	Zn	U	340.397	170.198	510.595	318.397	0	318.397	e

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD
d no data available, Taking into consideration that the waste stream is estimated to be hazardous then it is estimated that no portion of tailings are returned into the excavation voids
e no data available, here were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

Approximative 400 extractive waste management plans were approved and 100 sent back to operators to be updated with additional information until the end of 2018. 302 extractive waste management plans were received for review and approval by the competent body (the Ministry of Economy, Energy and Tourism) during the reporting period (1 May 2011 – 30 April 2014). 116 plans were approved, and the others were rejected temporarily until deficiencies were resolved or additional information provided. The facility operators were given instructions and time-limits for resolving the irregularities. This shows a big increase in comparison with the first reporting period when 59 plans have been submitted and only 9 have been approved.

This situation reflects an extended transition period due to a) disagreements and discussions with companies about requiring EWMPs if no extractive waste is generated, and b) disagreements and discussions with the European Commission about correct transposition of the Directive. The number of EWMPs received for review can be expected to have increased again in the 2018 report. Bulgaria has currently about 530 Concessions granted, and Bulgarian law now requires all Concessionaires to submit EWMPs. There is only one person within the Ministry of Energy allocated to review and approval of EWMPs.

Financial guarantees

Competent authority in charge of establishing and updating the financial guarantee is the Ministry of Energy. No further information on procedures concerning financial guarantees was provided.

Emergency preparedness

The competent authorities that are in charge of establishing the external emergency plans for Category "A" installations are the local Civil Protection Agencies (of which there could be about 29 across the country). In practice, there are three Cat A facilities at two mines: 1 at Chelopech and 2 at Elatsi.

The next table presents the number of inspections that take place per Cat A facility from each authority involved.

Table 6: Bulgaria, number of Cat A EWF inspections undertaken

Cat A inspections by authorities	Number of inspections per facility for each reporting period
By Min. of Energy	3 (1 /yr)
By Local Civil Protection Agency	3 (1 /yr)
By Regional Inspectorate for Environment & Water	0-3 (0-1/yr)

Production/waste reporting

The chain of reporting to the administrative body in charge of coordinating the answers to the Commission's questionnaire is the following: The companies report annually to the Ministry of Energy. The Ministry of Energy sends a report triennially to the Permanent Representation of Bulgaria to the EU in Brussels. The Permanent Representation of Bulgaria forwards the triennial reports to the European Commission. All of the steps of the reporting chain are compulsory.

The entity responsible for concessions (mining licence) and EW facilities permitting is the Ministry of Energy, still some relevant permit must be issued by the Minister of Environment. For all mining concessions (532) and the exploration permits (145) the Bulgarian state is co-owner with the mining operator. Most of the operators are private entities with the exception of a few state-owned like coal mines. There are no active mining projects remaining in the uranium extractive sector since the 90's. Based on the information provided by the representatives of Ministry of Energy there is no centralised database for extractive waste streams, the only available information is within/contained by the approximately 400 EWMPs approved by 2018 and some 100 to be approved with additional information later.

EWMPs must be reviewed and re-submitted to the Ministry of Energy at least every 5 years. Reports of all activities including progress against the EWMPs must be submitted to the Ministry of Energy annually. The Ministry of Energy must submit a report to the European Commission every 3 years as per the EWD.

There are two completely separate reporting lines. Companies submit waste figures according to the Waste Codes directly to the national statistics office, which then submits aggregated figures to Eurostat. These waste codes do not split out 'extractive waste' – only waste 'from the mining & quarrying sector'. Meanwhile, data on 'extractive waste' exists within the EWMPs and Progress Reports held, but not processed, by the Ministry of Energy. Classification and quantities of extractive wastes within extractive waste facilities are not reported to the Commission.

Production data is reported by commodity and by county (also to the national statistics office).
Data on 'extractive waste' exists within the EWMPs and Progress Reports held, but not aggregated, by the Ministry of Energy. Classification and quantities of extractive wastes within extractive waste facilities are not reported to the Commission. The final statistics are reported once only (also production figures to WMD, BSG and USGS).

Extractive waste facilities

Category A and non-Category A facilities

Table 7 provides an overview of the Category A extractive waste facilities in Bulgaria.

Table 7: Bulgaria, Overview Cat A Facilities from 2015 to 2017

EWF Bulgaria	Metallic	Non-metallic	Reference
N° of operating non-Cat A facilities	ND*	ND	Ministry of Energy - Natural Resources Concessions and Control Directorate
N° of operating Category A installations with a permit satisfying EWD	3	0	

*No data were available or provided

Closed and abandoned extractive waste facilities

For every EWF under the EWD, there is an 'operator' clearly identified until closure is approved.

In Bulgaria there are no cases where the competent authority is the 'operator'. 'Operators' of closed EWFs must in general hold a valid permit meeting all requirements of the EWD, certainly for facilities where production has ceased, but closure has not yet begun or been approved.

Ministry of Economy is in charge for rehabilitation and closure, including the state-owned historical mines through three entities: Eco Engineering, Eco Antracit, and Eco Rare Metals.
These entities act on behalf of Ministry of Economy for closure and rehabilitation: organizing bidding processes, project management and inspections of rehabilitation and closure works. There were three Government Decrees for closure of different types of historical mines 1992, 1994 & 1996 implemented since 2006.
For the rest (older), an inventory was published by the Ministry of Environment and Water at the time that the EWD was adopted. There are still orphan mining sites which fall under Ministry of Economy responsibility. They are included in national inventory. The inventory of closed and abandoned waste facilities is situated at webpage:
http://pdbase.government.bg/forms/public_permits.jsp?rios=0&teritory=0&district=0&popular=0&act=0&ewc=&find=&RuchFind=SearchClosed/Abandoned/.
For Uranium facilities, state owned enterprise Eco-Engineering Rare Metals (RM) is responsible, and the Ministry of Economy is the competent authority.
Otherwise, the Ministry of Energy also has a map of all previously worked deposits (from ~1920s to 1980s) that sits physically within the Ministry of Environment & Water offices.

No closure procedures were undertaken and/or approved during each reporting period, as presented in next table. Some coal mines have ceased production, but formal closure has not formally begun to avoid that the Ministry of Energy relinquishes legal ownership of the remaining ore (resource) to the local County. Some quarries have also ceased production, but formal closure under the EWD has not begun because no EWF was present.

Table 8 Closures of EWF in Bulgaria during reporting periods

Closures of EWF, Bulgaria	2008-2011	2012-2014	2015-2017
N° of closure procedures undertaken and/or approved during each reporting period	0 (zero)	0 (zero)	0 (zero)

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

Bulgaria has a centralized regime where all licenses for all kind of commodities are processed after a written application to the Ministry of Energy. Other relevant co-authorities are the Ministry of Environment and Waters and the Regional Inspectorates on Environment and Water which coordinate the environmental permitting with the Ministry of Environment.
The main legal act governing mineral exploration and extraction in Bulgaria is the “Law/Act for the underground resources” (Mining law). It was adopted in 1999 with several amendments, last amended in 2015. In most official translations it is named as “Subsurface Resources Act”. It regulates all activities related to permits for exploration, prospecting, and production (exploitation) for all kind of commodities. The Concession Law concerns the rights for exploitation.

As stated by the Mining Law, it applies to:
1. prospecting, exploration and extraction of subsurface resources on the territory of the Republic of Bulgaria, its continental shelf and the exclusive economic zone in the Black Sea;
2. conservation of the bowels of the earth through rational use of the subsurface resources in the course of prospecting, extraction and primary processing.
3. management of mining waste resulting from prospecting, extraction and primary processing of subsurface resources.

The Act does not apply to activities related to: a) research, training and teaching activities; b) extraction of gold from river beds through manual panning; and c) extraction of salts and elements from sea water.

Mining in Bulgaria is regulated by the Concessions Act (SG (No. /36/2.05.2006) and the Subsurface Resources Act (No. 23/12.03.1999). Other laws of relevance for permitting procedures include the Waste Management Act (53/13.07.2012), the Environmental Protection Act, the Nature Protection Act, the Protected Areas Act (133/11.11.1998), the Act for the protection of the environment (SG 91/25.09.2002), the Water Act (67/27.07.1999), Law for biological diversity (SG/77/09.08.2002) and the Health and Safety Working Conditions Act, among others.

Permits for exploration are granted by the Ministry of Energy upon approval by the Council of Ministers or, for the shelf and the exclusive economic zone, by the Council of Ministers.

Concessions for extraction of subsurface resources are granted by i) competition, ii) tender or iii) by right of a holder of license for prospecting and exploration or for exploration who has made a commercial discovery. Concessions for extraction may be granted for terms of up to 35 years, extendable for another 15 years. Following the Environmental Protection Act almost all mining activities are subject to an EIA, thus the Ministry of the Environment and Waters is frequently involved as a co-authority as well as the Regional Inspectorates, which act as regional environmental permitting authorities. Furthermore, a permit may be granted only after being coordinated and not rejected by other co-authorities such as the Ministry of Defense, Ministry of the Interior, National Security Agency (if national defense issues are at stake), the Ministry of Culture and the concerned municipality (local land use planning).

Main permitting problems involve slow processing of applications and conflicts with environmental legislation, particularly under the Law for the environmental protection, Law on protected areas and the National Ecologic Network (under the Law for biodiversity). The Law for the protected territories provides requirements for these areas and seems easier to follow. However, the Law for the environmental protection and the Law for the biodiversity provide many opportunities to NGOs, representatives of the local power (mayors) and individuals to contest already granted permits or even to contest a permission procedure. Another obstacle lies in the Investment Promotion Act, which determines that the extractive industry is not a priority.

Lists of permits are located at webpages https://www.me.government.bg/bg/themes/registar-na-razresheniyata-za-tarsene-i-prouchvane-613-396.html and https://me.government.bg/bg/themes-c333.html. A map with the granted concession areas for extraction are located at https://www.me.government.bg/bg/themes/koncesii-za-dobiv-735-406.html and https://www.me.government.bg/files/useruploads/files/karti/erkr_10.06.2019.pdf. A map of exploration and exploration units for oil and natural gas; https://www.me.government.bg/files/useruploads/files/karti/eve_wgs35_nefi&gaz.pdf.

A Register of permits for prospecting and exploration (current as of 10.06.2019) of 145 sites/perimeters is provided via webpage https://www.me.government.bg/bg/themes/registar-na-razresheniyata-za-tarsene-i-prouchvane-613-396.html.

Authorities governing mineral exploration and extraction

As established by the Mining Act, the main responsible state body presently is the Ministry of Energy. All applications have to be sent to this Ministry, Directorate Natural Resources Concessions and Control (https://www.me.government.bg/bg/departments-0.html).

There are several other relevant authorities that are involved in the granting process:

- Council of Ministers
- Ministry of the Environment and Waters
- Ministry of Culture
- Ministry of the Interior
- Ministry of Defense
- State Agency for National Security
- Local power

All licenses for all kind of commodities are processed after a written application to the Ministry of Energy. An application obligatory contains a “working program” for the entire period of the application as well as for each single year. The working program contains three main elements: the volume of the planned exploration works, the planned financial expenses and the measures for the protection of the environment.

A process for granting permission may be initiated by the competent authority (Ministry of Energy or by physical and juridical persons (or alliances between them). The procedure may be competition or tender. The competition can be attended, or not attended by the applicants, and the tender - via open or secret bidding.

The rights for exploitation are regulated mainly by the Mining Law which is the main act, but with compliance with the Concession Law.

All licenses are processed after a written application to the Ministry of Energy, Directorate of underground resources and concessions. However, the permissions is issued by the Council of Ministers under proposal of the Ministry of Energy.

The proposal should be motivated and accompanied by legal, financial, economic, environmental and social analyses and should be co-ordinated with the concerned ministries.

Administrative arrangements for waste management

The Ministry of Energy is the competent authority in charge of:

- verifying and approving the extractive waste management plans proposed by the operators.
- issuing and updating EWM permits
- providing location of list of EWM permits
- establishing and updating the financial guarantee
- making inspection of the waste facilities.

For Uranium facilities, the state owned enterprise Eco-Engineering, that reports to the Ministry of Economy, is in charge of making inspection of these waste facilities.
For facilities closed by government decree between 1992 and 2008, a different state owned enterprise reports their inspections to the Ministry of Economy.

Competent authority(ies) in charge of establishing the external emergency plans for Category “A” installations and providing a list of the external emergency plans are the local Civil Protection Agencies.

Croatia – Country Fact Sheet

Croatia and its minerals industry

Background

Croatia´s non-energy minerals extractive industry is mainly focused on the onshore extraction of construction minerals (sand, gravel, amphibolite, andesite, basalt, diabase, granite, dolomite, and limestone), and some industrial minerals (cement, clays, gypsum). Metal ores are no longer mined.

Mineral ownership

All mineral resources in Croatia are state-owned (Art §4 ML).

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Croatia are presented.

Table 1: Croatia, Annual mineral production per main commodity (t or Mt)

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	4,300	3,900	4,000	4,067	UEPG 2020
Crushed Rock	15,500	12,500	13,000	13,667	UEPG 2020
Industrial Minerals					
Gypsum (incl. anhydrite)	0,126	0,150	0,148	0,142	MINGOR, JISMS
Salt	0,112	0,112	0,019	0,081	MINGOR, JISMS
Dimension - Ornamental Stones					
Dimension stones (t)	531209	482187	517380	510259	Eurostat Prodcom
Energy Minerals					
Oil	0,613	0,677	0,682	0,657	no data

Table 2: Croatia, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Reference
Aggregates	250	225	225	UEPG 2020
Industrial Minerals				
Gypsum (incl. anhydrite)	7	5	4	MINGOR, JISMS
Salt	0	0	2	MINGOR, JISMS

Extractive waste generation

Next tables present extractive waste estimation of industrial minerals according to methodology of described in the report.

Table 3 Estimation of total industrial minerals excavation and waste in Croatia (Mt)

Croatia (Mt)	Production				Estimation		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Gypsum[a]	0,126	0,150	0,148	0,142	0,099	0,000	0,241
Salt	0,112	0,112	0,019	0,081	N/A	0,008	0,089

a incl. Anhydrite
b Rock = Average Stripping Ratio * Average Production
c Total Excavated Material = Rock + Average Production + Tailings
d Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Extractive waste is defined in the national legislation in the Ordinance on the management of waste from extractive industries (Reference OO 128/2008102).
The legislation is based on the EU EWD and includes the promotion of recovery of waste by recycling or reuse. Croatia has no mine production of minerals and metals with potentially hazardous wastes.

Croatia has no waste facility falling under the EWD and has not Class A facility.
The 'treatment' of mineral resources is not interpreted to include the combustion of energy minerals for the production of electricity/heat/energy.

Classification of Extractive Waste

Croatia has no list of waste materials to be regarded as inert according to EWD criteria, nor national threshold values for sites identified as not contaminated, or relevant national natural background levels.

The list of inert waste as referred to in Article 2 (3) of EU Commission's decision completing the definition of "inert waste" in implementation of Article 22 (1)f of the EWD has not been implemented.

Classification of Chemical Reagents applied in extractive sector

Croatia doesn't use any categories of chemicals reagents.

Re-use and placing back of extractive waste material

No information on reuse of extractive waste was available or provided.

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

Since there is no extractive waste facility, there also has not been any submission or rejections of such plans. Article 48 of the Law on Sustainable Waste Management (Official Gazette, No. 94/13, 73/17, 14/19, 98/19) for the operator of a waste management facility from the mining industry (mining economic entity) which is a producer of waste, the obligation to develop a Waste Management Plan from the mining industry is prescribed in accordance with the data from the mining project and in compliance with the principles of sustainable development.

The Ministry of Economy, Entrepreneurship and Crafts issues consent to the submitted Mining Industry Waste Management Plan prepared by the mining facility.

Financial guarantees

Prior to the start of operations, operators are required to name a central administrative institution responsible for providing a financial guarantee to comply with all requirements of category A facilities and for guaranteeing enough funds for the rehabilitation of contaminated land as per the waste management plans of the facilities. The financial security is calculated by estimating the probability of influence on the facility on the environment taking into account the characteristics of the site, the waste and future use of the area after its rehabilitation, assuming that independent and qualified third parties evaluate and execute work required for recovery. The amount of the financial guarantee must be adjusted in accordance with the work necessary for rehabilitation of the potential contamination of the land and in accordance with the Waste Management Plan. Competent authorities shall withdraw operators from this obligation once the facility is closed.
However, since no waste facility has been permitted, no such guarantee has been established.

Emergency preparedness

'Prevention of major accidents and public information' -Article 14 the necessary requirements in for major accidents prevention and intervention in case of such accidents and ensures that required information is transmitted immediately by the operator to the competent authority. Pursuant to Article 16 of this Ordinance in the case of a major accidents, the operator must provide all information necessary to the National Protection and Rescue Directorate in order to reduce the impacts on human health and to avoid potential environmental pollution. Also, in accordance with Article 37 of the Law on Protection and Rescue14 the operational and communication centre (NPRD) receives calls related to major accidents and promptly informs all competent authorities and coordinates communication amongst the operational forces. The operator has the obligation to inform within 48 hours, the Ministry for environmental protection (MENP) and the National Protection and Rescue Directorate of any event likely to have an effect on the stability of the facility/installation as well as of any undesirable environmental effect. Additionally, the operator must follow all the instructions given by the MENP so that measures may be taken to redress regular operation conditions and must bear all costs of such measures. If the operator is further a Seveso operator, according to Ordinance OG No. 113/08, all necessary data should be sent to CEA within 30 days to include information on the major accident in the "Registry of installations with dangerous substances" (RPOT) and the "Register of reported major accidents" (OPVN).

Regarding the practical arrangements taken to ensure that information on safety measures and on action required is provided to the public, requirements are described in Article 29a of the Law on Protection and Rescue14 and Article 20 (2) of Ordinance OG No. 128/2008 states that the public concerned must be informed, if:

- a permit application has been submitted,
- another country has been notified of the permit application due to potential transboundary effects caused by the facility/installation,
- in accordance with a special environmental protection regulation which, in the opinion of the competent authority, is relevant for the issuance or amendment of the permit concerned.

Moreover, Article 27 of Ordinance OG No. 128/2008 establishes the obligation for the competent authority to inform the competent authority from another State in case of installation with a potential transboundary impact. In addition, the same information has to be provided upon request by another State for installations with a potential transboundary impact. Exchange of such information on international level is the obligation of the NPRD according to Chapter III of the Regulation on Standard operating procedures.

However, since no waste facility has been permitted, there are no external plans currently in place for such facilities.

Extractive waste facilities

Croatia has no operating waste facilities falling under the MWD.

Croatian mining authorities stated in the 2017 workshop on the implementation of the Directive that there was no inventory yet of abandoned sites. In further communication, Croatia stated that they had not identified any sites for which Article 20 was applicable yet.
Croatia stated that an inventory was not required due to the absence of any closed or abandoned extractive waste facility within their boundaries.

Croatia does not have any Class A facility.

Legislation for exploration, extraction and extractive waste management

Ministry of Environmental Protection and Energy is competent for mineral resources, crude oil and natural gas.
https://mzoe.gov.hr/o-ministarstvu-1065/djelokrug-4925/energetika/naftno-rudarstvo-i-geotermalne-vode-za-energetske-svrhe/zakonodavstvo/5406
monja.zlimen@mingo.hr
Ministry of Environmental Protection and Energy is competent for waste management in Croatia.
https://mzoe.gov.hr/o-ministarstvu-1065/djelokrug-4925/otpad/1271

Croatia has a centralised regime and the authorities involved in permitting include the Ministry of Economy (issues permits/licenses for exploration and extraction), the Ministry of Environment and Nature Protection (determines specific conditions, restrictions and consent, impact assessment), the Ministry of Construction and Physical Planning (spatial planning documents necessary to start the procedure for granting a concession), the Ministry of Finance (provides financial and legal documents necessary to start the procedure for granting a concession) and the Ministry of Agriculture.

Cyprus – Country Fact Sheet

Cyprus and its minerals industry

Background

The metal mining industry of Cyprus was active in the production of minerals of copper, iron pyrite, gold, chromites. As well asbestos fibres were extracted. Since 1970 the mining industry is in recession. The only metal mining activity that exists today in Cyprus is the copper mine of Skouriotissa.

Industrial minerals Gypsum and Bentonite and aggregates are still extracted at the island.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Cyprus are presented.

Table 1: Cyprus, Annual mineral production per main commodity (t or Mt)

Production	2015	2016	2017	Average	Reference
Metals					
Copper (t metal content)	2.121	1.754	1.293	1.723	BGS
Industrial minerals					
Bentonite (Mt)	0,129	0,119	0,098	0,115	Reports from MS
Gypsum (incl. anhydrite) (Mt)	0,315	0,129	0,703	0,382	Reports from MS
Aggregates					
crushed rock (Mt)	3,90	5,50	7,00	5,47	UEPG
sand & gravel (Mt)	0,00	0,00	0,00	0,00	UEPG
Dimension stone, unspecified (t)	60.100	102.720	73.380	78.733	USGS
Clays for brick and tile manufacture (Mt)	0,058	0,076	0,107	0,080	USGS (2020)

Table 2: Cyprus, Total number of extraction sites per main commodity

Number of extraction sites	2015	2016	2017	Other year	Reference
Metals					
Copper	1	1	1		Euromines
Industrial minerals					
Bentonite	ND	ND	5	6 (2018)	moa.gov.cy, Info from MS
Gypsum (incl. anhydrite)	ND	ND	6	1 (2018)	moa.gov.cy, info from MS
Aggregates	24	24	25		UEPG
crushed rock					
sand & gravel					
Dimension stone, unspecified	ND	ND	ND		
Clays for brick and tile manufacture	ND	ND	ND		

ND No data available or provided

More information on individual production data of the principal mines and quarries in Cyprus is provided in Annexes C to I.

Extractive waste generation 2015-2017

Next tables present estimations of the metallic total average annual generation of extractive waste in Cyprus for the metallic mine (copper) and for industrial minerals. The estimations were derived (according to methodology described in §2.2 and Annex L) from production data and material flows of mines and quarries per commodity.

Table 3: Cyprus, Estimated extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (493.33t)	By-product from process	By-product from process (t)	Average ore production 2015-217	Rock[b](t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Skouriotissa	Cu	-	493.333	-	0	900.988	456.023	1.357.011	407.654

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 3. Estimation of total industrial minerals excavation and waste in Cyprus (Mt)

Cyprus (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Bentonite	0,129	0,119	0,098		0,081	0,000	0,196
Gypsum[a]	0,315	0,129	0,703	0,382	0,268	0,000	0,650

a incl. Anhydrite
b Rock = Average Stripping Ratio * Average Production
c Total Excavated Material = Rock + Average Production + Tailings
d Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Cyprus 'Extractive waste' is defined in the national legislation as "waste arising from the exploration, extraction, treatment and storage of mineral resources and the exploitation of quarries".

'Treatment' of mineral resources is interpreted as defined in the Directive and does not include the combustion of energy minerals to produce electricity/heat/energy.

Classification of Extractive Waste

Cyprus follows the definition of "inert waste" as stated in Art. 22(1)(f) of the Directive 2006/21/EC. No further list of waste materials to be regarded as inert according to EWD criteria has been established, nor any national threshold values for sites identified as not contaminated, or relevant national natural background levels.

Extractive waste is classified according to the provisions in Annex "Technical Requirements for Waste Characterisation" of the Commission Decision 2009/360/EC dated 30.4.2009.

The waste code that are used according to 955/2014/EC are the following:

- For copper: 01 01 01, 01 01 02 και 01 03 04
- For gold: 01 03 07*
- For aggregates and construction minerals: 01 01 02 and 01 04 10.

Classification of Chemical Reagents applied in extractive sector

In Cyprus only chemical agents that are used in the quarrying industry are flocculants to help aggregate fine suspended particles to form larger flocs so that the solids can more easily be separated from the water.

Every new project that falls under the EIA Directive, is evaluated upon the submission of the EIA study. If relevant risks arising from use of chemical agents are evaluated in the EIA.

For any restriction for specific chemical agents the Department of Environment follows the provisions of the REACH Regulation.

Re-use and placing back of extractive waste material

Available information on reuse of extractive waste material is provided in following table. No tailings are used for filling up excavation voids in Cyprus.

Table 5: Cyprus, Reuse of tailings for placing back into excavation voids (t)

MS	Property Name	Primary Commodity	Mine Type	Average Ore production 2015-2017 (t)	Estimates [a]			Tailings Management[b]		
					Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
CY	Skouriotissa	Cu	-	900.988	456.023	1.357.011	407.654	0	407.654	According to MS all the generated amount of tailings are deposited in an CAF

[a] Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
[b] Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

During the previous reporting period two waste management plans were submitted by the same company in Cyprus.

The first one was a new extractive waste management plan regarding a new facility that is classified as Category "A" and the other was an amendment for an existing extractive waste management plan. Regarding the amendment, the operator requested to declassify the Category "A" facility due to the fact that they have stopped the waste discharge in the tailing pond since April 29th of 2015 and the tailings are placed back in the excavation void.

Both of the waste management plans were approved by the Competent Authority after taking into consideration the suggestions of the Technical Committee and also the content of the EWMPs including all necessary explanations.

Financial guarantees

More specifically, the amount of the financial guarantee is calculated according to the provisions of Art. 28 (2) of the National Law 82(I)/2009 (Management of Extractive Waste Law). In particular, this calculation shall be based on the closure plan of the extractive waste facility in accordance with Art. 10 (1) (f), 29 and 30 of the National Law and on the characteristics of the location of the extractive waste facility, taking into account the general environmental vulnerability and sensitivity of the area. The regulations regarding the establishment of the financial guarantee contain provisions so that the amount of the financial guarantee that is already deposited to the Mines Service for each installation separately is taken into consideration.

Emergency preparedness

After the approval of the amendment for declassification the only Category “A” facility in Cyprus that already existed and also the approval of the new Category “A” facility, there is only one Category “A” facility left and that is covered by an emergency plan.

The list of the external emergency plans is available at the Department of Environment offices. Inspections during the reporting periods are presented in following table.

Table 6 Cyprus - Inspections of EWF during the reporting periods

EWF inspections	2008-2011	2012-2014	2015-2017
N° of inspections achieved in Inert waste installations for each reporting period	12	12	12
N° of inspections achieved in Cat A facility for each reporting period	ND	ND	1

Production/waste reporting

The chain of reporting upon receipt of the relevant notice from the European Committee for the completion and submission of the questionnaire, the Director of the Department of Environment gives instructions to the Head of the Unit responsible for the implementation of the Directive, who then coordinates with the responsible officer the relevant task. Once the questionnaire completed by the officer, is checked both by the Head of the Unit and the Director and send to the European Committee. When necessary, the Department of Environment request for data from other authorities (such as the Mines Services and the Geological Survey Department). The required national reporting frequency is every 3 years.

Extractive waste facilities

Category A and non-Category A facilities

Table 7 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Cyprus.

Table 7: Cyprus, Overview EWF & Cat A Facilities from 2015 to 2017

Number of EWF	Metallic minerals	Aggregates
N° of operating Category A installations covered by Seveso with a permit satisfying EWD	1	
N° of installation for which a permit has been issued in conformity with the EWD.	1	
N° of operating installations containing inert waste other than metallic minerals, industrial minerals, construction minerals, energy minerals		12

The competent authority in Cyprus defines "In operation" when there are extractive activities in a mine/quarry and extractive waste is being produced.

Closed and abandoned extractive waste facilities

During the last reporting period 41 facilities are considered closed and they are monitored by the Ministry of Agriculture, Rural Development and Environment (e.g. Mining Services, Department of Geological Survey, Department of Environment). The list of these facilities is provided at webpage http://www.moa.gov.cy/moa/environment/environmentnew.nsf/All/3FC88CAC22E5817AC225814C003CF79C?OpenDocument .

In Cyprus there are no cases where the competent authority is also 'operator' of a closed EWF.

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

The activities are governed by the Mines and Quarries Law (1953), http://www.moa.gov.cy/moa/mines/minesSrv.nsf/All/CF7BCA66EE5FDBCDC22574B90035C157/$file/Mines%20and%20Quarries%20(Regulation)%20Law.pdf.
The Mines and Quarries Regulations (1958) is presented at:
http://www.moa.gov.cy/moa/mines/minesSrv.nsf/All/B126A807CA0A99A2C22574B90036294A/$file/Mines%20and%20Quarries%20Regulations.pdf

The mine royalties are quoted at webpage:
http://www.moa.gov.cy/moa/mines/minesSrv.nsf/All/55D80E284F472AD1C22574B9003878CE/$file/Eighth%20Schedule%20(royalties).pdf

The expenditure and fees are regulated at webpages:
http://www.moa.gov.cy/moa/mines/minesSrv.nsf/All/FD7055E3C370332DC22574B9003892FD/$file/Second%20Schedule%20(fees).pdf and
http://www.moa.gov.cy/moa/mines/minesSrv.nsf/All/FD7055E3C370332DC22574B9003892FD/$file/Notification%20Reg%208%20(Prospecting%20Expenditure)%20KDP%20336-2012.pdf

Information on how to grant a Town planning Permit, which is a pre-required document to apply for a Mining Lease or a Quarry License, may be found on the website of the Town planning and Housing Department.

Information on how to publish an Environmental Impact Study concerning the development of a mine or a quarry as well as on the pollution of water may be found on the website of the Environment Service.

Information on the Legislation which concerns the atmospheric pollution, noise and subjects on health and safety at work, which are not covered by the Mines and Quarries Regulations, may be found on the website of the Department of Labour Inspection.

Authorities governing mineral exploration, extraction and extractive waste

The competent authority governing exploration and extraction is the Mines Service Department.
The competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators and in charge of issuing and updating the EWM permits is the Department of Environment.

Competent authority(ies) in charge of establishing and updating the financial guarantee is the Department of Mining Service.

The competent authority in charge of establishing the external emergency plans for Category "A" installations and in charge of establishing an inventory of closed and abandoned waste facilities is the Department of Environment.

Czech Republic – Country Fact Sheet

Czech Republic and its minerals industry

Background

Coal is the only significant indigenous energy resource in the Czech Republic. The country's proven coal reserves have been estimated at some 880 million tonnes. Brown coal, which accounts for more than 90% of these reserves, is mainly produced in north-western Bohemia, while hard coal is mined in northern Moravia. Significant quantities of hard coal are exported to Poland, Slovakia, Austria, Germany and Hungary.

There are five coal mining companies in the Czech Republic: OSTRAVSKO-KARVINSKÉ DOLY, the only hard coal producer, and four brown coal mining companies, SEVEROČESKÉ DOLY, owned by ČEZ and the biggest producer of brown coal, VRŠANSKÁ UHELNÁ, with coal reserves to last until 2055, SEVERNÍ ENERGETICKÁ with the largest brown coal reserves in the Czech Republic, and SOKOLOVSKÁ UHELNÁ, the smallest brown coal mining company. All of these coal mining companies have been privatised. The majority state-owned utility company, ČEZ, is the largest coal consumer in the Czech Republic and the most important Czech supplier of electricity.

Mineral ownership

The mining and quarrying industry´s share of total gross value added decreased from 1.2 % in 2005 to 0.8 % in 2014. Employment in mining and quarrying has also been falling over the long term and the industry´s share of total employment in the national economy fell to 0.6 % in 2014. Mining legislation in the Czech Republic distinguishes between 'reserved' minerals, which are state owned, and 'non-reserved' minerals (or deposits), which are owned by the landowner. All minerals with the exception of building stone, gravel and clays are 'reserved' minerals.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Czech Republic are presented.

Table 1: Czech Republic, Annual mineral production per main commodity (Mt)

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	20	18	20	19	UEPG 2020
Crushed Rock	40	37	38	38	UEPG 2020
Industrial Minerals					
Bentonite	0,369	0,374	0,254	0,332	BGS, CGS (2019), USGS (2021), WMD
Diatomite	0,015	0,026	0,034	0,025	BGS, CGS (2019), USGS (2021), WMD
Dolomite	0,451	0,440	0,450	0,447	CGS (2019), USGS (2021)
Feldspar	0,433	0,454	0,368	0,418	BGS, CGS (2019), USGS (2021), WMD
Gypsum (incl. anhydrite)	0,011	0,010	0,007	0,009	BGS, CGS (2019), WMD
Industrial sands	14,022	14,535	14,456	14,338	CGS (2019), USGS (2021)
Kaolin	3,454	3,540	3,669	3,554	CGS (2019), WMD
Limestone cement	10,568	10,995	10,787	0,020	CGS (2019)

Silica	0,014	0,018	0,017	0,016	CGS (2019)
Dimension - Ornamental Stones					
Dimension stone, unspecified (m^3)	187	156	111	151	CGS (2019)
Energy Minerals					
Coal	7,640	6,074	4,870	6,195	BGS (2020), CGS (2019
Lignite	38,351	38,646	39,310	38,769	CGS (2019)
Brick clay	1,219	1,325	1,579	1,374	CGS (2019)

Table 2: Czech Republic, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Average	Reference
Aggregates	373	382	387	381	UEPG 2020
Industrial Minerals					
Bentonite	7	7	9	8	CGS (2019)
Diatomite	1	1	1	1	CGS (2019)
Dolomite	2	2	2	2	CGS (2019)
Feldspar	9	9	9	9	CGS (2019)
Gypsum (incl. anhydrite)	1	1	1	1	CGS (2019)
Industrial sands	8	8	8	8	CGS (2019)
Kaolin	15	15	15	15	CGS (2019)
Limestone cement	22	22	22	22	CGS (2019)
Silica	1	1	1	1	CGS (2019)
Energy Minerals					
Coal	8	8	7	8	CGS (2019
Lignite	9	10	10	10	CGS (2019)
Dimension stone	54	64	63	60	CGS (2019)
Brick clay	24	20	25	23	CGS (2019)

Extractive waste generation 2015-2017

Next table presents the estimated extractive waste of industrial mineral production, according to the methodology described in the report, §2.2.

Table 3: Estimation of total industrial minerals excavation and waste in Czech Republik (Mt)

Czech Republik (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Bentonite	0,369	0,374	0,254		0,233	0,000	0,565
Diatomite	0,015	0,026	0,034	0,025	0,050	0,000	0,075
Feldspar	0,433	0,454	0,368	0,418	0,418	0,000	0,837
Gypsum	0,011	0,010	0,007	0,009	0,007	0,000	0,016
Kaolin	3,454	3,540	3,669	3,554	24,880	14,217	42,652
Lime	10,568	10,995	10,787	10,783	5,392	0,000	16,175

a Rock = Average Stripping Ratio * Average Production
b Total Excavated Material = Rock + Average Production + Tailings
c Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Extractive waste in Czech Republic can be any waste which the operator discards or intends or is required to discard, including extractive waste resulting from the extraction, treatment and processing of radioactive minerals that cannot be considered as radioactive waste and which arises from:

- During the exploration, extraction, treatment or storage of minerals and which according to the law regarding the impacts belong to waste from mining or treatment of minerals.
- In the extraction, treatment or storage of peat.

Classification of Extractive Waste

The Czech Republic has a list of waste materials to be regarded as inert according to EWD criteria, or national threshold values for sites identified as not contaminated, or relevant national natural background levels as published in the Decree No. 93/2016 Coll., on the Catalogue of waste types.
The criteria for the characterization of inert extractive waste are laid down in Section 11 of Decree No. 429/2009 Coll. The list of inert waste is set out in Annex 2 to Decree No. 429/2009 Coll.

In Czech Republic, a list of inert waste exists in accordance with Article 1(3) of Commission Decision 2009/359/EC:

- Annex No.2 of the Decree 429/2009 Coll., that implemented Dec.2009/359/EC "List of mining wastes that are considered inert"
  a) sands after washing,
  b) gravels after washing,
  c) substances created by the extraction of granites, granodiorites, gneiss, diorite, limestone, dolomite, travertine, which have not undergone chemical modification,
  d) non-recoverable fraction resulting from the extraction or mechanical treatment of granites, granodiorites, gneiss, diorite, limestone, dolomite, travertine, basalt and phpnolite that has not undergone chemical modification,
  e) greywacke."

'Treatment' of mineral resources is interpreted to include the combustion of energy minerals to produce electricity/heat/energy.

Risk assessment of 2009/337/EC Commission Decision of 20 April 2009 on the definition of the criteria for the classification of waste facilities in accordance with Annex III of Directive 2006/21/EC of the European Parliament and of the Council concerning the management of waste from extractive industries for abandoned sites as well is applied:
Art. 4,5 and 6 of the Decree No. 429/2009 Coll.
Art. 4 – Criteria for the classification of waste facilities due to failure or incorrect operation
Art. 5 – Loss of structural integrity for tailings dam
Art. 6 – Loss of structural integrity for caps.

The Czech Republic has not applied the waiver of the Landfill Directive paragraph 3 of Article 3: MS may declare at their own option, that the deposit of non-hazardous non-inert mine waste, to be defined by the committee established under Article 17 of this Directive can be exempted from the provisions in Annex I, points 2, 3.1, 3.2 and 3.3 (location screening, multiple barriers, leachate collection), but follows strictly the provisions of Directive 2006/21/EC. It cannot be applied - according to regards to the Art. 2 par. 4 of the Directive 2006/21/EC, Art. 2(4), 4. without prejudice to other Community legislation, waste which falls within the scope of this Directive shall not be subject to Directive 1999/31/EC.

Classification of Chemical Reagents applied in extractive sector

No information was provided.

Re-use and placing back of extractive waste material

No information was available about reuse of extractive waste for filling up excavation voids.

Waste management and permitting

Permitting procedures EWMP

The mine operator has to prepare 2 plans, for waste and for mining waste. Mine waste management plan for mining waste is submitted to the District Mining Authority. General waste management plan for waste is submitted to the Regional Office.

Mining waste management plans are approved by the Regional Mining Authorities; organizations are obliged to update these plans every 5 years. The operator is obliged to apply for approval of the changed plan whenever the deposited material is changed to a storage location and the hazard category is changed.

Financial guarantees

In Czech Republic, financial guarantees are being approved by the Regional Mining Authority. (Art. 13 par. 1 of the Act No.157/2009 Coll.):

"Financial reserves:

(1) Unless stipulated otherwise, the operator is obliged to activities related to the management of extractive waste in advance to create financial reserve. Provisions for creation of financial reserve under the Mining Act shall apply mutatis mutandis. The amount of the financial reserve must reflect the needs to ensure activities in the first sentence; this reserve is the cost of achieving, securing and maintaining income. The reserve is calculated on the basic of the assumption that independent and qualified third parties will assess and perform any rehabilitation work needed."

Emergency preparedness

Information about Emergency Plans was not available or was not provided. Competent authority in charge of establishing the external emergency plans for Category "A" installations is the Regional Government Authority.

Extractive waste facilities

Table 4 presents extractive waste facilities in Cech Republic. Czech Republic has 2 Cat A Extractive Waste Facilities for energy minerals extraction. An EWF 'in operation' is defined as a storage site at which mining waste is handled and storage site at which no remediation and reclamation has been carried out yet.

Table 4 overview Cat A and non-Cat A EWF

Number of EWF	Construction minerals	Energy minerals
Non-Cat A		
N° of operating installations containing inert waste	6	
N° of installations containing inert waste effectively closed by 31 December 2010	28	
N° of operating installations containing inert waste with a permit satisfying EWD	1	

N° of installations containing inert waste where closure is begun but not approved	1	
N° of installations containing inert waste where closure has been approved	15	
N° of installations containing non-inert and non–hazardous waste effectively closed by 31 December 2010	3	
N° of installations containing non-inert and non–hazardous waste where closure has been approved	1	
Cat A		2

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

In the field of exploration of minerals deposits the Ministry of Environment is the most important authority. The Ministry lays down the exploration areas, etc. In the sphere of exploitation, the District Mining Authorities are the most important state bodies. The District Mining Authorities (8 in total) are part of the State Mining Administration (SMA) which is composed also by the Czech Mining Office in Prague (central mining Authority).

Besides the Czech Mining Authority in Prague, the bodies of the SMA are the District Mining Authorities for the territories of: 1) Capitol city Prague and Central Bohemia Region, 2) Pilsen and South Bohemia Region, 3) Karlovy Vary Region, 4) Ústí na Labem Region, 5) Hradec Králové and Pardubice Region, 6) South Moravia and Zlín region, 7) Moravia Silesia and Olomouc Region and 8) Liberec and Hiland Region. The Czech Mining Authority is an appeal instance (as a central authority of state administration).

An application regarding prospecting and exploration is to be considered by the Ministry of the Industry and Trade with the approval of the Ministry of the Environment. An application regarding extraction will be managed by the Ministry of the Industry and Trade after a consultation with the Czech Mining Authority. The decisions of the State Mining Administration bodies are reviewable by an administrative justice. In the first instance there are the County courts which decide about the accusations. The second instance deciding about the cassation is the Supreme Administrative Court with the seat in Brno.

Legislation governing mineral exploration and extraction

The primary legal basis of mineral extraction activity is the Mining Law (Mining Act) No. 44 of 1988, as amended by Law No. 186 of 2006. For prospecting and exploration for reserved mineral deposits the most relevant law is No. 62/1988 Coll., on Geological Work (the Geological Act) as amended. Other important national Acts are the Act on EIA, Forest Act, Act on Land and Soil, Act on Nature and Landscape, etc. In the field of exploration of mineral deposits, the Ministry of Environment is the most important authority, i.e. the Ministry lays down the exploration areas. In the sphere of exploitation, the District Mining Authorities are the most important state bodies. The District Mining Authorities (8 in total) are part of the State Mining Administration (SMA), which is composed also of the Czech Mining Office in Prague (central mining authority).

For prospecting and exploration, an application for ‘reserved’ minerals is to be considered by the Ministry of the Industry and Trade with the approval of the Ministry of the Environment. Within the scope of planning and conducting the prospecting for and exploration of reserved mineral deposits, the organisation must consider the conditions and interests protected by 32 special regulations (Section 22 of the Act on Geological Work). These primarily refer to the laws for the protection of landscape and nature, agricultural and forest land, the Water and Mining Acts, etc. An organisation can prospect and explore for 'non-reserved' minerals only upon agreement with the landowner.

An application for the extraction of 'reserved minerals' will be managed by the Ministry of the Industry and Trade after consultation with the Czech Mining Authority. First 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 exploitation is issued by the District Mining Authorities. Together with the permission of mining activity a district mining authority usually decides about the creation of mining reserves for remediation and restoration and for mining damages. In the case of 'non-reserved' minerals (e.g. sand) the first and the essential condition of mining business is an authorisation for activity carried out by mining. The second condition is a zoning decision and the third one is the permission for exploitation of deposit of non-reserved mineral. The zoning decision is issued by a building office and the permission for exploitation of non-reserved deposit of minerals is issued by a District Mining Authority. The issuing of a mining permit depends also on fulfilling the demands of special acts, for example the Act on EIA, Forest Act, Act on Land and Soil, Act on Nature and Landscape, etc. The administrative bodies providing these acts have the position of interested co-authorities (e.g. water offices, spatial plan offices, etc.). The average permitting success rates in the period 2013-2015 were 43 % and 92 % for exploration and exploitation permits, respectively.

In the sphere of the Czech mining law the most important acts were in 2013 – 2016:

- The Act No. 44/1988 Coll., on the protection and utilization of mineral resources (The Mining Act), as amended later. It is originally a federal act and it is valid in both parts of former Czechoslovakia yet.

  The Act No. 44/1988 Coll.:
  - defines minerals,
  - makes a division of minerals (on 'reserved' and 'non-reserved'),
  - defines a mineral wealth,
  - regulates regime of issuing certificates on reserved deposit of minerals.

  This act regulates also:
  - deposit protection areas,
  - mining areas,
  - principles of economic using of mineral wealth,
  - some questions connected with remediation and restoration,
  - mining royalty from mining areas and from exploited minerals,
  - mining reserves on remediation and restoration and on mining damages,
  - problematics of old mining objects,
  - mining waters,
  - special impacts into the earth´s crust etc.

- The Act No. 61/1988 Coll., on mining activity, explosives and the State Mining Administration, as amended later. This act is the most important regulation in the domain of the Czech mining law and includes rules for:

  - mining activity,
  -activity carried out by mining,
  - health and safety at mining,
  - safety of operation in mining,
  - mining rescue service,

- technical facilities,
- qualifications necessary for pursuance of regulated professions,
- explosives (including their production and storage)
- blasting operations,
- underground objects,
- delicts and sanctions,
- structure of organisation of the State Mining Administration;

- The Act No. 62/1988 Sb., on geological works (The Geological Act), as amended later, declares which works are considered as a geological activity, defines conditions for pursuance of geological activities, solves the question of exploratory areas etc.
- The Act No. 157/2009 Coll., on mining waste management and on amendments to some laws, in wording by act No. 168/2013 Coll. This act is a regulation influenced by requirements of EU law, especially by requirements of Directive 2006/21/EU.

Many decrees and other secondary regulations were published to the acts mentioned above. Most cases of secondary regulation are performed by decrees issued by the Czech Mining Authority; sometimes it has a form of a governmental order. Except the basic secondary regulations - 45 essential decrees issued to the acts No. 61/1988 Coll., 44/1988 Coll. and 157/2009 Coll. - there are many decrees making amendments of this basic decrees.

From this regulation it is necessary to mention:

- Decree No. 22/1989 Coll., on safety and protection of work and safety of operations in mining activities and in extracting non-reserved minerals underground, as amended later; this decree is an essential regulation for underground mining. It has more than 330 articles and 3 annexes.

  This decree regulates (btw.):
  - basic requirements on working places in underground,
  - basic requirements on documentation,
  - basic requirements on technical facilities used in underground,
  - management of underground work,
  -q uestions of responsibility etc.

- Decree No. 26/1989 Coll., on safety and health protection and operational safety in mining activities and activities undertaken on the surface using mining methods, as amended later. The structure of the decree is very closed to the Decree No. 22/1989 Coll. This decree has more than 180 articles.

  This decree regulates (btw.):
  - basic requirements on working places on the surface,
  - basic requirements on documentation,
  - basic requirements on technical facilities used on the surface,
  - management of underground work,
  - questions of responsibility etc.

- Decree No. 51/1989 Coll., on health and safety protection at work and safety of operations in processing and refinement of minerals, as amended later. This is the third most important decree for the Czech mining and in the domain of the Czech Mining Law. It is focused on mineral processing, except the processing of gas and oil. The safety requirements described in decree No. 51/1989 Coll. are very similar to the demands solved in decrees No. 22/1989 Coll. and No. 26/1989 Coll.

- Decree No. 104/1988 Coll., on economical exploitation of reserved deposits, on permitting and notification of mining activities and notification of activities carried out by mining methods, as amended later, is a very important regulation. The decree was issued to realisation of the Act No. 44/1988 Coll. and to realisation of the Act No. 61/1988 Coll. Therefore, the decree regulates two problematics – the first one is a rational utilization of mineral deposits, the second one is a process of permitting of mining activities.

  The decree solves:
  - yield of deposits,
  - losses of materials at mining and at mineral processing,
  - documentation for permitting of mining.

Administrative arrangements for waste management

Extractive waste management plans and environmental permits

In Czech Republic, the Regional Mining Authorities in the Czech Republic is the competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators.
The State Geological Survey is responsible for maintaining a register of mining permits and all associated activities.

Financial guarantee

In theory the financial guarantee must be sent to the Regional Mining Authorities in the Czech Republic.

Inspection of waste facilities

In theory the competent authorities in charge of making inspection of the waste facilities are the Regional Mining Authorities and the Central Mining Authority in the Czech Republic.
For the 2015-2017 period, the number of inspections achieved in Inert waste installations was 12, and the number of inspections achieved in Non inert, non-hazardous installations was 27.
There is no data available for the periods 2008-2011 and 2012-2014, see Table 5.

Emergency plans

In theory, the competent authority in charge of establishing the external emergency plans for Category "A" installations is the Regional Government Authority.

Closed and abandoned waste facilities

The competent authority in charge of establishing an inventory of closed and abandoned waste facilities is the Czech Geological Survey.

In the Czech Republic, there are about 6600 closed or abandoned extractive waste facilities.
Conditions for closing procedure of the mining site are defined by the Czech Mining Authority, once all the conditions are fulfilled the site is closed and the land is returned to the previous owner.

Table 5: Czech Republic, Number of EWF inspections and closing procedures undertaken

	EU reporting period		
	2008-2011	**2012-2014**	**2015-2017**
N° inspections Inert extractive waste installations for each reporting period	ND	ND	12
N° inspections Non inert, non-hazardous installations for each reporting period	ND	ND	27
N° closure procedures undertaken and/or approved during each reporting period	ND	ND	ND

ND: no data provided / available

Denmark – Country Fact Sheet

Denmark and its minerals industry

Background

Denmark's land area is 43,000 km^2 (not including the self-governing regions of Greenland and the Faroe Islands). Denmark consists of the peninsula of Jutland and an archipelago of 406 islands, 73 of which are inhabited.
Mineral resources in Denmark are limited and composed mainly of industrial minerals and mineral fuels. Denmark has no active mines and lacks economically exploitable metallic mineral resources. The country has reserves of non-metallic materials such as chalk, clays, bentonite and kaolin, lime, salt, granite, and dimension stone as well as marine aggregates and loose aggregate. Denmark is the only European commercial producer of moler, which is a natural mixture of diatomite and smectite clay.

Mineral ownership

The land-based minerals belong to the landowner, marine resources on the sea floor (seabed and continental shelf) are owned by the State.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Denmark are presented.

Table 1: Denmark, Annual mineral production per main commodity

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	36,700	38,000	41,100	38,600	UEPG 2020
Crushed Rock	0,200	0,200	0,300	0,233	UEPG 2020
Industrial Minerals					
Bentonite	0,054	0,066	0,070	0,063	BGS, WMD
Chalk	0,973	1,030	1,058	1,020	USGS 2020
Diatomite	0,128	0,114	0,176	0,139	BGS, WMD
Dimension - Ornamental Stones					
Dimension stone	no data reported				USGS
Energy Minerals					
Peat	0,04	0,04	0,03	0,036	Statistics Denmark

Table 2: Denmark, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Average	Reference
Aggregates	332	432	417	394	UEPG 2020
Industrial Minerals	no data found / available / provided				

Extractive waste generation 2015-2017

The next table presents estimated values for extractive waste generation for industrial minerals. The estimation was done through the methodology described in the report, §2.2.

Table 3. Estimation of total minerals excavation and waste in Denmark (Mt)

Denmark (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Bentonite	0,054	0,066	0,070		0,044	0,000	0,108
Diatomite	0,128	0,114	0,176	0,139	0,279	0,000	0,418

a Rock = Average Stripping Ratio * Average Production
b Total Excavated Material = Rock + Average Production + Tailings
c Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Extractive waste is defined as "Waste from prospecting, extraction, treatment and storage of mineral resources and from working of quarries" (identical to definition in the EU Waste Directive).
Treatment of mineral resources is not interpreted to include the combustion of energy minerals for the production of electricity/heat/energy.

Classification of Extractive Waste

There is no separate list of inert waste according to the EWD but there is a possibility of making one in national legislation. The Danish Extractive Waste Facility Act contains a set of criteria that must be fulfilled by inert waste.

Extractive waste is characterized by background information about the extraction process, geological background information, and information about quantities, waste transport system, chemical agents used in treatment, classification according to the Danish Waste Act with specification of hazardous properties, planned type of waste facility and landfilling method, the geotechnical behaviour of the waste, the geochemical characteristics and behaviour of the waste

Classification of Chemical Reagents applied in extractive sector

Denmark doesn't have a mineral industry where chemical reagents are applied.

Re-use and placing back of extractive waste material

No information about reuse of extractive waste for filling up excavation voids was available or provided.

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

Under Section 5 of Order No 1500 of 14 December 2017 on managing extractive waste (hereinafter referred to as 'the Extractive Waste Order'), an operator must submit – as part of its application for approval – a draft waste management plan that fulfils the conditions laid down in Section 11 of the Order. Under Section 6(1)(1) of the Order, the approval authority may only approve the application if, among other things, it is satisfied that the waste management plan meets the requirements laid down in Section 11.
Relevant conditions must be laid down in the facility's permit – see Section 7(2)(2) of the Extractive Waste Order. In practice, at Ravnshøj extractive waste facility a new plan is adopted each time waste is deposited, as the waste is not homogeneous. Deposition of extractive waste is expected to occur very seldom in Denmark.

Financial guarantees

The permit has been revised for the only facility in Denmark where extractive waste is deposited. The approval and supervisory authority for extractive waste is the Environmental Protection Agency. The extractive waste deposited at Ravnshøj Miljøcenter is covered by the guarantee for the landfill site. This guarantee is compliant with the rules in the Extractive Waste Directive.

Emergency preparedness

Not applicable.

Number of EWMP in 2015-2017

There is only 1 Extractive waste facility for drilling mud in Denmark. This installation contains non-inert and non-hazardous waste.

There is not a Category A facility in Denmark.

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

Denmark has a simple and clear spatial planning system with a strongly decentralised division of responsibility. The municipality councils are responsible for overall land-use regulation at the local authority level with legally binding guidelines for property owners. The regional councils prepare strategic plans for development in each region. The Minister for the Environment is responsible for protecting national interests through national planning. According to the Planning Act, Regional Councils must prepare regional raw material plans for the extraction and supply of raw materials.

Legislation governing mineral exploration and extraction

The planning and administration of the extraction of raw materials is mainly governed by the Danish Raw Material Act (LBK no. 1585 of 2015), especially regarding raw materials extracted from open quarries on land or from the seabed, such as sand, gravel, stones, granite, lime and chalk, clay, moler and peat, and the less common materials: flint, marl, bog iron ore and sandstone[1].

Permits for raw materials extraction on land are granted by the Regional Council for the region where the extraction is going to take place. Under Section 8 of the Danish Raw Materials Act, the Regional Council has a duty to present the application to other relevant authorities, responsible for issuing separate permits in case this is required according to other legislation, so that the information provided can be assessed in parallel. This is known as the “coordination obligation” (*samordningspligt*). The application must be sent to the other authorities immediately upon receipt of a correctly completed application. This system facilitates the process for applicants and enables the permits to be issued faster.

The obligation for the regions to coordinate with other authorities in case the extraction needs permits under other legislation than the Raw Material Act, has existed since the 1970’ies.

Other legislation that might affect the authorisation of extraction is for instance the Museums Act (dealing with protected cultural heritage), the Act on Environmental Protection (e.g. waste water), the Forestry Act (e.g. protected forests), the Planning Act (e.g. local planning for the area), the Nature Protection Act (protected areas, habitats, species) etc. It is therefore important that the different authorities with authorisation responsibility can coordinate the treatment of applications.

[1] The extraction of raw materials such as oil, natural gas, salt and geothermal energy are coved by the Act on Danish Subsoil Exploitation (LBK No. 960 of 2011 with later amendments).

Coordination not only facilitates the process and makes it faster for those who apply for permits, it is also a way to avoid administrative duplication.

It should be kept in mind, however, that the coordination obligation only covers the permits necessary for the raw material extraction itself – any other permits that might be needed in connection with the planned work (e.g. access to a public road) are not automatically covered.

There is also an obligation for the Region to consult certain other authorities responsible for interests that must be considered by the Region when granting a permit under the raw materials act. The consultation of other authorities must be organised immediately upon receipt of a correctly completed application and the consulted authorities normally have a deadline of four weeks to provide their response statement.

When the Region has sent the application to the relevant authorities that have to grant permits or issue response statements, the applicant must be informed that the decision to grant permit will be put on hold until the position of the other authorities has been received. In case the consulted authorities oppose the application and are not able to grant their permits, the Region has to inform the applicant and provide them with information on how to complain. Permits granted by other authorities should be sent to the Region so that they can be sent out together with the permit issued under the raw materials act. Conditions set by the other authorities must be included in the permit issued under the raw materials act. The system in effect functions like a 'one-stop-shop'.

Land based raw materials: the Regional Councils are responsible for the development of a plan for extraction and supply of raw materials in Denmark, in which new extraction areas and areas with raw material potential is being selected. A company can thus apply for an extraction licence within one of these areas. Exceptionally permits are granted outside the dedicated extraction areas for the abstraction of special raw materials and raw materials that locally are hard to find.
The exploration and extraction of Danish non-energy minerals is mainly governed by the Raw Materials Act of 2015 and by the Act on the Use of the Danish Subsoil of 2011. Another important regulation is Government Regulation No. 1306 of 2015 on Marine Raw Materials. The Raw Materials Act does not apply in the Faroe Islands and Greenland.
Denmark has a 'one-stop shop' (also called 'one-door authority') for the issuing of permits (exploration, extraction) related to land and marine-based minerals. This authority has the responsibility of sending the application among the public entities affected by the application. The hearing process lasts 4 weeks. Each public entity can either grant or turn down the application or they can request additional provisions that the applicant must fulfil to get the permission. It is the responsibility of the Regional Council to assess whether an Environmental Impact Assessment should be made for the applied extraction activity.
The authorities for land-based minerals are the Regional Councils (from 1 July 2014) and for marine-based minerals the Danish Nature Agency (Naturstyrelsen), an organisation under the Danish Ministry of Environment. The Regional Councils are also responsible for surveying raw materials and planning for their extraction and supply.

Licensing procedures for exploration and extraction

Concerning exploration for land-based raw materials, a permit is not required when the expected number of extracted samples is less than 200 m^3 (per year) and the samples are not used commercially. If the amount of sample material exceeds 200 m^3 per year or it is to be sold, the Regional Council must be notified and can within a period of 4 weeks set up specific requirements (including reclamation requirements) for the exploration activity. The exploration of land-based raw materials is a subject primarily governed by a contract between the landowner and the explorer.

According to §5 of the Danish Raw Materials Act it is the responsibility of the Regional Councils to conduct exploration for raw materials on land. Every 12th year the Regional Councils develop a plan for extraction and supply of raw materials in their region of Denmark, which is revised and updated every 4th year. An 8-week public hearing process is connected to each update of the plan, where everyone can provide comments or express their reservations towards the proposed areas. If a company would like to extract raw materials on land it has to send an application to the specific Regional Council that covers the area of interest. According to §18 of the Danish Raw Materials Act it is the responsibility of the Nature Agency to conduct exploration for marine based raw materials and the results form the basis for the definition of areas for extraction activities. However, it is possible for a company to explore for marine based raw materials; it must follow the rules specified by the Government Regulation no. 1306 of 24 November 2015. An extraction permit (or exploitation license) is normally valid for a period of 10 years, after which it can be renewed. The specific conditions listed in the extraction permit are publicly available information. A 4-week period of appeal is implemented after the permit has been issued. The average length to get a permit is estimated to be less than half a year for all types of licenses.

Denmark has an established 'one-stop shop' for the issuing of permits (exploration, extraction) related to land and marine-based minerals. For land-based the authority are the Regional Councils and for marine-based the Danish Nature Agency. The Danish system runs under a principle known as the 'coordination obligation': when an applicant for minerals extraction must submit a single standard application form that covers all permits required, under Section 8 of the Raw Materials Act, the municipality to which the application for a raw materials extraction permit is submitted has a duty to present the application to other relevant authorities (which issue separate permits), which assess the information provided in parallel. This covers all the necessary permits to initiate with a mineral extraction activity (but it does not automatically cover any other permits that might be needed in connection with the planned work, e.g., access to a public road.

Administrative arrangements for waste management

Every 3 year a waste management report has been submitted by Danish Environmental Protection Agency to the EU Commission (2008-2011, 2012-2014, 2015-2017).

Closed and abandoned waste facilities

Closure is regulated by Section 16 of the Extractive Waste Order and the conditions in the permit, as well as Section 25 and Annexes 4 and 5.
There are no closed facilities in Denmark. This information used to be on the Nature Agency website, as they had the task of drawing up and updating the list of closed facilities. In case there will be closed facilities in future, they will be listed on the Environmental Protection Agency website, www.mst.dk.

Estonia – Country Fact Sheet

Estonia and its minerals industry

Background

The most studied resources in Estonia are oil shale (used in energy and chemical industry), peat (agriculture, heat production, medicine), limestone and dolostone, gravel, sand and clay (building material, glass, machinery, paper and cellulose industries, agriculture).
Phosphorite (agriculture, chemical industry) and graptolite argillite (processing industry) were explored during the 20th century, which was followed by mining. Several types of metallic ores (molybdenum, polymetals, pyrite, iron, strontium, uranium, vanadium) existing in the basement (lies at a depth of 100 to 800 m) and in graptolite argillite (claystone containing organic matter) have been specifically prospected and explored.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Estonia are presented.

Table 1: Estonia, Annual mineral production per main commodity (Mt or t)

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	7,00	6,50	9,40	7,63	UEPG 2020
Crushed Rock	5,50	6,00	8,20	6,57	UEPG 2020
Industrial Minerals					
Chalk and dolomite	1,044	0,962	1,348	1,12	CFS, ESD
Clays & Kaolin	0,058	0,065	0,069	0,06	CFS, ESD
Limestone & gypsum	2,441	2,693	2,988	2,71	CFS, ESD
Dimension - Ornamental Stones (t)					
Marble, granite, sandstone, pophyry, basalt, others (exl. Slate)	340	338	600	426	Esti Statistica
Energy Minerals					
Peat (Fuel)	0,089	0,089	0,013	0,06	USGS (2020)
Oil shale	14,908	12,692	15,634	14,41	EESTI Energia (2019), ESD
Clay, unspecified, including kilts, used in construction	0,058	0,047	0,061	0,055	Eurostat Prodcom; USGS (2020)

Table 2: Estonia, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Average	Reference
Aggregates	290	280	300	290	UEPG 2020
Industrial Minerals					
Chalk and dolomite	7	7	9	8	CGS (2019)
Clays & Kaolin	1	1	1	1	CGS (2019)
Limestone & gypsum	2	2	2	2	CGS (2019)
Energy Minerals					
Peat (Fuel)	ND	266	ND	266	Niitlaan (2017)
Dimension - Ornamental Stones	ND	ND	ND		
Clays	ND	ND	ND		

Extractive waste generation 2015-2017

In the next table the total annual generation of extractive waste in Estonia is presented for 2015, 2016 and 2017.

Table 3: Estonia, Annual Total Extractive Waste Generation from 2015 to 2017 (Mt), source https://www.keskkonnaagentuur.ee/en/waste-2

Annual Total Extractive Waste Generation	2015	2016	2017
Total extractive waste generated	24,72	24,44	25,22
Total extractive waste classified as hazardous	9,23	9,75	11,08
Total extractive waste classified as hazardous from oil shale	8,97	9,52	10,80
Total extractive waste classified as non-hazardous	15,49	14,69	14,14
Total other extractive waste classified as non-hazardous	0,26	0,23	0,28

Table 4 presents an estimation of industrial minerals based on production.

Table 4: Estimation of total industrial minerals excavation and waste in Estonia

Estonia (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Lime[a]	2,6928	2,98815	2,8281		1,418	0,000	4,255

a Limestone & gypsum
b Rock = Average Stripping Ratio * Average Production
c Total Excavated Material = Rock + Average Production + Tailings
d Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

No information was provided.

Classification of Extractive Waste

Estonia does not have a list of waste materials to be regarded as inert according to EWD criteria, or national threshold values for sites identified as not contaminated.

Classification of Chemical Reagents applied in extractive sector

No information was provided.

Re-use and placing back of extractive waste material

No information on use of extractive waste for filling excavation voids was available or provided.

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

In Estonia, 157 plans were reviewed in the last reporting period (2015-2017).

Financial guarantees

Financial guarantees for Cat A facilities are not applicable.

Emergency preparedness

Emergency Plans for Cat A facilities are not applicable.

Extractive waste facilities

Estonia has 4 extractive waste facilities for energy minerals extraction.
Estonia has no Class A facility.

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

In the field of exploration of minerals deposits the Ministry of Environment is the most important authority. The Ministry lays down the exploration areas, etc. In the sphere of exploitation, the District Mining Authorities are the most important state bodies. The District Mining Authorities (8 in total) are part of the State Mining Administration (SMA) which is composed also by the Czech Mining Office in Prague (central mining Authority).

Besides the Czech Mining Authority in Prague, the bodies of the SMA are the District Mining Authorities for the territories of: 1) Capitol city Prague and Central Bohemia Region, 2) Pilsen and South Bohemia Region, 3) Karlovy Vary Region, 4) Ústí na Labem Region, 5) Hradec Králové and Pardubice Region, 6) South Moravia and Zlín region, 7) Moravia Silesia and Olomouc Region and 8) Liberec and Hiland Region. The Czech Mining Authority is an appeal instance (as a central authority of state administration).

An application regarding prospecting and exploration is to be considered by the Ministry of the Industry and Trade with the approval of the Ministry of the Environment. An application regarding extraction will be managed by the Ministry of the Industry and Trade after a consultation with the Czech Mining Authority. The decisions of the State Mining Administration bodies are reviewable by an administrative justice. In the first instance there are the County courts which decide about the accusations. The second instance deciding about the cassation is the Supreme Administrative Court with the seat in Brno.

Legislation governing mineral exploration and extraction

Estonia published its minerals strategy in 2017. Estonia has neither a dedicated national resource efficiency strategy nor an action plan. The topic is covered in a number of other policies and strategies. Resource efficiency has broad meaning in “Estonia 2020 – National Reform Programme”: achieving sustainable economic growth which means continuous development of a more resource efficient, nature conserving and competitive economy. However, the scope has not yet been de-fined. Resource efficiency and waste policies are linked in the National Waste Management Plan 2014–2020, which focuses on waste prevention. It also focuses on modern product design, clean resource saving production and the recycling of already produced materials (European Environment Agency, 2016 –

Estonia), http://www.mica-project.eu/wp-content/uploads/2016/03/D5.6_RMI-implementation-status-quo-and-needs-in-EU-28.pdf

The Government of the Republic has approved the proposal for the preparation of the "National Development Plan for the Use of Oil Shale 2016–2030" (hereinafter "the oil shale development plan", "the oil shale development plan 2016–2030", or "the development plan") with directive No. 138 of 4 April 2013. The general objective of the oil shale sector is the enforcement of national interest, which means the effective and efficient use of oil shale as a nationally strategic resource and ensuring the sustainable development of the oil shale sector. Pursuant to the Earth's Crust Act, the annual total oil shale mining limit based on all the permits is 20 m tons, i.e. the oil shale reserve registered in the Environmental Registry without the calculated mining losses (including the reserve left in the pillars).

Oil shale mines and opencasts are mainly located in Ida-Viru County, only the old Ubja mine and the current Ubja opencast are in Lääne-Viru County. By now, oil shale has been mined on the territories of 13 local governments (https://www.envir.ee/sites/default/files/2016_2030ak_ingl.pdf).

Despite the opposition of the local government, the Environmental Board extended the excavation permit for the mine in Estonia until 2049. The annual rate of oil shale mined increased from 8.2 million tons to 10 million tons (https://www.miningmetalnews.com/20190802/1152/estonian-environmental-board-extended-permission-oil-shale-excavation).

The "National Development Plan for the Use of Construction Minerals 2011–2020" forms the basis for determining 40% of the initial level of the impact indicator of waste rock recovery58, based on which crushed stone from waste rock can generally be used to construct certain elements on roads with a smaller traffic load; however, it is not suitable for the construction of motorways of high road classification. Thus, crushed stone from waste rock cannot be used as a replacement of quality construction crushed stone everywhere. At the same time, crushed stone from waste rock is good for manufacturing low class concrete. In 2011–2013, waste rock recovery amounted to over 50%; however, that was achieved due to several large construction works
National Transport Development Plan 2014–2020"13 (hereinafter "the transport development plan") handles environmental friendliness and nature preservation, energy saving, safety, and universal design. In road construction, the oil shale waste rock from oil shale mining is one of the most important alternatives for natural building materials, and the maximum use of this waste is highly important for the oil shale development plan. Under normal circumstances, the usage of oil shale waste rock from oil shale extraction is currently 30% in a year and therefore, it is important to analyse whether the waste from oil shale extraction and processing (limestone of the caprock, enrichment waste, oil shale waste rock gravel, oil shale ash) can also be used as alternative construction materials (https://www.mkm.ee/sites/default/files/transpordi_arengukava.pdf).

The Estonian Environmental Strategy until 2030: the aim of the strategy is the environmentally friendly extraction of minerals, i.e. saving water, the landscape, and air, as well as using minerals efficiently with minimal loss and waste. The measures of the strategy are the preparation and implementation of long-term national development plans for the use of the mentioned minerals (the basis of the development plans are the schemes for the optimal use of the resource, promoting the use of the resources in accordance with national needs on a scientific basis), and directing the activity of enterprises that extract and use minerals towards environmental safety by implementing a system of regulations and aids. Therefore, the Environmental Strategy provides the objectives and courses of action for preparing an oil shale development plan that ensures that oil shale is extracted and used as sustainably and economically efficiently as possible, ensuring the supply of oil shale for the oil shale industry and taking into consideration the accompanying environmental impact (http://www.keskkonnainfo.ee/failid/viited/strateegia30.pdf).

National Waste Management Plan 2014–2020" (hereinafter "the waste management plan") also includes the waste prevention programme. One of the problems defined in the waste management plan that needs to be solved is the large amount of waste and oil shale waste rock created in the production of oil shale energy, and which have a low recovery rate. Although in the past few years, the Best Available Techniques (BAT) have been implemented increasingly more in the oil shale industry, and the recovery of oil shale waste rock and oil shale ash has also increased; new options for reducing waste and increasing the recovery rate will be continually sought for, which also serves as a prerequisite for implementing the oil shale development plan (http://www.envir.ee/sites/default/files/riigi_jaatmekava_2014-2020.pdf).

Administrative arrangements for waste management

Extractive waste management plans and environmental permits

In Estonia, the Ministry of the Environment is the competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators and for issuing and updating EWM permits.

Financial guarantee

In theory the financial guarantee has to be sent to the Ministry of the Environment in Estonia, but Estonia has no Cat A facilities.

Inspection of waste facilities

In theory the competent authority in charge of making inspection of the waste facilities is the Ministry of the Environment in Estonia.

Emergency plans

Emergency Plans are not applicable.

Closed and abandoned waste facilities

The competent authority in charge of establishing an inventory of closed and abandoned waste facilities is the Ministry of the Environment. In Estonia, there are 3 closed EWF which are regularly monitored.

Finland – Country Fact Sheet

Finland and its minerals industry

Background

Finland has a long history of mining activity, and Finnish metallurgical technology and manufacturers of mining equipment are well known throughout the international mining community. The extraction of copper, nickel, cobalt, zinc and lead ores as well as chromium, vanadium and iron deposits has provided the raw material base for the country's metal industry, with significant processing and refining of copper and nickel concentrates at Harjavalta, zinc at Kokkola, and chromium at Kemi, and of iron at Raahe. The major industrial minerals mined in Finland are carbonates, apatite and talc.

Mineral ownership

Metallic and industrial minerals, gemstones, marble and soapstone (claimable minerals) are state regulated/controlled and compensation goes to the landowner. Non-claimable minerals (e.g. dimension stones such as granite, aggregates) are construction minerals (owned by landowner).

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Finland are presented.

Table 1: Finland, Annual mineral production per main commodity (10^6 t, Au & Ag in kg)

Commodity	2015 Mt	2016 Mt	2017 Mt	Average Mt	Reference
Apatite concentrate	0,957	0,940	0,979	0,958	Tukes, Eurostat Prodcom, USGS
Biotite	0,038	0,011	0,047	0,032	Tukes
Feldspar	0,038	0,019	0,015	0,024	BGS, Tukes, USGS, WMD
Magnesite	0,022	0,054	0,064	0,047	Tukes, WMD
Mica concentrate	0,012	0,052	0,011	0,025	Tukes
Quartz	0,104	0,093	0,072	0,089	Tukes
Soapstone	0,017	0,013	0,013	0,014	Tukes
Talc	0.332	0.346	0.355	0.344	BGS, Tukes, WMD
Crushed rock	UEPG	6,00	8,20	6,57	UEPG 2020
Sand & gravel	7,00	6,50	9,40	7,63	UEPG 2020
Recycled aggregates	2	2	2	2	UEPG 2020
Pyrite concentrate (FeS_2)	0,719	0,879	0,771	0,790	Tukes 2021
Chromium concentrate	1,070	0,972	1,099	1,047	Tukes 2021
Nickel concentrate	0,150	0,193	0,212	0,185	Tukes 2021
Zink concentrate	0,084	0,112	0,141	0,112	Tukes 2021
Copper concentrate	0,193	0,207	0,193	0,198	Tukes 2021
Cobalt concentrate	0,035	0,026	0,019	0,027	Tukes 2021
Gold (kg)	8.342	8.865	9.102	8.770	Tukes 2021
Silver (kg)	13.051	16.348	13.654	14.351	Tukes 2021
Dimension stone (soapstone)	0,471	0.350	0,470	0,430	Tukes (2015; 2016, 2017)

Table 2: Finland, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Other year	Reference
Apatite concentrate	1	1	1		Tukes (2015, 2016, 2017)
Biotite	No data found / available / provide				
Feldspar	4	4	4		Tukes (2015, 2016, 2017)
Magnesite	3	2	2		Tukes (2015, 2016, 2017)
Mica concentrate	No data found / available / provide				
Quartz	4	3	3		Tukes (2015, 2016, 2017)
Soapstone	5	4	5		Tukes (2015, 2016, 2017)
Talc	4	4	4		Tukes (2015, 2016, 2017)
Crushed rock Sand & gravel Recycled aggregates	2530	2530	2140	2530 (2019	UEPG (2020)
Pyrite concentrate (FeS_2)	By-product				Euromines
Chromium concentrate			1		Euromines
Nickel concentrate			1		Euromines
Zink concentrate			1		Euromines
Copper concentrate			3		Euromines
Cobalt concentrate	By-product				Euromines
Gold (kg)			5		Euromines
Silver (kg)	By-product				Euromines
Dimension stone (soapstone)	5	4	5		Tukes (2015, 2016, 2017

Individual production data of the principal mine and quarries in Finland are listed in Annexes D, G, H.

Extractive waste generation 2015-2017

In the next table the total annual generation of extractive waste in Finland is presented for 2016 and 2017. For the year 2015 no data was available or provided.

Table 3: Finland, Annual Total Extractive Waste Generation from 2015 to 2017 (Mt), source Statistics Finland, (www.tilastokeskus.fi)

Annual Total Extractive Waste Generation (ton)	2015	2016	2017	Comment
Total extractive waste generated	ND	93,7	89,0	
Total extractive waste classified as hazardous	ND	0,6	0,4	total, hazardous as defined in waste framework directive.
Total extractive waste classified as non-inert and non–hazardous.	ND	88,9	85,0	total, nonhazardous as defined in waste framework directive.
Total extractive waste classified as inert	ND	ND	ND	
Total unpolluted soil resulting from prospecting, extraction, treatment and storage of mineral resources	ND	4,1	3,5	total, nonhazardous as defined in waste framework directive.
Total excavated material resulting from prospecting, extraction, treatment and/or storage of mineral resources that is neither reported as production nor reported as waste	ND	9,2	12,5	not reported as waste as defined in waste framework directive and waste statistics regulation.

ND: no data available / provided

In the following paragraphs the more specific information on generation of extractive waste per extractive sector is presented per commodity.

Extractive waste from Aggregates sector

At the aggregates sites excavated extractive waste material (inert) is reused on site but exact numbers were not available/provided. Some excavated material resulting from prospecting, extraction, treatment and/or storage of mineral resources is neither reported as production nor reported as waste, see Tables 3 and 4.

Table 4: Finland, On site re-used aggregates (Mt)

Commodity	2015	2016	2017	Reference
Crushed rock	0	0	ND	UEPG annual reports
Sand & Gravel				

Extractive waste from Industrial minerals sector

According Statistics Finland (www.tilastokeskus.fi) 17,9 Mt of waste rock was generated in 2020 due to production of industrial minerals including Carbonate rock, Industrial rock and Gemstone, see next Table.

Table 5, Finland, waste rock from industrial minerals production (Mt)

Extractive Waste from Industrial minerals	2015-2017	Other year (EIA&EWMP 2020)	
Waste Rock	ND	17,9	incl Carbonate rock, Industrial rock and Gemstone
Tailings	ND	ND	

ND: no data provided / available

Annually generated Extractive Waste (waste rock and tailings) related to production of Industrial Minerals Fieldspar, Magnesite and Talc is estimated through the methodology described in the report, §2.2. Next table presents estimates of those industrial minerals.

Table 6: Estimation of total minerals excavation and waste in Finland (Mt)

Finland (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Feldspar	0,038	0,019	0,015		0,024	0,000	0,048
Magnesite	0,022	0,054	0,064	0,047	0,047	0,028	0,121
Talc	0,332	0,346	0,355	0,344	0,344	0,000	0,689

a Rock = Average Stripping Ratio * Average Production

b Total Excavated Material = Rock + Average Production + Tailings

c Tailings = Ratio * Average production

Extractive waste from Metallic ore sector

Annual Extractive Waste numbers for Metallic ore are based on actual (2020) EIA and EWMP waste rock data from the principal metal mines and through generic waste production per commodity production for 2017 according Statistics Finland (www.tilastokeskus.fi).

Table 7: Finland, Estimation of extractive waste generated through production of metal ores (Mt)

Extractive Waste from Metallic ores	2015	2016	2017	Other year (EIA & EWMP 2020)
Waste Rock	ND	ND	ND	48,9
Tailings	ND	ND	21,8	ND

ND: no data available / provided

Estimates based on Finnish metal mines production according methodology of Annex H are presented in next table.

Table 8: Finland, Estimates of extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217	Rock[b](t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Kittila	Au	U	6	Au, Ag	20	1.567.080	1.347.030	2.967.327	1.620.270
Jokisivu	Au	O&U	-	-	0	212.448	318.672	532.119	0
Orivesi	Au	U	-	-	0	93.268	46.634	139.902	0
Pampalo	Au	O&U	4.783	-	0	185.671	92.836	278.507	180.888
Pyhasalmi	Cu	O&U	13.400	Zn+Au	690.851	1.339.244	634.993	1.974.237	634.993
Kemi	Cr	O&U	1.040.719	-	0	2.003.806	97.995	2.101.801	963.087
Pahtavaara	Au	O&U	2.477	Au, Cu	128.273	247.990	123.995	371.985	117.240
Talvivaara, Sotkamo, Kajaani	Ni	O	22.575	Zn, Ni	15.209	11.927.360	13.472.428	25.399.788	11.889.576
Kevitsa	Cu	O	83.500	Cu, Ni	109.500	6.214.500	18.643.500	24.858.000	6.021.500
Kylylahti (Luikonlahti TMF)	Cu	U	58.246	Cu,Zn	4.753	779.667	389.833	1.169.500	716.667
Vammala plant	Au	-	183.429	-	0	305.716			122.286
Laiva (Raahe region)	Au	O	659.830	-	0	1.805.605	319.261	2.124.866	1.145.775

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Waste legislation in Finland is based on EU legislation. In Finland there is a different legal implementation for the mainland of Finland and the Åland Islands.

Extractive waste can be soil, waste rock, tailings material, etc., originated from extractive industry operations. Waste is divided into inert, non-hazardous, and hazardous categories.

Definitions are provided in the Government Decree on:

- Extractive Waste (190/2013; amendments up to 102/2015 included) on governmental webpage https://www.finlex.fi/en/laki/kaannokset/2013/en20130190_20150102.pdf),
- Waste Act (646/2011; amendments up to 528/2014 included) on the governmental webpage https://www.finlex.fi/fi/laki/kaannokset/2011/en20110646_20140528.pdf).

Classification of Extractive Waste

The waste classification in Finland is based on the Waste Act under EU Waste Framework Directive. The inert waste classification is based on:

- Annex 1 (Classification of extractive waste as inert waste) in the Government Decree on Extractive Waste (190/2013 amendments up to 102/2015 included),
- Waste Act (646/2011; amendments up to 528/2014 included) on the webpage https://www.finlex.fi/fi/laki/kaannokset/2011/en20110646_20140528.pdf),
- Government decree on waste (179/2012) and list of waste (in Finnish) https://www.finlex.fi/data/sdliite/liite/6094.pdf.

In Finland, a list of inert waste in accordance with Article 1(3) of Commission Decision 2009/359/EC has been established, see the links below:

- Publication "Classification of inert extractive waste - Waste rock left after quarrying", 2011 https://helda.helsinki.fi/bitstream/handle/10138/37032/SY21_2011_Kaivannaisjatteen_luokittelu_pysyvaksi.pdf?sequence=1,
- Annex 1 (Classification of extractive waste as inert waste) in the Government Decree on Extractive Waste (190/2013; amendments up to 102/2015 included) on the webpage https://www.finlex.fi/en/laki/kaannokset/2013/en20130190_20150102.pdf),

National threshold values for soil are published through the Government Decree on the Assessment of Soil Contamination and Remediation Needs on the webpage https://www.finlex.fi/fi/laki/kaannokset/2007/en20070214.pdf.

Classification of Chemical Reagents applied in extractive sector

Risks arising from the processing of minerals with chemical agents are evaluated in the EIA. Further details are provided in the Guide "Environmental Impact Assessment Procedure for mining projects in Finland": http://julkaisut.valtioneuvosto.fi/handle/10024/75001.

The chemical legislation and use of specific chemical agents in Finland are based on EU legislations (such as REACH).

Re-use and placing back of extractive waste material

Next table provides information on use of tailings for filling excavation voids.

Table 9: Finland, Reuse of tailings for placing back into excavation voids (t)

Property Name	Primary Commodity	Mine Type	Average Ore production 2015-2017 (t)	Estimates[a]			Tailings Management[b]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Kittila	Au	U	1.567.080	1.347.030	2.967.327	1.620.270	252.255	1.368.015	According to available information the tailings are classifed into two streams (a) a waste stream that is characterised as Neutralisation Potential (NP) and (b) CIL tailings. Only a part of the NP tailings is used for the filling of excavation voids
Jokisivu	Au	O&U	212.448	318.672	531.119		0		
Orivesi	Au	U	93.268	46.634	139.902		no tailings		
Pampalo	Au	O&U	185.671	92.836	278.507	180.888	0	180.888	According to KAIVOSVASTUU (Available here https://www.kaivosvastuu.fi/en/yrityskortti/endomines-oy/) only the 53.0% of waste rock is utilised and there are no data for the usage of tailings.
Pyhasalmi	Cu	O&U	1.339.244	634.993	1.974.237	634.993	279.397	355.596	According to KAIVOSVASTUU (available here: https://www.kaivosvastuu.fi/en/yrityskortti/pyhasalmi-mine-oy/) 44% of generated tailings are used for filling excavation voids
Kemi	Cr	O&U	2.003.806	97.995	2.101.801	963.087	0	963.087	According to KAIVOSVASTUU (available here: https://www.kaivosvastuu.fi/en/yrityskortti/outokumpu-chrome-oy/) "From fine concentrate plant, tailings are pumped into tailings pond area, where solids are deposited and water goes to clarifying ponds. Concentrator plant takes process water from clarifying ponds." So no tailings are used for filling excavation voids
Pahtavaara	Au	O&U	247.990	123.995	371.985	117.240	0	117.240	no data avaialbe Taking into consideration data from different sources in the internet "The mine's previous Swedish owners, Lappland Goldminers, declared bankruptcy in 2014 and the mine has been closed down ever since." So during the period of investigation there were not produced amounts that could be returned into the excavation voids

Property Name	Primary Commodity	Mine Type[a]	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management[c]		
				Rock (t)	**Total Excavated Material (t)**	**Tailings (t)**	**Tailings for filling excavation voids or other uses in the mine**	**Tailings (t) for deposit**	**Source**
Talvivaara, sotkamo, kajaani	Ni	O	11.927.360	13.472.428	25.399.788	11.889.576	0	11.889.576	According to Talvivaara Projekti Oy TALVIVAARAN KAIVOSHANKKEEN YMPÄRISTÖVAIKUTUSTEN ARVIOINTISELOSTUS published by LAPIN VESITUTKIMUS OY and page 33 the generated rock from the open pit Kolmisopen will be used for filling excavation voids. The tailings that are in a slurry form are deposited.
Kevitsa	Cu	O	6.214.500	18.643.500	24.858.000	6.021.500	0	6.021.500	According to the presentation for Kevitsa Mine (https://www.boliden.com/globalassets/investor-relations/reports-and-presentations/capital-markets-day/2017/cmd/7-kevitsa---expansion-to-9-mtonnes.pdf) (page 16) the generated tailings are divided into (a) low sulfur tailings and (b) high sulfur tailings that are deposited into two different tailings deposition
Kylylahti (Luikonlahti TMF)	Cu	U	779.667	389.833	1.169.500	716.667	0	716.667	According to the technical report "Boliden Summary Report" published in 2019 (Available here https://www.boliden.com/globalassets/operations/exploration/mineral-resources-and-mineral-reserves-pdf/2019/resources_and_reserves_kylylahti_2019-12-31.pdf) in Kylylahti cemented rock fill (CRF) and/or waste rock used as material for filling excavation voids
Vammala plant	Au	-	305.716	152.858	458.574	122.286	no tailings		
Laiva (Raahe region)	Au	O	1.805.605	319.261	2.124.866	1.145.775	0	1.145.775	There were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.

a Mine type: O = open pit; U = underground mining

b Rock = Stripping Ratio x Average Ore Production

Total Excavated Material = Rock + Average Ore Production

Tailings = Average Ore Production – Concentrate – By-Products (process)

b Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

The extractive waste management plans (EWMP) are included in the environmental permit, which are licensed by the Regional State Administrative Agencies (AVIs). The operator is responsible to check the EWMP in every five years minimum and make a notice of the checking to the supervising authorities (Centre for Economic Development, Transport and the Environment (ELYs)). If the EWMP contains significant changes, it will require a permit change (AVI).
More detailed information on procedures is given under paragraph Administrative arrangements for waste management.

Financial guarantees

According to Finland's Environmental Protection Act (527/2014), Sections 59-61, and Government Decree on Extractive Wastes (190/2013) - Section 10, operators are required to provide a financial guarantee to secure the appropriate waste management, supervision and measures required for terminating operations, or thereafter. Determination of the financial guarantees is provided in the Government Decree on Extractive Waste under: Section 10 (102/2015) "Financial guarantee for a waste facility for extractive waste" and under Annex 5 "Determining the amount of the financial guarantee for a waste facility for extractive waste" (https://www.finlex.fi/en/laki/kaannokset/2013/en20130190_20150102.pdf) and https://www.finlex.fi/en/laki/kaannokset/2014/en20140527.pdf (including amendments 2015 and 2016).

The environmental permit shall give the necessary regulations on the financial guarantee (set out in section 59) and on providing the guarantee. Acceptable financial guarantees are a guarantee, insurance, or pledged deposit. The party issuing the financial guarantee shall be a credit or insurance institution, or another commercial financial institution, domiciled in a European Economic Area country. The financial guarantee shall be assigned to a competent supervisory authority indicated in the environmental permit before operations commence. A financial guarantee concerning a waste facility for extractive waste shall be provided before the depositing of extractive waste begins at the waste facility.

The financial guarantee shall remain valid continuously or be renewed at regular intervals for a minimum of three months after the measures covered by the guarantee have been carried out and the supervisory authority has been notified about them. If the validity of the financial guarantee is extended, renewal shall take place before the previous period of guarantee comes to an end.
The financial guarantee for a landfill shall remain valid until monitoring and other aftercare following the closure of the landfill come to an end. The permit authority shall release the financial guarantee upon application once the operator has fulfilled the necessary obligations. The financial guarantee may also be partly released.

Emergency preparedness

The revised Finnish Dam Safety Act (494/2009) came into force on 1 October 2009 and a Government Decree on Dam Safety (319/2010) started on 5 May 2010.
A Dam Safety Guide (in Finnish) was completed in 2011 and updated in 2018: https://www.environment.fi/en-US/Waters/Use_of_water_resources/Dams_and_dam_safety/Dam_Safety_Guide. The purpose of the guide is to complement and elucidate the law and the decree through examples and descriptions.

The Dam Safety Guide is designed to support the tasks of dam owners and others who work at dams. The guide takes up the designing and construction of dams, classification, dam safety documentation as well as the dam break hazard analysis and the emergency action plan. It explains matters in connection with dam maintenance, use, monitoring and inspections as well as the obligations of the dam owner.

According to the Section 48 of the Finnish Rescue Act (379/2011) the local rescue departments (organized by municipalities) are responsible for establishing external emergency plans for Category A installations, in cooperation with the plant operator. The external emergency plans are seen for instance in the webpages of Regional Rescue Departments.

Extractive waste facilities

Table 10 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Finland.

Table 10: Finland, Overview EWF & Cat A Facilities from 2015 to 2017

EWF information	2015 - 2017	Other year	Reference
Nr. EWF metal extraction	no data found / available / provided	30 (2020)	Review EIA and EWMP over 2020
Nr. EWF non-metal extraction	no data found / available / provided	48 (2020)	Review EIA and EWMP over 2020
Nr. Cat A Facilities metal extraction	11 (2017)	8 (2020)	AFW study 2017, Review EIA and EWMP over 2020
Nr. Cat A Facilities non-metal extraction	4 (2017)	2 (2020)	AFW study 2017, Review EIA and EWMP over 2020

A review of EIA and EWMP of the active Finnish mines and quarries in 2020 delivered a total of 10 Cat A facilities. In 2018 the supervising regional ELY Centres reported to the EU Commission 11 Category A waste facilities. In the 2017 EU study "Assessment of Member States' performance regarding the implementation of the Extractive Waste Directive; appraisal of implementation gaps and their root causes; identification of proposals to improve the implementation of the Directive" (Ref 38054 Amec Foster Wheeler, 2017) a total of 15 Cat A Facilities were listed. Probably the difference is related to the operational phase: fully closed facilities seem not to be included in the reports from ELY Centres.

In Finland there is not an operator appointed for every closed EWF. Although, the Ministry knows who has been operating the closed and abandoned waste site. Member State Finland requires any 'operators' of closed EWFs to hold a valid permit according all the requirements of the EWD.

In Finland there are according to Tukes no cases where the competent authority is the 'operator' of a closed EWF.

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

An overview of authorities governing mineral exploitation and extraction is presented in the next Table.

Table 11: Finland, Overview of authorities governing mineral exploitation & extraction

Authority		Activity / Responsibility
TUKES	Finnish Safety and Chemicals Agency	Responsible for: - Onshore and offshore mining permits (exploration: ore prospecting permits) and extraction: mining permit) https://tukes.fi
AVI	The Regional State Administrative Agencies	- Granting the environmental permits - Arrange official hearings with other public authorities and other stakeholders. https://avi.fi/en/regional-state-administrative-agencies
ELY Centres	Regional Centres for Economic Development, Transport and the Environment	- Supervision and control of the EIA procedure - Issuing official statements on the EIA program and on the EIA report. https://www.ely-keskus.fi/web/ely-en
Metsähallitus	Owner of State-owned land	- Involved in the granting of exploration permits by TUKES. https://www.metsa.fi/en/
Ministry of Environment		- Involved in the granting of exploration permits by TUKES. - Provide permits in nature conservation areas established before the Nature Conservation Act (1096/1996). https://ym.fi/en/front-page
Municipalities		- Granting planning permission for extraction permits
Land survey offices		- Give their consent for extraction permits

Legislation governing mineral exploration and extraction

The primary legal basic of mineral extraction activity is the Mining Act 621/2011 which covers metallic ores and industrial minerals (https://www.finlex.fi/en/laki/kaannokset/2011/en20110621.pdf). The Finnish Mining Act has the principle that the mineral exploitation rights belong to the discoverer.

The Government Decree on mining activities (391/2012) also provides important provisions to the Mining Act. Non-claimable minerals are regulated by the Land Extraction Act No. 555/1981.

The present Finnish Mining Act came into force in 2011. Compared to the previous Mining Act (1965) the new act included more of public hearing, increasing possibilities to influence for individuals, landowners, municipalities and other authorities. Also, the environmental issues were taken stronger into account in the new act. Furthermore, the act better secured the rights of the Sámi people.

Other relevant laws are, inter alia, the Nature Conservation Act (1096/1996), the Environmental Protection Act (527/2014), the Act on the Protection of Wilderness Reserves (62/1991), the Land Use and Building Act (132/1999), the Water Act (587/2011), the Reindeer Husbandry Act (848/1990), the Off-Road Traffic Act (1710/1995) and the Government Degree on Mine Waste (190/2013).

The sector is furthermore covered by an environmental protection legislation, legislation on Environmental Impact Assessment, waste legislation and water legislation (MINLEX - Study on the legal framework for mineral extraction and permitting procedures for exploration and exploitation in the EU, Dreistetten Austria 2016).

Following tables contain the main laws that regulate the mineral extraction in Finland.

Table 12: Finland, Direct legislation governing mineral exploration & extraction

Legal Act		Location / Reference
Mining Act	Ministry of Employment and the Economy	Act 621/2011
Land Extraction Act	Regulation on non-claimable minerals	Act 555/1981
Government Decree on mining activities	Provides important provisions to the Mining Act	Act 391/2012
Government Degree on Mine Waste	Regulation on Mine Waste	Act 190/2013

Table 13: Finland, Indirect legislation governing mineral exploration & extraction

Legal Act	Location
Nature Conservation Act	Act 1096/1996
Environmental Protection Act	Act 527/2014
Act on the Protection of Wilderness Reserves	Act 62/1991
Land Use and Building Act	Act 132/1999
Water Act	Act 587/2011
Reindeer Husbandry Act	Act 848/1990
Off-Road Traffic Act	Act 1710/1995

Licensing procedures for exploration and extraction

Exploration permits

Finland does not have a so called “one stop shop” for exploration related permits. In addition to permits granted based on the Mining Act additional permits or evaluations may be required depending on the natural conditions and location of the area. Additional permits are evaluated and granted pursuant to the relevant acts, e.g. the Environmental Protection Act (527/2014), Water Act (587/2011), Nature Conservation Act (1096/1996) or Land Use and Building Act (132/1999).
An exploration permit remains valid for a maximum of four years, and it may be extended for a maximum of three years at a time. In total, the permit may remain valid for a maximum of 15 years. The average legal timeframe for exploration permit handling is several months in forested areas and 1-2 year in Natura 2000 areas (as long as no appeals take place). In Sámi Homeland areas it may be 1 year for gold panning and may extend to 2 years for other types of exploration.

Mining Permits

Permits related to mining activities are in Finland granted by the Finnish Safety and Chemicals Agency (“Tukes”), as the Finnish mining authority, and according to procedures defined in the Mining Act.
An environmental impact assessment under the Act on Environmental Impact Assessment Procedure (252/2017) is also needed for a mining permit procedure. EIA procedure applies to all projects that may be expected to have considerable negative environmental effects, for instance if the area of extraction or excavation is larger than 25 hectares. The permitting processes of mining permit and environmental permit, including water permit which is required for water resources management projects, are separate and the evaluations are made independently by the authorities competent to grant the permits or assess the evaluations in question. The permits are independent in a way that a certain permit is not necessarily a prerequisite to obtaining another permit. However, acquiring all needed permits and conducting an environmental impact assessment if needed is a prerequisite for the realization of a project. Mining activities cannot be started before all procedures have been completed and all permits have gained legal force, unless an enforcement order has been given by an administrative court.
Tukes and other co-authorities involved have no statutory time frames for permitting but statutory time frames are included in the Nature Conservation Act and the Environmental Protection Act, whereby authorities´ decisions on Natura 2000 assessments must be made within 6 months.

Concerning extraction permits, a mining permit remains valid until further notice after becoming legally valid. The expected average legal time frame in consecutive days for permit handling is 180 days for a mining permit (as long as no EIA is needed), 180-360 days with EIA and related statement by the ELY centre.
Permitting success rates are high: no applications were rejected by the authorities from 2013 to 2015. Incomplete applications were asked to be completed by the Mining Authority. This is very often the case. If the operator finds out that it is not worthwhile to continue with exploration and there are no provisions obliging the operator to keep on exploring.
Permits issued before 2010, permits issued 2010 to 2013 and permits issued since 2014 are provided through webpage: https://www.ymparisto.fi/en-US/Forms_permits_and_environmental_impact_assessment/Permits_notifications_and_registration/Environmental_permits.

Administrative arrangements for waste management

Every 3 year a waste management report has been submitted by Finland's Ministry of Environment to the Commission (2008-2011, 2012-2014, 2015-2017).

Extractive waste management plans and environmental permits

The Regional State Administrative Agencies (AVIs) are the state authorities charged with issuing environmental permits under Finland's Water Act (587/2011) and Environmental Protection Act. The state authorities handle permits for activities with major environmental impacts, as well as all permits under the Water Act. Other environmental permits are dealt with by the municipal environmental protection authorities.

The extractive waste management plans (EWMP) are included in the environmental permit, which are licenced by the AVI. The operator is responsible to check the EWMP in every five years minimum and make a notice of the checking to the supervising authorities (Centre for Economic Development, Transport and the Environment (ELYs)). If the EWMP contains significant changes, it will require a permit change (AVI).

If there is a need to update the permit because of the significant changes in the EWMP, the supervisory authority may initiate the authorization procedure, after issuing the invitation to the operator (if the operator refused to apply permit). In some cases, the operator apply the new permit or changes to the existing permit from the AVI.

Financial guarantee

The competent authorities in charge of establishing and updating the financial guarantee are the Regional State Administrative Agencies (AVI) and Finnish Safety and Chemicals Agency (Tukes).
At the Mainland of Finland the permit requirement applies to wider selection of extractive operations than in the Directive 2006/21/EC. According to the Environmental Protection Decree (713/2014, Section 1) the responsibility for issuing and updating environmental permits for waste facilities, mining, as well as peat production and related drainage work, lies with the Regional State Administrative Agencies (AVI Agencies). Quarrying operations and extraction of stone, gravel, sand, clay or earth require a land extraction permit issued by the municipality (Land Extraction Act 555/1981, Section 4).

The authority issuing the environmental permit is also responsible for accepting and renewing the financial guarantee for the licensed operation.

According to the Environmental Protection Act, Section 61, and Government Decree on Extractive Wastes (190/2013), Section 10, the operator of the extractive waste facility must raise the financial guarantee to the benefit of the regional ELY Centre responsible for supervising the environmental permit before any extractive waste is deposited into the facility. On the application of the operator, the permit authority (AVI Agency) is entitled to release the financial guarantee either partly or totally once the closure of the facility and rehabilitation of the land affected by the facility has been completed.

At the Åland Islands according to the Environmental Protection Act (2008:124, Chapter 5) the responsibility for issuing and updating permits lies with the authority Ålands miljö- och hälsoskyddsmyndighet. The authority issuing the environmental permit is also responsible for accepting and renewing the financial guarantee for the licensed operation according to the Decree on Extractive Waste (2008:108).

According to the Ministry of Environment (received comment June 2020) in 2018 the supervising regional ELY Centres reported to the EU Commission 89 waste facilities that were covered by financial guarantees in September 2017. These included: 11 Category A waste facilities; 44 non-hazardous, non-inert waste facilities; and 34 inert waste facilities. The total number of waste facilities covered by financial guarantee contained also certain inert waste facilities that do not need a financial guarantee according to the Directive 2006/21/EC. The financial guarantee requirement in the Finnish Environmental Protection Act is extended also to other operations than those covered by the Directive."

Inspection of waste facilities

According to the Environmental Protection Act (527/2014), Section 21, at the Mainland of Finland the Regional ELY Centres are responsible for supervision of the extractive waste facilities, including making inspections. Additionally, the environmental protection authorities of municipalities take part to the supervision in accordance with the Environmental Protection Act.

The Regional ELY Centre of Kainuu is named as the dam safety authority in accordance with the Dam Safety Act (494/2009) for mine and waste dams in the whole mainland Finland.

The Åland Islands: According to the Environmental Protection Act (2008:124 Section 28b §) and the Decree on Extractive wastes (2008:108, Section 2) at the Åland Islands the authority Ålands miljö- och hälsoskyddsmyndighet is responsible for making inspections.

Radiation and Nuclear Safety Authority (STUK) supervises radiation and nuclear safety in Finland.

Emergency plans

According to the Section 48 of the Rescue Act (379/2011) the local rescue departments (organized by municipalities) are responsible for establishing external emergency plans for Category A installations, in cooperation with the plant operator. The external emergency plans are seen for instance in the webpages of Regional Rescue Departments.

Closed and abandoned waste facilities

The regional ELY Centres, the Finnish Meteorological Institute, the Finnish Environment Institute and the Ministry of the Environment maintain an environmental protection database to which each regional ELY Centre is obliged to record information on closed or abandoned extractive waste facilities that might cause serious risk of pollution of the environment (the Environmental Protection Act, section 222, and the Government Decree on Extractive Waste, Section 15).
The Ministry of the Environment (competent authority) has conducted in 2011-2012 a study concerning the inventory of closed waste facilities in Finland. The national list has been re-evaluated with authorities from ELY centres by Ministry of the Environment in 2020.

From the Finland's report 2018: According to the regional ELY Centres, 5 closure procedures of waste facilities were approved and 2 closure procedures were undertaken during the reporting period (Table 14). Three approved and one undertaken closure procedures concerned extractive waste facilities for non-hazardous, non-inert waste. Two approved and one undertaken closure procedures concerned waste facilities for inert waste (at Mainland Finland).

The supervising regional ELY Centres further reported of 9 waste facilities that were both closed and monitored by 2017. However, it should be noted that some of these facilities have been closed before the Directive 2006/21/EC came into force, hence the closure procedures and monitoring obligations might deviate from the ones set in Article 12 of the Directive (Mainland Finland).

Table 14: Finland, Number of closing procedures undertaken

Closure procedures Finland	EU reporting period		
	2008-2011	2012-2014	2015-2017
N° closure procedures undertaken and/or approved during each reporting period	ND	ND	7

ND: no data provided / available

France– Country Fact Sheet

France and its minerals industry

Background

France has gradually transitioned in the past two decades from being a mineral producer and processor of mineral commodities to being principally a processor and manufacturer of mineral goods and commodities. In metropolitan France, some exploration for metals continues but the mining of metals has ceased; however, the extraction of aggregates and industrial minerals and processing of metal commodities is ongoing. In the French overseas departments and territories, metals extraction is ongoing, e.g. nickel in New Caledonia, gold in Guyana.

Mineral ownership

Metallic and industrial minerals are State-owned minerals (‘mined substances’). Rights to extract quarried minerals (such as sand and gravel) belong to the landowner (§3 Mining Code).

The reform consolidated version of the Mining Code dated April 12 2016 includes three fundamental points:

- The separation of the quarry system from the mining system;
- The possibility granted to an operator to work without the landowner authorisation (different from the quarry system);
- The separation between the authorisation system: mining title, concession (extraction permit), granted by the State and the mining policy system depending upon the prefectural authority (work monitoring, goods and people protection).

Under French Law, the exploitation of materials defined as “eligible for concession”' is ruled by the regulations on mines, and the exploitation of materials defined as “non-eligible for concession” is ruled by the regulations on quarries. The materials “eligible for concession” include mineral substances that were considered strategic and of prime importance for national sovereignty. These substances are mainly hydrocarbons, salt, potash and metals. To the contrary, quarries are mainly used to extract building material (limestone, chalk, slate, gypsum). The legal difference between mines and quarries (Art 100-1 Mining Code) depends upon the extracted substance: mines operate where the products listed in Article L. 111-1 of the Mining Code minerals are extracted: coal, oil and gas, precious metals, such as gold and silver, base metals, such as copper, lead, iron or zinc, and strategic metals, such as tungsten or indium. The extraction method (open pit or underground) is not relevant to the classification. Quarry products are those not listed in Article L. 111-1 of the Mining Code, mainly building materials (limestone, chalk, slate, sand and alluvial gravel, ornamental stones) and industrial minerals. Only bauxite and phosphates are considered industrial minerals under the French Mining Code. No industrial mineral can benefit from Mining Law exemptions unless a specific legal decision is made by the highest court (*Conseil d’Etat*) to re-attach it to the Mining law. So far, few deposits have been granted this status. Talc, kaolin, quartz, andalousite, diatomite, calcium carbonate, silica, clays, etc. are all under quarry regulation.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in France are presented.

Table 1: France, Annual mineral production per main commodity (Mt)

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	111	114	120	115	UEPG 2020
Crushed Rock	182	184	186	184	UEPG 2020
Industrial Minerals					
Bentonite	0,036	0,043	0,024	0,034	BGS, WMD
Chalk	2,626	2,622	3,028	2,759	Eurostat, USGS (2021)
Diatomite	0,090	0,090	0,090	0,090	BGS, WMD
Feldspar	0,550	0,550	0,550	0,550	BGS, WMD
Gypsum (incl. anhydrite)	2,027	4,183	3,014	3,075	Eurostat, USGS (2021), WMD
Kaoline	0,275	0,264	0,279	0,273	BGS, WMD
Limestone, agricultural and industrial	9,224	6,964	10,526	8,905	USGS (2021)
Mica	0,021	0,020	0,019	0,020	USGS (2021)
Rock Salt	0,500	0,500	0,500	0,500	Braun (2019)
Talc, steatite & pyrophillite	0,450	0,450	0,470	0,457	WMD
Dimension - Ornamental Stones					
Dimension stone (Mt)	1,451	2,224	2,799	2,158	Eurostat Prodcom
Energy Minerals					
Oil	6,571	6,770	5,974	6,438	ND
Gas (Mm3)	28	28	28	28	ND
Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays); (Mt)	0,476	0,400	0,567	0,481	Eurostat Prodcom

Table 2: France, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Other year	Reference
Aggregates	2723	2684	2822	N.D*	UEPG 2020
Industrial Minerals					
Bentonite	5	N.D	N.D	N.D	
Chalk	12	N.D	16	N.D	BRGM (2015, 2020c)
Diatomite	4	N.D	4	2 (2020)	BRGM (2015, 2020a)
Feldspar	11	N.D	N.D	N.D	BRGM (2015)
Gypsum (incl. anhydrite)	19	N.D	N.D	N.D	BRGM (2015)
Kaoline	9	N.D	11	N.D	BRGM (2015, 2020b)
Limestone, agricultural and industrial	24	N.D	N.D	N.D	BRGM (2015)
Mica	2	N.D	N.D	N.D	BRGM (2015)
Rock Salt	1	1	1	N.D	No official reference
Talc, steatite & pyrophillite	1	N.D	N.D	1 (2020)	BRGM (2015, 2020d)
Dimension stone	N.D	N.D	N.D	721 (2015)	BRGM (2015b)
Clays	N.D	N.D	N.D	195 (2015)	BRGM (2015)

**ND - no data available or provided*

There are not data available/provided of extraction sites for the other commodities in France.

Extractive waste generation 2015-2017

Estimations for metallic and industrial minerals are presented in the following tables. Estimations are made according to methodology described in the report, §2.2 and Annex L.

Table 3: France, *Estimated extractive waste per metallic mine (t)*

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217	Rock[b](t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Gardanne plant	Al	-	350.000	-	0	927.500	0	927.500	577.500

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4: Estimation of total industrial minerals excavation and waste in France

France (Mt)	Production			Average production 2015-2017	Estimations		
	2015	2016	2017		Rock[c]	Tailings from beneficiation[d]	Total excavated material[e]
Bentonite	0,036	0,043	0,024	0,034	0,024	0,000	0,058
Diatomite	0,090	0,090	0,090	0,090	0,180	0,000	0,270
Feldspar	0,550	0,550	0,550	0,550	0,550	0,000	1,100
Gypsum[a]	2,027	4,183	3,014	3,075	2,152	0,000	5,227
Kaolin	0,275	0,264	0,279	0,273	1,909	1,091	3,273
Talc[b]	0,450	0,450	0,470	0,457	0,457	0,000	0,913

a incl. Anhydrite
b Talc, steatite & pyrophillite
c Rock = Average Stripping Ratio * Average Production
d Total Excavated Material = Rock + Average Production + Tailings
e Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Extractive waste in France is defined as in the EU Waste Directive.

Classification of Extractive Waste

The waste classification in France is based on:

- The Ordinance of 19/04/10 relating to the management of waste from the extractive industries (OJ No 180 of 6 August 2010),
- Article R. 541-8 of the Environment Code (European waste catalogue).
- Circular of August 22, 2011 relating to the definition of inert waste for the quarrying industry.

Classification of Chemical Reagents applied in extractive sector

No information on classification of chemical agents was provided.

Re-use and placing back of extractive waste material

No tailings of Gardane plant are used for filling excavation voids.

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

The competent authority in charge of issuing and updating EWM permits is the Ministry of Sustainable Development.

A list of permits is available online with information concerning the geographic location, the name of the organisation, the sector, substance mined and an outline of actions required by the permit: https://www.ecologie.gouv.fr/sites/default/files/2017%2003%2017%20Tableau_Mise_en_ligne%20Inventaire%20DDIE%20pour%20site%20internet.pdf

Financial guarantees

Decree No. 2010-1389 of November 12, 2010, relating to the obligation to provide financial guarantees before the opening of research or mining work. Article L. 162-2. The opening of exploration or mining work is subject to the constitution of financial guarantees for mines with waste management facilities when an operational failure, such as the collapse of a heap or breakage of a dike, could cause a major accident, based on a risk assessment taking into account factors such as current or future size, location and impact of the installation on the environment. The calculation of financial guarantees (Order of February 9, 2004), relating to the determination of the amount of financial guarantees for the rehabilitation of quarries provided for by the legislation on classified installations (NOR: DEVP0430043A) (OJ March 31, 2004) speaks of a reference amount, the revisions of which are carried out by a third-party organization approved under article 40 of the decree.

Emergency preparedness

Between 2014-2017 3 installations were classified at Class A, two were in closure. All of them are/were covered by emergency plans.

Number of EWMPs

In the period from 2014 to 2017 a total of 754 extractive waste management plans were received and validated.

Extractive waste facilities

Between 2014-2017 3 installations were classified at Cat. A, two were in closure. According to Amec, Foster, Wheeler study (2017) 31 non-Cat A facilities are registered.

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

For onshore minerals, the main responsible authority for issuing mining permits (ministerial authorisation) for non-energy minerals (metallic ores and industrial minerals, state-owned) is the Ministry of Economy, Industry and Digital [*Ministère de l'Economie, de l'Industrie et du Numérique*].
In the case of exploration, the responsible authority is the Ministry of Ecological Transition [*Ministère de Transition Écologique, https://www.ecologie.gouv.fr.*

Quarry materials or substances depend on the Ministry of Environment, Energy and Sea. The quarries authorisation are regulated by the Environmental Code (Classified installations or ICPE) , under a Prefectoral authorisation before starting field works, in accordance with the *Schéma Départemental des Carrières* (Quarry Departmental Scheme). For quarrying activities on the near Continental Platform, permits are provided by the Prefectoral Administration, under the Ministry of Environment, Energy and Sea authority.

For offshore minerals, the main authority issuing permits is the Marine Ministerial Committee (*Comité Ministériel de la Mer*) with the agreement from the Ministry of Environment, Energy and Sea. The Marine Ministerial Committee was created in 2002 and comprises the Ministry of Environment, Energy and Sea along with the Ministry of Economy, Industry and Digital, the Ministry of Finances, the Ministry of Foreign Affairs, and the Ministry of Overseas. The Committee is in charge of the marine resources extraction on the Continental Platform. For decision making, the Committee relies on the following institutional operators: French Research Institute for the Exploitation of the Sea (IFREMER), the National Centre for Scientific Research (CNRS), the French Geological Survey (BRGM) and the Institute of Research of the Development (IRD).

The mining laws defined by Decree n°2006-648 and Decree n°2006-649 constitute the mining laws applicable in France, although its overseas administrative departments, territories and collectivities are, in certain instances, governed by other specific legislative and regulatory provisions which may vary or supplement those of the Mining Code and the Decrees. The law applicable in the onshore jurisdiction is valid also on the French continental shelf.

Legislation governing mineral exploration and extraction

Under French Law, the exploitation of materials defined as ''eligible for concession'' is ruled by the regulations on mines, and the exploitation of materials defined as ''non-eligible for concession'' is ruled by the regulations on quarries. Exploration and extraction operations are governed mainly by two centralised items: the French Mining Code, which defines the mine nature and the exploitation conditions along with post-mine dispositions, and the French Environmental Code, which contains provisions related to nature conservation, water management, public participation etc. Quarries with extraction of materials intended to civil engineering and public construction works belong to the Classified Installations for the Environment Protection (ICPE[1]) section 2510.

Licensing procedures for exploration and extraction

In France, landowners have no right over the underground minerals or substances eligible for concession. Indeed, mines are subject to the ''concession'' rule. ''Concession'' refers to the contract, signed between the French State and a legal person or corporate body, authorising the extraction of the substance subject to the contract against a fee. The word ''concession'' is also used to define the area granted to this person or body to perform his or its activity. Therefore, the concession is the administrative entity of reference in Mining Law (Art L-132-1 to L 132 –7).

The mining extraction permit is granted through a national order from the Minister of Mines, after a public inquiry is carried out according to the conditions defined in the Chapter III of the Title II of the Book n°1 of the Environment Code, according to the opinion of the General Council of Mines.

The extractive mining activity is controlled by the Mining and Environment Codes. French mining law has a number of specificities. The State alone can confer upon the operator the right to exploit a mine,

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[1] In France, a "classified installation for environmental protection" (ICPE) is an installation operated or owned by any natural or legal person, public or private, that can present danger or nuisance for the convenience of residents, health, safety, public health, agriculture, protection of nature and environment, conservation of sites and monuments. ICPEs are ruled by "book 5" (Livre 5), Environmental Code.

under conditions that are fixed by law, with mining substances being considered as an element of national wealth. Although, it is a hybrid legislation, certain aspects of it are as much in the domain of public law as private law. Mining law concerns the substances of mines that belong to the nation, whilst so-called "quarries-extracted" substances (materials and granulates and certain minerals) belong to the owner of the land, according to the Art 552 of the Civil Code. The Mining Code defines mine materials whose public usefulness justifies the possibility of access to the land resource required for extraction. The notion of mine is based on the nature of the materials, whether extraction is open-cast or underground.

<u>Extraction permit for quarry</u>
"Quarried substances", governed by the Environment Code as Classified installations for Environment Protection (ICPE, ordonnance 2012-34 dated January 11, 2000) include aggregates such as limestone, igneous rock, and both sand and gravel. Rights to extract quarried minerals belong to the owner of the land.

The Prefect may grant or refuse the authorisation.

Large quarries activities are subject to an administrative authorisation (decision 2011-91 dated January 20, 2011) and listed in the Annex to the Environment Code (Art R. 551-9). The ICPE permit governs all emissions and connected activities carried out at the same site of an ICPE. There are around 500,000 ICPE in France according to the Ministry of Ecology, Sustainable Development and Energy (MEDDE, now Ministry of Ecological Transition).

The mineral extraction, use and reintroduction into waste stockpiles should ensure appropriate confinement, i.e. that is throughout the life-cycle, emissions to the environment, particularly the air and water, should be limited and controlled. Legislation has been enacted obliging Departments to produce plans for quarried minerals.

Article 1 specifies that the plan must include the following:

- Inventory of known resources,
- Analysis of the demand for minerals, Mining waste management in European Union Annex n°7 8/16,
- Impact of existing quarries on the environment;
- Evaluation of future local needs;
- Setting of objectives to ensure the wise use of resources and to minimise impacts on the environment;
- Examination of transport networks;
- Environmentally protected areas;
- Preferred after use for mineral extraction sites.

<u>The opening of mining works</u> subject to authorisation is currently conditional on the elaboration of an environmental impact study and a public enquiry provided for under the Environment Code. The grant of a Concession is also subject to a public enquiry, and, since 1st January 2013, a law amending the Environment Code and aiming at ensuring compliance with article 7 of the Environmental Charter subjects the grant of a PER to compliance with the provisions ensuring the participation of the public. There is an alignment of the conditions for the information and participation of the public prior to the possible grant of a mining title or an authorisation for mining works.

Administrative arrangements for waste management

Competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators is the Ministère du Developpement Durable (DGPR-BSSS, now Ministère de la Transition Écologique).

The same Ministère de la Transition Écologique is in charge of issuing and updating EWM permits, establishing and updating the financial guarantees, making inspection of the waste facilities, and establishing an inventory of closed and abandoned waste facilities.

Extractive waste management plans and environmental permits

A list of permits is available online with information concerning the geographic location, the name of the organisation, the sector, substance mined and an outline of actions required by the permit

https://www.ecologie.gouv.fr/sites/default/files/2017%2003%2017%20Tableau_Mise_en_ligne%20Inventaire%20DDIE%20pour%20site%20internet.pdf

Financial guarantee

No dedicated information was provided.

Closed and abandoned waste facilities

The website of the French Ministry of the Environment, Energy and Sea includes dedicated webpages on extractive waste, with links to legislation, guidance, the register of abandoned and closed sites, and a dedicated webpage on mining uranium.

Germany – Country Fact Sheet

Germany and its minerals industry

Background

Germany has a long mining tradition, which dates back to the early middle Ages. Germany´s NEEI sector consists mainly of the extraction of potash and rock salt and the large majority of industrial minerals, plus construction aggregates. Extraction mainly takes place in the federal states of Mecklenburg-Western Pomerania, Brandenburg, Saxony, Thuringia, Hesse, and Rhineland-Palatinate. Soils and Stones are produced in Saxony, Mecklenburg-Western Pomerania and Brandenburg, salts in Thuringia and Hesse. The Federal Mining Act ("Bundesberggesetz" – BBergG) distinguishes between the landowned ("Grundeigenen") and 'free for mining' ("Bergfreien") minerals, § 3 BBergG.

The Federal Ministry for Economic Affairs and Energy provides an annual statistic on the mining economy in Germany in which every mineral is listed.
In Germany different permits are issued by different administrative procedures. Generally, the legislative hierarchy determines which procedure is applicable; secondly it depends on lex specialis.

Mineral ownership

Land owned minerals include some industrial and construction minerals (basalt lava except the columns basalt; bauxite; bentonite and other clays containing a high proportion of montmorillonite clays; roofing slates; feldspar, kaolin, pegmatite sand; mica; diatomaceous earth; quartz and quartzite; soapstone, talc; etc.). The 'free for mining' minerals are not owned by the state or by any private person and can be explored and exploited by those who hold the permission according to the Federal Mining Act. They include metallic minerals and some industrial minerals such as actinium and the actinides, aluminium, antimony, arsenic, beryllium, lead, boron, caesium, chromium, iron, francium, gallium, germanium, gold, hafnium, indium, iridium, cadmium, cobalt, copper, lanthanum and the lanthanides, lithium, manganese, molybdenum, nickel, niobium, osmium, palladium, phosphorus, platinum, polonium, mercury, radium, rhenium, rhodium, rubidium, ruthenium, scandium, sulfur, selenium, silver, strontium, tantalum, tellurium, thallium, titanium, vanadium, bismuth, tungsten, yttrium, zinc, tin, graphite, potash and magnesia.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Germany are presented.

Table 1: Germany, Annual mineral production per main commodity (t or Mt)

Commodity	2015	2016	2017	Average	Reference
Metals					
Iron, used as aggregate (t)	467690	514004	447300	476331	BGS
Industrial Minerals					
Baryte (Mt)	0,045	0,049	0,034	0,043	BGR (2017, 2018), BGS, USGS (2021)
Bentonite (Mt)	0,393	0,393	0,416	0,401	BGR (2017, 2018), BGS, WMD
Chalk (Mt)	1,700	1,700	1,700	1,700	BGR (2017, 2018)
Diatomite (Mt)	0,053	0,055	0,057	0,055	BGR (2017, 2018), BGS
Feldspar (Mt)	0,253	0,285	0,277	0,272	BGR (2017, 2018), BGS

Fluorspar (Mt)	0,050	0,053	0,045	0,049	BGR (2017, 2018), BGS
Graphite (t)	398	502	422	441	BGR (2017, 2018), BGS
Gypsum (incl. anhydrite) (Mt)	4,200	3,970	4,450	4,207	BGR (2017, 2018), BGS
Kaolin (China Clay) (Mt)	3,734	4,740	5,168	4,547	WMD
Potash (Effective) (Mt)	36,777	31,551	35,973	34,767	BGR (2017, 2018)
Rock salt (Mt)	6,124	5,617	6,531	6,091	BGR (2017, 2018)
Quartz (Mt)	0,033	0,037	0,034	0,035	BGR (2017, 2018)
Aggregates					
crushed rock (Mt)	207	218	223	216	UEPG
sand & gravel (Mt)	231	247	256	245	UEPG
Dimension stone					
Dimension stone (t)	443574	429925	462646	445382	BGR (2016;2017)
Energy Minerals					
Coal (Mt)	6,223	3,849	3,669	4,580	BGR (2016, 2017), WMD
Lignite (Mt)	178,064	171,547	171,286	173,632	BGR (2016, 2017), BGS (2020), Euracoal, WMD
Clay (sum) (Mt)	19,258	20,201	19,313	19,591	BGR (2016;2017)

Table 2: Germany, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Reference
Metals				
Iron	ND*	ND	1	Euromines
Ind Minerals				
Baryte	1	1	1	BGR 2015, 2016, 2016
Bentonite	7	7	not reported	BGR 2015, 2016, 2016
Chalk	no data found / available / provided			
Diatomite	1	1	1	BGR 2015, 2016, 2016
Feldspar	3	4	4	BGR 2015, 2016, 2016
Fluorspar	2	2	2	BGR 2015, 2016, 2016
Graphite	1	1	1	BGR 2015, 2016, 2016
Gypsum (incl. anhydrite)	60	60	60	BGR 2015, 2016, 2016
Kaolin (China Clay)	no data found / available / provided			
Potash (Effective)	6	6	6	BGR 2015, 2016, 2016
Rock salt		7		BGR 2015, 2016, 2016
Quartz	3	3	3	BGR 2015, 2016, 2016
Aggregates	2771	2660	2733	UEPG
crushed rock	ND	ND	ND	
sand & gravel	ND	ND	ND	
Dimension stone				
Dimension stone	ND	ND	ND	
Energy Minerals				
Coal	ND	ND	ND	
Lignite	ND	ND	ND	
Clay (sum)	205	210	ND	BGR 2015, 2016, 2016

*ND No data available/provided

More information on individual production data of the principal mines and quarries in Germany is provided in Annexes C to I.

Extractive waste generation 2015-2017

Estimations of extractive waste generated from industrial mineral production are presented in Table 3. Estimations were made according to the methodology described in the report, §2.2.

Table 3: Estimation of total industrial minerals excavation and waste in Germany

Germany (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Baryte	0,045	0,049	0,034		0,047	0,009	0,098
Bentonite	0,393	0,393	0,416	0,401	0,280	0,000	0,681
Diatomite	0,053	0,055	0,057	0,055	0,110	0,000	0,165
Feldspar	0,253	0,285	0,277	0,272	0,272	0,000	0,543
Fluorspar	0,050	0,053	0,045	0,049	0,148	0,098	0,295
Graphite	0,0004	0,0005	0,0004	0,0004	0,0009	N/A	0,0013
Gypsum[a]	4,200	3,970	4,450	4,207	2,945	0,000	7,151
Kaolin	3,734	4,740	5,168	4,547	31,831	18,189	54,567
Potash	36,777	31,551	35,973	34,767	N/A	139,068	173,835
Salt	6,124	5,617	6,531	6,091	N/A	0,609	6,700

a incl. Anhydrite
b Rock = Average Stripping Ratio * Average Production
c Total Excavated Material = Rock + Average Production + Tailings
d Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Germany the definition of Extractive Waste results from § 2 No. 7 KrWG (mining exception clause) in conjunction with Section 22a (1) ABBergV.
A supplementary technical definition is provided by LAB from May 2014: "Criteria for the delimitation of mining waste (Section 22a (1) sentence 1 ABBergV, Section 2 (2) No. 7 KrWG)".

In Germany, ‘treatment’ of mineral resources is interpreted not to include the combustion of energy minerals to produce electricity/heat/energy. Essentially, the burning of coal and lignite, for example, does not fall under the scope of the Mining Law. Only a few smaller "mine power plants" (now called "industrial power plants") are operated under the BBergG.

Classification of Extractive Waste

Germany does not have a list of waste materials to be regarded as inert according to EWD criteria.

Extractive waste is classified according § 22a Paragraph 3 of ABBergV (including reference to the EU EWD). The classification is:

- Category A, dangerous
- not dangerous
- unpolluted soil, inert waste.

Classification of Chemical Reagents applied in extractive sector

Classification of chemical reagents in Germany goes according to REACH. Any restrictions to use of a specific chemical agent are as implemented through REACH and CLP.

When relevant for the operation, risks arising from the processing of minerals with chemical agents are evaluated in the EIA.

Re-use and placing back of extractive waste material

No information was available or was provided on reuse of extractive waste.

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

In Germany there is only an obligation to prepare and submit a management plan for extractive waste (cf. § 22 a ABBergV). There is no obligation for submitting a general waste management plan.

Between 2014-2017 there were 67 submitted and approved extractive waste management plans.

Financial guarantees

There is no national legislation on financial guarantees with reference to the Mine Waste Directive, Article 14, but § 56 Abs. 2 BBergG gives the possibility to demand financial guarantees.

Emergency preparedness

For Category A facilities external emergency plans would have to be established on the basis of the relevant Länder regulations by the civil protection authorities. According to § 22a paragraph 5 ABBergV, the entrepreneur provides the authority with the information required for external emergency planning.

A national implementation about emergency preparedness is the "enforcement notices to §22a ABBergV" from 12/11/2009 which states:
"6. Emergency planning, inspections Article 17 of Directive 2006/21 / EC stipulates that waste disposal facilities requiring approval are to be inspected by the competent authority before the deposit can be commenced and then at regular intervals. The operator must make all waste management records available for inspection . These obligations are basically covered by the BBergG due to the operational plan obligation and the mining supervision. The TAC is to develop guidelines on the details of the inspections to be carried out, which are not yet available.
However, since Directive 2006/21 / EC requires at least one inspection in the form of a drive-over before starting the disposal activity, the authorities should proceed accordingly. It is advisable if the authority draws up a traffic plan in writing, depending on the risk potential of the facility, and specifies traffic intervals taking into account the particularities of the individual case. "

The Civil protection Authorities of the Länder are in charge of establishing the external emergency plans for Category “A” installations.

Production/waste reporting

The chain of reporting to the administrative body in charge of coordinating the answers to the Commission’s questionnaire is from Länder mining authorities via the State Ministry of Economics to the Federal Ministry of Economics to the EU Commission. All steps of the reporting chain are compulsory. The required reporting frequency is according to Article 18 of Directive 2006/21/EC.

The waste data are generated by the mining authority through individual research. The production or waste data are reported according to the EU reporting form. The provided statistics sent to the European Commission on 1 February are final.

Extractive waste facilities

Category A and non-Category A facilities

Between 2014-2017 Germany had 229 extractive waste facilities. There were 2 operating Class A facilities. Table 4 provides an overview of the Extractive Waste Facilities in Germany.

Table 4: Germany, Overview EWF & Cat A Facilities from 2015 to 2017

EWF Germany	Number of EWF					Reference
	In Operation	In Operation with permit according requirements EWD	In Transition (closed before 2010 and falling under the scope of Article 24 (4))	Closure procedure is still ongoing (Article 12)	Closed or abandoned	
Cat A	0	2	0	3	0	BMWI
Non-Cat A of which inert waste	4	36	1	2	0	BMWI
Non-Cat A of which non-hazardous non-inert waste	1	36	7	88	49	BMWI
TOTAL	5	74	8	93	49	

In the 2017 EU study "Assessment of Member States' performance regarding the implementation of the Extractive Waste Directive; appraisal of implementation gaps and their root causes; identification of proposals to improve the implementation of the Directive" (Ref 38054 - Amec Foster Wheeler, 2017) a total of 5 Cat A Facilities were identified (of which 2 were closed). Therefore, probably the difference with the more recent list of BMWI is related to change in the operational phase.

Closed and abandoned extractive waste facilities

In the period 2014-2017 Germany reported 58 closures in process and 48 completed closures. The difference with numbers in Table 4 (93 closures in process) are probably related to more recent changes in the operational phase.

Every closed EWF has an appointed 'operator'. In Germany there are no cases where the competent authority is also the 'operator'.
In Germany it is required that 'operators' of closed EWFs hold a valid permit meeting all requirements of the EWD (final closure and operating plan according to BBergG).

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

The primary legal basis of mineral extraction activity is the Federal Mining Act ("Bundesberggesetz"-BbergG) No. 1310/1980, as amended by Law No. 2833/2006. However, there is no uniform body of law on mineral extraction in Germany, and Federal States have their own ordinances and regulations, i.e. 'old laws' (mining permits, concessions) prior to the enactment of the Federal Mining Law in 1980 can partly remain in effect according to §§ 149 et seq. BBergG. Other relevant federal laws include the Water Resources Act (WHG), Emission Control Act, Environmental Impact Assessment Act, Nature Conservation Act, among others. The German Federal system is characterized by the fact that the legislative competencies are held by the Federation (Bund) whereas the execution of the laws is regularly conducted by the Federal States (Länder) as their own affair (Article 83 of the Basic Law). Thus, the public authorities in charge of the execution of the Federal Mining Act are part of the administration structure of the Federal States. The regional authorities have comprehensive administrative instruments for efficient supervision, including the approval of mining decrees (§ 65 et seq. BBergG), the grant, refusal and withdrawal of mining rights and permits, the approval of operational plans as well as the power to give individual instructions for prevention of dangerous situations (§§ 71 et seq. BBergG) and the right to be informed by the mining companies (§70 BBerG).

With regard to exploration permits, the Federal Mining Act contains three different types of permits: whoever wants to explore for 'free for mining' minerals needs to obtain an authorization ('Erlaubnis'). An application in written form including the operation plans relating to the proposed technical execution of the measures and a time schedule must be submitted to the relevant mining authority of the federal state. The most substantial reason for rejection may be public interest. The concept of public interest allows the authority to restrict or to deny the approval for an operations plan for reasons of public interest outside of the mining act (e.g. in the interest of area and urban planning, conservation of nature and the countryside, or protection against air pollution and noise). Because the mining authorities are different facilities from the federal states, the approval procedure time varies.

With regard to exploitation permits, approval procedures fall under the Federal Law on Protection from Emissions ("Bundesimmissionsschutzgesetz"), the General Building Code ("Baugesetzbuch") / Federal Law on the Conservation of Nature ("Bundesnaturschutzgesetz") and the Federal Water Resources Management Act ("Wasserhaushaltsgesetz"). Under the Federal Mining Act, exploration, and extraction of 'free for mining 'minerals require a mining license, which represents merely a right granted by the State for the economic utilization of 'free for mining' minerals. To carry out mineral extraction operations it is furthermore necessary to obtain an approval of the operation plans from the competent relevant authority. The mine property ('Bergwerkseigentum') can only be granted to a holder of this approval. To obtain mining rights, the mining company must be granted the right to use the land for the purpose of exploration and extraction of the minerals.

Obtaining of relevant authorizations may be difficult due to the indispensable consideration of many laws. According to § 11 No. 10, § 12 I S.1 of the Federal Mining Act, a permit is to be refused if overriding public interests would disqualify the exploration or exploitation activity. Consideration should therefore be given to the matters of nature conservation, landscape protection, regional planning, traffic planning and water protection. These interests are concretized in legally regulated procedures. During the granting procedure, the authorities whose tasks are the exercise of public interests (§ 15 Federal Mining Act) must be involved.

Important court decisions provide information on the protection of third parties and expropriations of land in favour of mining projects. Among other things, they make clear that groundwater is a common property and therefore not subject to possession and other civil claims. A careful examination of possible grounds for refusal helps to achieve a successful approval procedure. Although no statistics on the actual number of permits requested (and approved or denied) are kept, the decision on the granting of the permit is a conditional decision, as in the case of all other mining authorizations. Thus, the authority is obliged to approve the authorizations if the above-mentioned grounds for refusal do not apply.

In Germany the mining permits granting procedure is highly decentralized. The main responsible authorities for issuing mining permits are the regional Mining Authorities. The national mining authority, the Federal Ministry of Economy and Energy, only has the function of coordinating and cooperating with the Regional Mining Authorities, which is done via the Mining States Commission.

Germany has an established 'one-stop-shop' system, with the mining authority as the main responsible for the whole permitting procedure and the single point of contact for the applicant.

An environmental law is relevant for the implementation and planning of mining projects. A "pure" Federal Environmental Act does not exist in Germany. Environmental law rather contains several individual acts. There are two different approaches pursued to integrate environmental protection into the legal system. Firstly, there is the so-called medial environment protection which shall protect certain environmental media, such as laws for the protection of soil and water. On the other hand, an integrated environmental protection is pursued. This means that the environmental compatibility of a method is examined within an authorization procedure, which itself has not necessarily an environmentally protective effect.

The Federal Mining Act states in § 142 BBergG that the state governments or the authorities which are selected by the state governments are responsible for the selection of the relevant authorities which shall deal with mining and mining permission. This means that in every federal state an individual mining authority exists. The Federal States execute Federal laws, i.e. laws from the federal legislature which apply to the entire country are applied by the individual states and therefore executed by the state's authorities. A specificity is that legal provisions of the federal states which provide permissibly more stringent requirements for a project than it is provide by the federal regulation. This may lead to different inspection results. This means that the protective measures which are originally based on federal law might be stricter in each federal state. In any case each Federal State certainly cannot reduce the protective measures from the Federal State. Apart from that, the federal mining law does not provide a certain administrative authority for mining in general.

In addition, the requirements of certain environmentally protective standards must be met. According to these standards, some tests merge to a single permission authorization procedure (concentration effect). Some of these tests must also be applied in parallel if several authorities are involved. It must be taken into account that a further application of some acts such as the Federal Act on the Conservation of Nature (BNatschG), the Federal Act on the Protection from Emissions (BImschG), the Federal Act of Water Resource Management (WHG), Federal Law on Waste Management, the Construction Planning Law (Building Code), might be necessary.
In Germany these process steps are also given through rules of the Federal Mining Act. They are divided into exploration, exploitation and completion.

Authorities governing mineral exploration and extraction

The German Federal system is characterised by the fact that the legislative competencies are held by the Federation (Bund) whereas the execution of the laws is regularly conducted by the Federal States (Länder) as their own affair (Article 83 of the Basic Law). Thus, the public authorities in charge of the execution of the Federal Mining Act are part of the administration structure of the Federal States. The main task of the mining authorities is the supervision of the provisions (regulations and orders) of the Federal Mining Act, inclusive of the approved operational plans. The authorities have comprehensive administrative instruments for an efficient supervision, including the approval of mining decrees (§ 65 et seq. BBergG), the grant, refusal and withdrawal of mining rights, the approval of operational plans as well as the power to give individual instructions for prevention of dangerous situations (§§ 71 et seq. BBergG) and the right to be informed by the mining companies (§70 BBerG).

Legislation for extractive waste management

For procedures according to the BBergG, generally, the lower mining authority shall be responsible. Legal issues related to nature conservation arising from the Federal Nature Conservation Act, are generally taken into account in the tests of the respective technical authority (e.g. the mining authorities or water authority). This principle is called “backpack-principle”. The Water Resource Act (WHG) states that the official responsibility shall be taken by the lower water authorities. The execution of the Federal Pollution Control Act, the Building Code and the Closed Substance Cycle and Waste Management Act is also regulated by the federal states.

Administrative arrangements for waste management

Mining authorities of the BundesLänder are in charge of:

- verifying and approving the extractive waste management plans proposed by the operators
- issuing and updating EWM permits
- establishing and updating the financial guarantee
- establishing an inventory of closed and abandoned waste facilities.

Inspection of the waste facilities happens according to the national implementation "enforcement notices to §22a ABBergV" that has started on 12/11/2009.

The Civil protection Authorities of the Länder are in charge of establishing the external emergency plans for Category “A” installations.

Greece – Country Fact Sheet

Greece and its minerals industry

Background

Greece is one of the major EU producers of perlite, bentonite, bauxite, magnesite, lignite and nickel.

Mineral ownership

The metallic minerals ownership belongs to the State. After obtaining the mining concession the owner of the mining rights should get the required permits and approvals which include approval of the EIA study and of the technical study (about one more year). Mining concessions are granted by YPEN (presidential decrees), are valid for 50 years and can be extended for two additional 25-year periods.

For industrial minerals and marbles, the landowner has the exclusive right (which of course can be conceded to a third party) to explore and extract them, under the presumptions and the limitations of the relevant legislation.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Greece are presented.

Table 1: Greece, Annual mineral production per main commodity (t, kg or m^3)

Production	2015	2016	2017	Average	Reference
Metals					
Nickel (t)	20800	21800	19100	20567	BGS
Bauxite (t)	1831000	1880000	1927000	1879333	BGS
Lead (t)	14500	14300	12600	13800	BGS
Zinc (t)	13174	18866	17300	16447	BGS
Gold (kg)	510	86	1324	640	BGS
Ind minerals					
Amphibolite (Mt)	0,019	0,036	0,038	0,031	Ypeka
Attapulgite (Mt)	0,108	0,045	0,054	0,069	BGS, USGS (2019a,b), Ypeka
Bentonite crude (Mt)	1,123	0,883	1,088	1,031	BGS, USGS (2019a,b), Ypeka
Gypsum (incl. anhydrite) (Mt)	0,649	0,778	0,547	0,658	BGS, USGS (2019a,b), WMD, Ypeka
Huntite (Mt)	0,016	0,023	0,014	0,017	Ypeka
Magnesite (Mt)	0,383	0,398	0,443	0,408	Ypeka, WMD
Olivine (Mt)	0,022	0,025	0,023	0,023	Ypeka
Perlite (Mt)	0,891	0,921	0,933	0,915	BGS, USGS (2019a,b), Ypeka
Pumice (Mt)	0,581	0,659	0,971	0,737	Ypeka
Quartz (Mt)	0,075	0,142	no data	-	Ypeka
Zeolite (t)	360	110	2454	975	Ypeka
Aggregates					
crushed rock (Mt)	20,50	42,10	42,50	35,03	UEPG
sand & gravel (Mt)	0,10	0,10	0,20	0,13	UEPG

Dimension/Ornamental stone					
Dimension stone (Marble, slate stone - 2,8 g/cm³) (t)	543250	510170	535700	529707	Ypeka
Energy minerals					
Lignite (Mt)	46,308	32,675	37,803	38,929	BGS (2020), Euracoal, WMD, Ypeka
Clay (cement products and ceramic bricks) (Mt)	1,501	1,604	2,077	1,727	Ypeka

Table 2: Greece, Total number of extraction sites per main commodity

Number of Extracion sites	2015	2016	2017	other year	Reference
Metals					
Nickel			11		Euromines
Bauxite			18		Euromines
Lead			3		Euromines
Zinc					Euromines
Gold	*byproduct*				Euromines
Ind minerals					
Amphibolite	no data found / available / provided		2		
Attapulgite	no data found / available / provided				
Bentonite crude	no data found / available / provided		10		
Gypsum (incl. anhydrite)	no data found / available / provided		6		
Huntite	no data found / available / provided			2 (2013)	Tzeferis P.G. (2015)
Magnesite	no data found / available / provided				
Olivine	no data found / available / provided		2		
Perlite	no data found / available / provided		7		
Pumice	no data found / available / provided		1		
Quartz	no data found / available / provided		4		
Zeolite	no data found / available / provided		1		
Aggregates	196	198	198		UEPG
crushed rock					
sand & gravel					
Dimension/Ornamental stone	ND	ND	ND		
Energy minerals	ND	ND	ND		
Clay	ND	ND	ND		

ND: no data available / provided

More information on individual production data of the principal mines and quarries in Greece is provided in Annexes C to I.

Extractive waste generation 2015-2017

In the next tables the total average annual generation of extractive waste estimation (according to thr methodology described in the report, §2.2 and Annex L) in Greece is presented for metallic mines and for industrial minerals.

Table 3: Greece, Estimated extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Mount Oiti region (1 site)	Al	U	0	-	0	0	0	0	0
Gkiona (13 sites)	Al	U	1.191.940	-	0	1.191.940	595.970	1.787.910	0
Mount Parnassos region	Al	I	636.400	-	0	636.400	318.200	954600	0
Olympias	Pb	U	12.938	As-Au	4.733	69.633	34.817	104.450	51.962
Greece Mavres – Petres (Stratoni)	Pb	U	13.090	Zn	29.110	173.596	86.798	260.394	131.396
Greece Evoia island (4 sites)	Ni	O	1.100.000	-	0	1.100.000	1.399.200	2.499.200	0
Agios Ioannis (4 sites)	Ni	O	89.115	-	0	104.277	15.162	119.439	15.162
Kastoria (3 sites)	Ni	O	430.000	-	0	430.000	5.618.000	6.048.000	0
Mytilineos S.A. (Aluminium of Greece)	Al	-	687.759	-	0	1.444.295	-	1.444.295	756.535

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4: Estimation of total industrial minerals excavation and waste in Greece

Greece (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[c]	Tailings from beneficiation[d]	Total excavated material[e]
Bentonite[a]	1,123	0,883	1,088		0,722	0,000	1,754
primary mineral	1,123	0,883					
final product	0,808	0,683					
Gypsum[b]	0,649	0,778	0,547	0,658	0,461	0,000	1,119
Magnesite	0,383	0,398	0,443	0,408	0,408	0,245	1,061
Perlite	0,891	0,921	0,933	0,915	0,458	0,137	1,510

a Bentonite crude
b incl. Anhydrite
c Rock = Average Stripping Ratio * Average Production
d Total Excavated Material = Rock + Average Production + Tailings
e Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Greek legislation extractive waste is defined according to Article 3 paragraph 2 of the Joint Ministerial Decision 39624/2209/E103/2009 - Measures and regulations for the management of waste from the extractive industry in accordance with Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC (Government Gazette 2076/B/2009): “waste which is generated by the prospecting, extraction and treatment of mineral resources and the working of quarries”

In Greece ‘treatment’ of mineral resources is not interpreted to include the combustion of energy minerals for the production of electricity/heat/energy.

Classification of Extractive Waste

Greece does not have a list of waste materials to be regarded as inert according to EWD criteria, or national threshold values for sites identified as not contaminated.
Extractive waste is classified within Greece according to decision 2009/337/EC and the List of Waste 955/2014/EU.

Classification of Chemical Reagents applied in extractive sector

No information was provided on classification in Greece of chemical agents used in extractive sector.

Re-use and placing back of extractive waste material

Information on reuse of extractive waste is provided in following table.

Table 5: Greece, Reuse of extractive waste for placing back into excavation voids (t)

Property Name	Primary Commodity	Mine Type	Average Ore production 2015-2017 (t)	Estimates[a]			Tailings Management[b]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Mount Oiti region (1 site)	Al	U	0	0	0	0	no tailings		
Gkiona (13 sites)	Al	U	1.191.940	595.970	1.787.910	0	no tailings		The extractive waste is inert material from the excavation process. There is no beneficiation process. Typically, the excavated material is returned back to the excavation voids, but if this is not technically feasible, some amount is deposited in the EWF Lakes Lyritses
Mount Parnassos region	Al	I	636.400	318.200	954.600	0	no tailings		The extractive waste is inert material from the excavation process. There is no beneficiation process. Typically, the excavated material is returned back to the excavation voids, but if this is not technically feasible, some amount is deposited in the EWF Rodia. For the year 2015-2017 all the excavated material was returned back to excavation voids and zero material was deposited in the EWF
Olympias	Pb	U	69.633	34.817	104.450	51.962	40.619		The company Hellas Gold S.A. is operating in two mines (Olympias and Stratoni-Mavres Petres). All the generated waste that does not fulfill the technical characteristics to be placed back in the excavation voids are deposited in the CAF Kokkinolakkas. There is one EWF for two mines.
Mavres – Petres (Stratoni)	Pb	U	173.596	86.798	260.394	131.396	66.220		
Greece Evoia island (4 sites)	Ni	O	1.100.000	1.399.200	2.499.200	0	no tailings		

a Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
b Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Property Name	Primary Commodity	Mine Type	Average Ore production 2015-2017 (t)	Estimates[a]			Tailings Management[b]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Agios Ioannis (4 sites)	Ni	O	104.277	15.162	119.439	15.162	no tailings		The management of extractive waste is according to the waste hierarchy. Some amounts of the waste stream 01 01 01 will be used as a material for construction. Also, some amounts will be used as a filling of excavation voids and then the operator should cover the sterile material with soil (for rehabilitation purposes). The amounts of waste that cannot be used will be deposited into the EWFs. According to the AETC the company has licensed two EWFs, but in some time these facilities will be connected and then it will be one large EWF.
Kastoria (3 sites)	Ni	O	430.000	5.618.000	6.048.000	0	no tailings		The management of extractive waste is according to the waste hierarchy. Some amounts of the waste stream 01 01 01 will be used as a material for construction. Also, some amounts will be used as a filling of excavation voids and then the operator should cover the sterile material with soil (for rehabilitation purposes). The amounts of waste that cannot be used will be deposited into the EWFs. According to the AETC the company has licensed two EWFs.
Mytilineos S.A. (Aluminium of Greece)	Al	-	1.395.312	-	1.395.312	756.535	0		This operation is a plant for producing alumina from bauxite. There is not a mine inside the operation. All the generated amounts of tailings are deposited into a non-CAF facility.The deposition of bauxite residue are under BREF for non ferrous metals

a Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
b Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

EWMP submission takes place at two units:

1. The Directorate of Environmental Licensing receives the following EWMPs as part of the Environmental Impact Assessment for all Metallic Minerals Mines and for industrial mineral mines, contraction minerals and aggregates of which the mine area is bigger than 25 hectares or bigger than 15 hectares inside a protected area (NATURA). The EWMPs that are submitted to the Directorate of Environmental Licensing is approved and reviewed every five years.
2. The Decentralized Administration receives the EWMP from all the other cases. The procedure that is followed by the Decentralized Administration is unknown.

Every ten years the Greek Environmental Ministry requests a revision of the EIA (and EWMP).

Financial guarantees

Financial guarantees are calculated during the procedure of licensing for the whole installation. In Greece Extractive Waste Facilities are part of the installation and are not licensed separately.

Emergency preparedness

In Greece, only one emergency plan is submitted. This emergency plan corresponds to the Category A EWF Kokkinolakkas (Hellas Gold S.A.). This emergency plan has been submitted to the Mineral Raw Materials Policy Directorate. There is not technical approval of the Emergency Plan. The Directorate of Mineral raw materials policy in cooperation with the Inspectors-Controllers Body evaluate the plan.

Production/waste reporting

The Directorate of Environmental Licensing is in charge of answering the Commission's questionnaire according to Decision 2009/358/EC. Those steps that are compulsory in the Decision 2009/358/EC are reported. The required reporting frequency is every 3 years.

Greece does not specifically report waste. According to Directive 2006/21/EC and the Decision 2009/358/EC on the harmonisation, the regular transmission of the information and the questionnaire referred to in Articles 22(1)(a) and 18 of Directive 2006/21/EC the MSs are not obliged to collect data for waste generation.

Equally the Greek extractive industries are not obliged to send yearly waste production data to the Directorate of Environmental Licensing.
The Greek Industries (including the extractive industries) are obliged to submit on the Electronic Waste Register yearly the amounts of waste that they produce (included the extractive waste), however, solely the waste production is not available to the corresponded Directorate of the ministry. According to the representatives of the Ministry, the Ministry does not have the resources to review and check all the EWMPs to export this type of data (estimated yearly waste production).
The waste codes that are used in Greece are strictly in accordance with 955/2014/EU (List of Waste – LoW) and they are belonging in the following sub-groups:

- 01 01 wastes from mineral excavation
- 01 03 wastes from physical and chemical processing of metalliferous minerals
- 01 04 wastes from physical and chemical processing of non-metalliferous minerals

The extractive waste is classified during the procedure of licensed of Environmental Impact Assessment under specific waste codes from the above-mentioned sub-groups. However, the ministry does not keep a catalogue of the waste codes that are used by the extractive industries.
The aggregate section does not produce extractive waste. Even if the quarry does not produce extractive waste and the licensing procedure is to be evaluated by the Directorate of Environmental Licensing (>25ha or in NATURA area) the Directorate asks for the EWMP submission.
The marble quarries produce inert extractive waste, that are declared in an Electronic Waste Register.

Extractive waste facilities

Category A and non-Category A facilities

The applied condition of an EWF 'in operation' is in Greece any EWF that has an approved EWMP and where at the same time the procedure of closing the EWF has not yet started.

The EWFs are licensed by the Directorate of Environmental Licensing according to the EIA, since the EWF are not licensed as different part of the whole installation (mines, enrichment plans etc.). Only the one Category A EWF (Kokkinolakkas of Hellas Gold S.A.) is to be licensed by the Mineral raw materials policy Directorate in order to operate.

Table 6 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Greece. The data have been taken from the latest report for the implementation of Directive 2006/21/EC,
http://www.ypeka.gr/LinkClick.aspx?fileticket=ys1P3MCiGkQ%3d&tabid=824&language=el-GR

Table 6: Greece, Overview EWF & Cat A Facilities from 2015 to 2017

EWF Greece	Number of EWF	Reference
Non Cat A		
EWF in operation under EWD	241	Ypeka
EWF under Article 12 "Closure and after-closure procedures"	66	Ypeka
closed/abandoned EWF under Article 20	19	Ypeka
Installation with permit in conformity with the EWD.	241	Ypeka
Operating installations containing inert waste	217	Ypeka
Installations containing inert waste effectively closed by 31 December 2010	0	Ypeka
Operating installations containing inert waste with a permit satisfying EWD	234	Ypeka
Installations containing inert waste where closure is begun but not approved	0	Ypeka
Installations containing inert waste where closure has been approved	60	Ypeka
Operating installations containing non-inert and non–hazardous waste	7	Ypeka
Operating installations containing non-inert and non–hazardous waste with a permit satisfying EWD	7	Ypeka
Installations containing non-inert and non–hazardous waste where closure has been approved	6	Ypeka
EWF that are under Article 20 Inventory of closed waste facilities	19	Ypeka
Cat A		
Operating Category A installations	1	Ypeka

Closed and abandoned extractive waste facilities

As the EWF in Greece are not considered as solely installations, but part of the whole extractive activity, today in Greece there are not abandoned metal mines since the metal mining concessions are granted by YPEN (presidential decrees), are valid for 50 years and can be extended for two additional 25-year periods (over 100 year).

For the rest of cases the private body (the owner of the land) is the operator for every closed EWF. In Greece there are no cases where the competent authority is also the 'operator' of a closed EWF.

In 2012 The Greek Ministry of Environment and Energy in cooperation with the Ministry of Development and Investments conducted an inventory of closed waste facilities, including abandoned facilities. The inventory should be updated every three years and is published via webpage (in Greek): http://www.ypeka.gr/Default.aspx?tabid=824&language=el-GR

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

The basic mining legislation is the 'Mining Code' (Legislative Decree, L.210/1973) amended by L.274/1976). Additional important legislation includes L.669/1977 on the exploitation of ornamental rocks and industrial minerals, L.1428/84 as amended by L.2115/93 on the exploitation of aggregates, and Mining and Quarrying Activities' Regulation (KMLE) (Ministerial Decision 2223-FEK1227/14-6-2011). In Greece, the basic legislation for the environmental permitting of all types of projects and activities is Law 4014/2011.

This Law applies to the permitting of mining projects and activities in combination with Ministerial Decision 37674/2016 (on the classification of projects / activities into groups and categories, depending on the significance of their environmental impacts) and Joint Ministerial Decision 167563/2013, which specifies the procedures and criteria for this permitting, under the provisions of Law 4014/2011. Based on Joint Ministerial Decision 37674/2016, the majority of projects of Group 5 "Extractive Activities" belong in Sub-categories A1 and A2 and only some exploration activities in Category B.

Authorities governing mineral exploration and extraction

From the Greek Ministry of Environment and Energy the following directorates are in charge for the mineral exploration and extraction:

- Directorate of Environmental Licensing
- Mineral raw materials policy Directorate
- Directorate of Waste
- Inspectors-Controllers Body.

The De-centralized Administration grants consent for exploration activities for marbles and industrial minerals on public (state-owned lands), while the Administrative Region grants exploitation permits for aggregates on private areas. Concerning exploration for 'Metallic Minerals' or 'Ores', a Mineral Exploration Licence (MEL) is issued on a first-come first-served basis by the Deputy Head of the Administrative Region. The Licence has three years duration, is valid for a maximum area of 10,000 acres, and is equivalent to the title of ownership. The average length of time to get a Mineral Exploration Licence (MEL) for 'Ores' is between 2 and 3 months. The Environmental Terms Approval decision (AEPO) is a Ministerial Decision issued by YPEN, and constitutes a pre-requisite for the approval of exploration activities (from the date of application, it takes between 2 and 4 months until a decision is made).

Legislation for extractive waste management

The legislative framework concerning the management of extractive waste is based on the Joint Ministerial Decision 39624/2209/E103/2009 on measures, conditions, and limitations for the management of waste from extractive industries, in compliance with the provisions of the EWD.

The Mineral raw materials policy Directorate is in charge of

- issuing and updating EWM permits,
- managing the list of permits and in charge of establishing and updating the financial guarantees.
- establishing the external emergency plans for Category "A" installations.
- Managing the list of the external emergency plans.

The Special Secretariat for the Environment and Energy Inspectorate (SSEEI) is in charge of inspection of the waste facilities.

Directorate of Environmental Licensing (in collaboration with Mineral raw materials policy Directorate) is in charge of establishing an inventory of closed and abandoned waste facilities.

Administrative arrangements for waste management

The EWMPs from Metallic Minerals Mines are submitted to the Ministry of Environment and Energy Directorate of Environmental Licensing, as part of the Environmental Impact Assessment (EIA).

The EWMPs from industrial mineral mines, contraction minerals and aggregates are submitted, as part of the EIA:

- If the mine area is over 25 hectares the EWMP is submitted to the Ministry of Environment and Energy Directorate of Environmental Licensing
- Unless, if the mine area is over 15 hectares and the mine is set in protected area NATURA the EWMP is submitted to the Ministry of Environment and Energy Directorate of Environmental Licensing
- Otherwise, the EWMP is submitted to the Decentralized Administration of the region where the mine is located.

Hungary – Country Fact Sheet

Hungary and its minerals industry

Background

The National Registry on Mineral Raw Materials and Geothermal Resources consists of more than 4,000 registered mining areas.
Metallic ores are limited to manganese and bauxite. Main industrial minerals are bentonite and perlite. Principal energy minerals in Hungary are lignite, petroleum, and natural gas. Beside that extraction of several aggregates takes place.

Mineral ownership

According to the present Act, mineral raw materials of Hungary in their natural occurrence shall be state property. Such treasures form a part of natural resources and national assets of the country. The Hungarian Office for Mining and Geology keeps the records of mineral resources and reserves of Hungary.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Hungary are presented.

Table 1: Hungary, Annual mineral production per main commodity (Mt)

Commodity	2015	2016	2017	Other year (2018)	Average	Reference
Manganese	0,015	0,005	0		0,007	HGS (2019
Bauxite	0,008	0,017	0,001		0,009	HGS (2019
Bentonite	0,014	0,020	0,035		0,023	HGS (2019
Diatomit	0,001	0,001	0,001		0,001	BGS
Perlite	0,031	0,071	0,080		0,061	HGS (2019
Aggregates - Sand and gravel	40,0	30,0	ND	48,0	39,3	UEPG
Aggregates - Crushed rock	16,0	21,0	ND	21,0	19,3	UEPG
Dimension stones (t)	43689	130716	233250		135885	Eurostat Prodcom,HGS, USGS (2021)
Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays); (Mt)	0,048	0,052	0,050		0,050	Eurostat Prodcom

Table 2: Hungary, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Reference
Manganese	1	1	0	MBFSZ
Bauxite	1	1	1	MBFSZ
Bentonite	5	4	6	MBFSZ
Diatomit	1	1	1	MBFSZ
Perlite	2	2	2	MBFSZ
Aggregates	760	511	540 (2018)	UEPG
Dimension stones	20	20	21	HGS
Common clays	ND*	ND	ND	

**ND No data available or provided*

More information on individual production data of the principal mines and quarries in Hungary is provided in Annexes C to I.

Extractive waste generation 2015-2017

In the next table the total average annual generation of extractive waste in Hungary is presented. The data are provided by Mining and Geological Survey of Hungary (MBFSZ). The applied unit of provided data is m^3 (instead of tons). These provided data do not distinct between overburden, waste rock or tailings.

Table 3: Hungary, Overburden or Extractive waste per commodity (m^3)

Commodity	Overburden / extractive waste (heaps) (m3) Average from 2015 to 2017	Reference
Manganese ore	1638440	MBFSZ
Bauxite	2415301	MBFSZ
Basalt	41	MBFSZ
Andesite	0	MBFSZ
Bentonite	92768	MBFSZ
Dacite	0	MBFSZ
Diatomite	120	MBFSZ
Dolomite	574279	MBFSZ
Granite	228212	MBFSZ
Gravel	8785744	MBFSZ
Limestone	9181352	MBFSZ
Peat	17137	MBFSZ
Perlite	6135419	MBFSZ
Quartzite	51509	MBFSZ
Rhyolite	619536	MBFSZ
Sand	974723	MBFSZ
Sandstone	604205	MBFSZ
Schist	0	MBFSZ

The next table presents annual extractive waste in m^3.

Table 4: Hungary, Annual Extractive waste (heaps and tailings) generation (m^3)

Annual EW (m^3)	2015	2016	2017	Reference
Total Extractive Waste	10781	530394	706371	MBFSZ
Inert	10781	372511	701578	MBFSZ
Non-inert	0	157883	4793	MBFSZ
Hazardous	0	0	0	MBFSZ

The Hungarian Mining and Geology Office has a dedicated webpage on extractive waste within its website http://www.mbfh.hu.

Information on Extractive Waste from metallic and industrial minerals production (in tons) as estimated through the methodology described in §2.2 and Annex L is presented in Tables 5 and 6.

Table 5:Hungary, Estimated waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concent rate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Nyirád Mine	Al	O	0	-	0	0	0		
Fenyőfő I	Al	O	0	-	0	0	0		
Fenyõfõ II	Al	O	0	-	0	0	0		
Bokonyoszlop	Al	U	n.d.	n.d.	0	25.000	12.500	37.500	

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 6: Estimation of total industrial minerals excavation and waste in Hungary

Hungary (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Bentonite	0,014	0,020	0,035		0,016	0,000	0,039
Diatomite	0,001	0,001	0,001	0,001	0,002	0,000	0,003
Perlite	0,031	0,071	0,080	0,061	0,030	0,009	0,100

a Rock = Average Stripping Ratio * Average Production
b Total Excavated Material = Rock + Average Production + Tailings
c Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Hungary the waste legislation is based on EU legislation. The reuse of waste heaps is considered a mining activity which must be authorized by the competent authority. Furthermore, the Hungarian Office for Mining and Geology has commissioned the Hungarian Geological and Geophysical Institute to prepare an assessment to identify the quality, quantity, and the possible exploitation options of the secondary raw materials in the extractive waste facilities.

Classification of Extractive Waste

The extractive waste in Hungary is classified by EWC codes. A complementary legislation (apart from the EWD), by which the extractive waste is characterised is the GKM Ministerial Decree No. 14/2008

(IV. 3.) on mining waste management and Annex 2 of the mining waste characterization (VM Ministerial Decree No. 72/2013 (VIII. 27)).

There is no information yet on lithology for heaps and tailings in the inventory of operational mines. Only the type of raw material that is subject to mining is known at the moment. The mineral resource inventory is being modernized and will be including information from extractive mine heaps and tailings (updating lithology and position data. Extractive mine heaps from construction, industrial minerals and coal mineral mining are considered as inert wastes mainly. For energy resources, the exploitation drilling muds have specific EWC codes that can be used to identify inert or non-inert categories.

Classification of Chemical Reagents applied in extractive sector

In Hungary any risks arising from the processing of minerals with chemical agents are evaluated in the EIA (314/2005. (XII. 25.) of the environmental impact assessment and the unified environmental use permitting procedure). Annex 2 (a) refers to risks related to production of non-ferrous metals from ores, concentrates or secondary raw materials by metallurgical, chemical or electrolytic processes.
Annex 4 refers to possibilities of accidents and failures that may cause an impact on the environment, and the resulting factors.

According to The Mining Act (1993. XLVIII.) 2. § in Hungary the usage of any kind of technology which uses cyanide is forbidden.

Re-use and placing back of extractive waste material

Available information on reuse of extractive waste is provided in following table.

Table 7: Hungary, Reuse for placing back into excavation voids and land remediation with waste rock from metal and non-metallic sectors (103 m3)

Reuse of waste rock	2015	2016	2017	Reference
Used for placing back into excavation voids and land remediation	423	1019	ND	MBFSZ

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

According to the Mining Law (Act No. XLVIII of 1993 on mining) all mines and quarries that are in operation need to have management plans for mining wastes. The plans are categorized according to the different types of mineral resources.
The competent authorities in charge of verifying and approving the extractive waste management plans proposed by the operators are the Mining Departments of Regional Government Offices (Waste Management Technical Operation Plan). The same authorities are in charge of issuing and updating EWM permits. The lists of permits are available at the Regional Government Offices.

No information was provided by interviewed authorities on the number of EWMP that had been submitted, approved or rejected during 2015 to 2017.

Financial guarantees

According to the Act No. XLVIII of 1993 on mining for a concession contract, the Regional Government Offices will require the provision of financial guarantees. The financial guarantee is used to finance the mining activities and mine closures and landscaping, as well as possible mine damage (including environmental damage and rehabilitation work from waste treatment facilities).
The GKM Ministerial Decree No. 14/2008 (IV. 3.) on mining waste management contains rules on financial guarantees. The Mining Departments of Regional Government Offices are in charge of establishing and updating the financial guarantees.

Emergency preparedness

According to the Decree No. 14/2008 (IV. 3.) on Mining Waste Management (5. § (7)) in cooperation with the mayor of the local municipality, the regional body of the National Directorate General for Disaster Management, Ministry of the Interior (NDGDM, "OKF") prepares an external emergency plan within 6 months after the issuance of the operating permit for the mining waste management facility to the municipality endangered by a major accident. The operator shall provide the data and information necessary for the preparation of the external emergency plan to the regional body of the OKF.

By complying with EU obligations, Hungary implemented SEVESO III Directive. By coordinating the organization of the Deputy Director General of the National Directorate General for Disaster Management of the Ministry of National Defense, disaster management is prepared for the full implementation of related tasks. The operators of the concerned plants need to fulfill their obligations under the Directive and the relevant national regulations.

According to GKM Ministerial Decree No. 14/2008 (IV. 3.) on mining waste management 5. § (6), in the event of a major accident, the operator immediately provides the mining authority with all the information required to help minimize its consequences for human health and to assess and minimize the extent – actual or potential – of the environmental damage. In case of a major accident affecting an area beyond the waste facility site, the information provided by the operator should cover the following:
a) the circumstances of the major accident,
b) hazardous substances involved in major accident,
c) the information required for the assessment of the impacts on the population and the environment,
d) the information relating to the measures taken.

Concerning practical arrangements taken to ensure that information on safety measures and on action required is provided to the public, Hungary specifies that according to GKM Ministerial Decree No. 14/2008 (IV. 3.) on mining waste management, the mining authority shall ensure that the information on safety measures relating to possible major accidents, containing at least the elements listed in Section 2 of Annex 3, is provided, free of charge to the public concerned.

Information provided by the operator is forwarded by the mining authority to another Member State in case of an installation with a potential transboundary impact (according to 35. § (15) of the Governmental Decree No. 203/1998. (XII.19.) on implementation of the Mining Act).

The Mining Departments of Regional Government Offices are in charge of making inspection of the waste facilities. The number of EWF inspections and closing procedures undertaken were not provided during interviews (Table 8).

Table 8: Hungary, number of EWF inspections and closing procedures undertaken

	EU reporting period		
	2008-2011	**2012-2014**	**2015-2017**
N° inspections Inert extractive waste installations for each reporting period	Data not available or not provided		
N° inspections Non inert, non-hazardous installations for each reporting period	Data not available or not provided		
N° closure procedures undertaken and/or approved during each reporting period	Data not available or not provided		

Competent authority in charge of establishing the external emergency plans for Category "A" installations is the National Directorate General for Disaster Management, Ministry of the Interior (OKF regional bodies), in cooperation with the mayors. A list of the external emergency plans was not provided during interviews.

Extractive waste facilities

Category A and non-Category A facilities

Table 9 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Hungary.

Table 9: Hungary, Overview EWF & Cat A Facilities from 2015 to 2017

EWF information	2015 - 2017	Other year 2019	Reference
Nr. EWF metal extraction	28	ND	AFW Table (2017), MBFSZ (2019)
Nr. EWF non-metal extraction	2	ND	AFW Table (2017), MBFSZ (2019)
Nr. Cat A Facilities metal extraction	19	3	AFW Table (2017), MBFSZ (2019)
Nr. Cat A Facilities energy minerals	2	3	AFW Table (2017), MBFSZ (2019)
Nr. Cat A Facilities other non-metal extraction	0	ND	AFW Table (2017), MBFSZ (2019)

In the 2017 EU study "Assessment of Member States' performance regarding the implementation of the Extractive Waste Directive; appraisal of implementation gaps and their root causes; identification of proposals to improve the implementation of the Directive" (Ref 38054 - Amec Foster Wheeler, 2017) a total of 21 Cat A Facilities were identified. Probably the difference with more recent list of MBFSZ is related to the operational phase: fully closed facilities seem not to be included anymore in the reports from MBFSZ. According to MBFSZ (2019) the classification has not yet been fully finalized. As soon as new metallic minerals parameter data are available, other closed mine waste facilities will be further classified as "Category A" or "Not Category A".

Closed and abandoned extractive waste facilities

The actual closing procedure (termination of an extractive site) is for the competency of the Mining Departments in Government Offices.
In the Closed Mine Waste Facility Inventory (MWF) 1027 facilities are registered. In this MWF both abandoned and closed mines are registered. Competent authority(ies) in charge of establishing an inventory of closed and abandoned waste facilities is the Mining and Geological Survey of Hungary – subdepartment of Inventory for Closed Mining Waste Facilities (BHKL). Inventory of closed and abandoned waste facilities is located at http://elginfo.elgi.hu/mwf/mwf2012E.pdf

Recent inventory of mining areas (BATER) is available here: https://www.mbfsz.gov.hu/hatosagi-ugyek/nyilvantartasok/banyaszati-teruletek (in Hungarian). The categorization is available only for inert and non-inert sites.

Every closed EWF has an assigned operator. There are no cases in Hungary where the competent authority is the "operator". In case of lacking operators, a state owned company would undertake these task. According EWD the state of Hungary requires "operators" of closed EWFs to hold a valid license that meets all EWD requirements.

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

The primary legal basic of mineral extraction activity is the Mining Law No. XLVIII of 1993 as amended by Law No. CXXXIII of 2007. Mining permitting procedures are regulated by the Mining Law (Act No. XLVIII. 1993 on Mining) and its implementing legislation (Governmental Decree No. 203/1998. (XII.19.), (Minlex Hungary Country report, 2017).

Authorities governing mineral exploration and extraction

The main responsible authority for mining is the Ministry of National Development, and under its jurisdiction, the Hungarian Office for Geology and Mining (Magyar Bányászati és Földtani Hivatal – MBFH) and the Mining Departments of the County Government Offices. Whether an area is open (exploration is permitted through exploration permits granted by the regional authorities) or closed (exploration permit can be obtained through mineral concession, which is contracted centrally) is determined by the MBFH in decrees. The MBFH issues licenses for geological and mineral exploration, extraction, the utilization of waste rocks, explosion activities, and activities related to water source protection. Since April 2015 regional mining authorities and several other authorities have merged to form so called “governmental authorities”, and now the permitting procedure is considered a “one-stop-shop”. According to the Art 42 (4) ML: With the exception of the cases defined in legal rule, in the authority type matters falling under the competence of the mine supervision, the mine station competent in the region has to proceed at the first instance, and the MBFH has to proceed at the second instance. Other important authorities are represented by the environmental and nature conservation Inspectorate (with several regional and national directorates), the General Directorate of water management, the main service of the plant and soil protection (Minlex Hungary Country report, 2017).

Legislation for extractive waste management

The national legislation (GKM Ministerial Decree No. 14/2008 (IV. 3.) on mining waste management) uses the flowchart form the MWD. The following table contains the main laws that regulate the mineral extraction in Hungary.

The legislation given in Table 10 regulates the management of mining waste. Based on these, the authorities involved in the supervision, control, and licensing of both operating and closed / abandoned waste treatment facilities (ministry responsible for their management) are:

- Mining Supervision (Ministry for Innovation and Technology - ITM),
- National, regional and district environmental and nature protection authorities (Cabinet Office of the Prime Minister - ME),
- National Directorate General for Disaster Management (Ministry of the Interior - BM),
- Construction and Building Supervision Authority (Cabinet Office of the Prime Minister - ME).

Table 10: Hungary, legislation governing extractive waste management

Legal Act	Subject	Location / Reference
GKM Ministerial Decree	on mining waste management	No. 14/2008 (IV. 3.)
KvVM Ministerial Decree	on certain rules and conditions related to landfills	No. 14/2008 (IV. 5.)
Government Decree	on the designation of bodies responsible for administrative tasks in water management and water management and water protection	No. 223/2014 (IX. 4.)
Ministerial Act	on nuclear power	No. CXVI. of 1996

Administrative arrangements for waste management

Annual reporting of the volume of mine heaps and raw materials is compulsory according to the national Mining Law and its implementation Gov. Decree. Processing of reported datasets is continuous and data for mine heaps arrives with data for raw materials together from a specific active operational site but in the inventory these data are handled separately.

The companies report directly to the to the MBFSZ regarding the changes in volume and production of extractive mining waste. The total quantity of extractive waste is publicly available at web page https://mbfsz.gov.hu/en/inventory-mineral-resources. The waste management plan shall include in attachment the declaration of the operator that the major accident prevention plan, the safety system for its implementation, and the internal emergency plan are prepared, and that these documents are also attached.

The required national reporting frequency is annually (deadline 28 of February in each year) and is reported per mining site by using the Eurostat waste codes.
Recently there are no ore mines and quarries that would provide hazardous extractive mine waste that would require reporting of changes in quality especially regarding its high level of impurities. In case of notice and measurements of impurities companies must report the case to environmental inspectorates.

Ireland – Country Fact Sheet

Ireland and its minerals industry

Background

Ireland is a country on an island off the north-western fringe of Europe. Ireland's territory extends into the Atlantic Ocean with its marine territory almost ten times (Sea area: 880,000km^2) the size of its 70,273km^2 land area. Ireland is a modern knowledge-based economy focusing on services, the agricultural and food, and high-tech industries such as pharma-chem, medical devices and Information and Communications Technologies. The Irish economy is heavily dependent on exports from the food and high-tech sectors and foreign direct investment, especially for the latter. The construction sector in Ireland has been severely affected by the recession and the 2008-2013 Irish banking crisis. However, the sector returned to growth in 2014.

The Irish Government's mineral policy is:
"To support the development of Ireland's mineral resources in an environmentally and socially responsible way, recognising the economic contribution that mineral extraction can make, through the provision of well-paid secure jobs in rural areas that often have relatively limited employment opportunities."

Ireland ranks 11th in the world for zinc concentrate production, and is a significant producer of lead concentrate, silver and alumina. Ireland is a major exporter of zinc and lead concentrates to the EU. In addition, the country has significant deposits of gypsum, limestone, and smaller quantities of copper, silver, gold, barite, lithium and dolomite.

Mineral ownership

Minerals are either State owned or privately owned, but any mineral deposit may also have a combination of both ownerships. The proportion of private and State owned minerals is unknown. State owned minerals were mainly established through the Land Commission's processing of lands/minerals being transferred from landlords to the tenants. During this process, minerals were generally transferred to the State and the surface rights to the tenant. In addition some private minerals were acquired by the State. However, to ensure orderly development of minerals, the right to mine is vested in the Minister (currently the Minister for Communications, Climate Action and Environment) and this applies to both State and privately held minerals. All gold and silver are State owned.

The main Irish Mining Law, the Minerals Development Acts (1940-1999), identifies "scheduled minerals" as a group consisting mainly of metals and industrial minerals such as gold, silver, copper, lead, tin, sulphur, molybdenite, barytes, feldspar, gypsum, rock salt, etc. The right to mine "scheduled minerals" is vested in the Minister. Non-scheduled bulk minerals such as stone, clay, gravel and sand commonly belong to the landowner (are privately owned). These materials do not require a mining licence for extraction. However, working of these materials does require planning permission from the Planning Authorities and in some cases an IPC licence.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Ireland are presented.

Table 1: Ireland, Annual mineral production per main commodity (t, Mt or kg)

Production	2015	2016	2017	Average	Reference
Metals					
Lead (t metal content)	31300	19582	17083	22655	BGS
Zinc (t metal content)	236300	147797	130580	171559	BGS
Silver (kg metal content)	3770	1080	1340	2063	BGS
Ind minerals					
Gypsum (incl. anhydrite) (Mt)	0,250	0,250	0,200	0,233	BGS, WMD
Aggregates					
crushed rock (Mt)	22,00	26,00	27,80	25,27	UEPG
sand & gravel (Mt)	6,00	7,00	7,50	6,83	UEPG
Energy Minerals					
Peat (Fuel)	0,769	0,679	0,744	0,731	Energy by Fuel
Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays); (Mt)	ND*	0,089	ND		Eurostat Prodcom

*ND No data available or provided

Table 2: Ireland, Total number of extraction sites per main commodity

Number of extraction sites	2015	2016	2017	Reference
Metals				
Lead (t metal content)		*byproduct*		Euromines
Zinc (t)	1	1	1	Euromines
Silver (kg)		*byproduct*		Euromines
Gypsum (incl. anhydrite)	ND	ND	ND	
Aggregates	430	430	430	UEPG
crushed rock				
sand & gravel				
Energy Minerals	ND	ND	ND	
Clays	ND	ND	ND	

More information on individual production data of the principal mines and quarries in Ireland is provided in Annexes C to I.

Extractive waste generation 2015-2017

The next tables present estimations of extractive waste generated at metal mines and at total industrial minerals production in Ireland. Estimations were made according to methodology decribed in the report, §2.2 and Annex L.

Table 3: Ireland, Estimated extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Aughinish alumina refinery	Al	-	1.392.019	-	0	2.923.240	0	2.923.240	1.531.221
Navan Tara Mines	Zn	U	250.000	Pb	34000	2.370.333	1.185.167	3.555.500	2.086.333

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4: Estimation of total industrial minerals excavation and waste in Ireland

Ireland (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Gypsum[a]	0,250	0,250	0,200		0,163	0,000	0,397

a incl. Anhydrite
b Rock = Average Stripping Ratio * Average Production
c Total Excavated Material = Rock + Average Production + Tailings
d Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Ireland's national legislation 'extractive waste' is defined as in the EU Waste Directive.
In Ireland 'treatment' of mineral resources is not interpreted to include the combustion of energy minerals for the production of electricity/heat/energy.

Classification of Extractive Waste

No list of inert waste materials has been specified in Ireland.
'Inert waste' is defined in S.I. 566/2009 as: "waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater. The waste shall fulfil all of the criteria detailed in Commission Decision (EC) No. 2009/359/EC 7 or any amendment thereto.

Classification of Chemical Reagents applied in extractive sector

In Ireland chemical reagents for categories collectors, frothers, and depressants are used. Application and any restriction of those chemicals is taken into account in the permit.
Protocols for the use of the chemicals are available. Legislation for use of chemicals applies according Dir. COMAH (Control of Major Accident Hazards).

Re-use and placing back of extractive waste material

Available information on reuse of extractive waste is provided in Table 5.

Table 5: Ireland, Reuse of extractive waste for placing back into excavation voids (t)

Property Name	Primary Commodity	Mine Type[a]	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management[c]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source[c]
Aughinish alumina refinery	Al	-	2.923.240	0	2.923.240	1.531.221	the bauxite is imported/ not applicable	1.531.221	
Navan Tara Mines	Zn	U	2.370.333	1.185.167	3.555.500	2.086.333	1.043.167	1.043.167	The coarse fraction of the mill waste product is used for backfill while the remnant tailings are pumped 2km to a tailings management facility

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

A mine operator has requirements for the management of waste and to produce an extractive waste management plan under their integrated license authorized by the Environmental Protection Agency (Currently called Communications, Climate Action and Environment).

Financial guarantees

In the first instance the developer makes an estimate of the funds likely to be required to remediate the site including any mine waste facility whether upon cessation of the operation due to the exhaustion of the ore deposit or for any other reason before the exhaustion of the ore deposit. This estimate is verified by the Department of Communications, Energy and Natural Resources; the Environmental Protection Agency and the Local Authority in whose functional area the mine is located and their advisors. The parties agree to the type of instrument that will host the funds and the amount to be put into the dedicated financial instrument. This fund is reviewed periodically and amended if required.

Emergency preparedness

Emergency Plans are in place for the facilities of:

- Boliden Tara Mines Ltd
- Aughinish Alumina Ltd
- Galmoy Mines Ltd (now closed and in aftercare phase)
- Vedanta Lisheen Mining Ltd (now closed and in active closure phase)

A location of a list of the external emergency plans is not available. Number of inspections are presented in the next table.

Table 6: Ireland, number of EWF inspections

Inspections EWF	2008-2011	2012-2014	2015-2017
N° of inspections achieved in Inert waste installations for each reporting period	69	476	105
N° of inspections achieved in Non inert, non-hazardous installations for each reporting period	Not available	48	Not available

Production/waste reporting

The chain of reporting to the administrative body in charge of coordinating the answers to the Commission's questionnaire is the following: EC -> DCCAE (Department of Communications, Climate Action & Environment) -> EPA -> DCCAE -> EC.

All steps of the reporting chain are considered compulsory as exchange of information with EC is an obligation.

At national level all waste types are reported on a yearly basis to the EPA (i.e. including non extractive waste).

Extractive waste is excluded from Eurostat reporting. The statistics provided to the European Commission on 1 February are final. The local Irish (municipal) authorities maintain the reported information in their functional areas.

A list of Waste code annual tonnages are available on the EPA website for individual licensed companies, mainly for Aughinish Alumina Limited and Boliden Tara Mines. Only 2 EPA licensed sites generate significant amounts of extractive waste. Figures for these two companies are provided here:

- http://www.epa.ie/licences/lic_eDMS/090151b2806e306e.pdf for Boliden Tara Mines for their 2018 Annual Environmental Report.
- http://www.epa.ie/licences/lic_eDMS/090151b2806e3b33.pdf for Aughinish Alumina for their 2018 Annual Environmental Report.

Extractive waste facilities

Category A and non-Category A facilities

During the period 2014-2017 Ireland has reported 27 facilities under the supervision of the EPA. The EPA is the competent authority for all Category A facilities and extractive waste facilities associated with an EPA licensed activity. Local Authorities are the competent authority for everything else. According to EPA there is no inventory of all extractive waste facilities and in the period 2014-2017 there were a total of 2 operating metal mines classified as Cat A. Inventory of Extractive Industries for Ireland is available via http://www.epa.ie/ei/#/.

In the 2017 EU study "Assessment of Member States' performance regarding the implementation of the Extractive Waste Directive; appraisal of implementation gaps and their root causes; identification of proposals to improve the implementation of the Directive" (Ref 38054 - Amec Foster Wheeler, 2017) a total of 4 Cat A Facilities were identified. Probably the difference with more recent list of EPA is related to the operational phase: fully closed facilities seem not to be included anymore in the reports from EPA.

Table 7 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Ireland.

Table 7: Ireland, Overview EWF & Cat A Facilities from 2015 to 2017

Type of EWF	Number of EWF
Non-Cat A	25
Cat A	2

Closed and abandoned extractive waste facilities

All EPA authorised closed Extractive Waste facilities do have an ‘operator’. The State is never the operator.
‘Operators’ of closed EWFs need to hold a valid permit meeting all requirements of the EWD as the permit continues into closure and after closure and relevant conditions.
The reporting of the closed facilities is twice a year. It reports on concentrates. Galmoy mine stopped producing in 2012 and Lisheen mine stopped producing in 2015. Irish EPA is monitoring both sites.

A joint report with an inventory of closed and abandoned waste facilities was written by EPA Ireland, Exploration & Mining Division and Geological Survey of Ireland 2009, information available via http://watermaps.wfdireland.ie/ExtractiveFacilities/Default.aspx

Next table presents number of closures during reporting periods.

Table 8: EWF closures Ireland

Closures	2008-2011	2012-2014	2015-2017
N° of closure procedures undertaken and/or approved during each reporting period	2	3	2
N° of installations closed and regularly monitored	0	2	2

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

The primary legislation applying to mineral extraction are the Mineral Development Acts from 1940 to 1999 (The 2006 Act refers only to the remediation of old mine sites. The Acts relevant to exploration and development are 1940 to 1999). All mining of ‘scheduled minerals’ requires either a Lease under the Minerals Development Act 1940 for minerals in State ownership, or a License under the Minerals Development Act of 1979 for privately owned minerals. Both are issued by the Minister for Communications, Climate Action and Environment. Another important law for the permitting is the Planning and Development Act 2000 which regulates planning permissions from local authorities. The legislation applies to the exploration and/or development of minerals both onshore and offshore. Most exploration activities are exempt from planning unless a screening for AA or EIA indicates that they are likely to have a significant effect on the environment.

In summary, three main permits are required before a new mineral development can take place:
1. Planning Permission
2. An Integrated Pollution Control (IPC) Licence
3. A State Mining Lease or License (this is only issued once the other two permits have been granted)

Authorities governing mineral exploration and extraction

In Ireland a single licence is required for exploration and this is obtained from the Department of Communications, Climate Action and Environment. A mine requires three permits, these are issued by the EPA, the relevant Local Authority and the Department of Communications, Climate Action and Environment.

For exploration, the only authority is the Minister for Communications, Climate Action and Environment, which acts through the Exploration and Mining Division (EMD) of the Department of Communications, Climate Action and Environment. EMD is responsible for both onshore and offshore mineral exploration licences.

For the extraction phase there are three authorities involved, each granting a different permit (three permits are required for any mining project to develop):

- A mining licence or lease, granted by the Minister for Communications, Climate Action and Environment. The EMD is the body which carries out the regulatory functions of the Minister .To obtain a mining lease, the applicant must submit a detailed operations plan which has to address a range of issues (bankable Feasibility Study, method of working, transport, , closure plan, financial sureties.).
- Planning permission must be obtained from the relevant Local Authority or An Bord Pleanála. County Councils are responsible for any mineral development within their jurisdiction and have extensive powers to enforce the terms of planning permissions, and to take action against any unauthorised developments. Planning permission is required for any development. This is essentially the construction of buildings and structures and other planning issues such as transport matters. Individual Local Authorities are responsible in the first instance for planning applications. Appeals are handled only by An Bord Pleanála
- The 'environmental permission' is handled by the Irish Environmental Protection Agency (EPA) (both the initial application and any appeals). The EPA prepares and implements its own environmental monitoring programmes. It is important as it is responsible for awarding the Integrated Pollution Control (IPC) licence and also handles the industrial Emissions. .
- For the award of this triple-step mining permit, EMD and the EPA, both national agencies, make the process more centralised than decentralised, i.e. a pure centralization is not the case in Ireland.

For offshore potential extraction mining permits, the authority would be the EMD and the EPA, no local authority would be included in the process. For the post-closure phase, such operations are included in the applications to develop a mineral deposit. All three activities listed under mining also apply but at the actual initial applications. An investor will not be permitted to develop a mine without an approved mine closure plan (which includes aftercare and management of the site). The High Court is the only Court listed in the Legislation. As with any case brought to the High Court appeals can be taken to the Supreme Court and indeed to the European Courts but these are not covered in legislation related to mining, planning or the environment.
Offshore mineral exploration licences are issued by the Minister for Communications, Climate Action and Environment. Any mining/development project would currently require permits from both the

EPA and from the Minister for Communications, Climate Action and Environment. However, the permitting of marine projects is currently under review in Ireland.

Administrative arrangements for waste management

Irish EPA is the competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators, and issuing and updating EWM permits. The location of list of permits is at the offices of EPA.

The competent authorities in charge of establishing and updating the financial guarantee are EPA Ireland, Local Authority and DCCAE (Exploration & Mining Division - EMD).

The competent authority in charge of making inspection of the waste facilities is EPA.

The competent authorities in charge of establishing the external emergency plans for Category "A" installations are the Operators in conjunction with local authorities. A location of a list of the external emergency plans is not available.

Italy – Country Fact Sheet

Italy and its minerals industry

Background

Extraction of non-energy minerals in Italy is mostly focused on industrial and construction minerals such as bentonite, bleaching earth, limestone, marble, granite, clay, sand, travertine, ceramic minerals (feldspar, kaolin, refractory). Nowadays there are nearly 4900 active quarries, a quarter of which are concentrated in only two regions (Lombardy and Veneto), which together have on their territory more than 1000 authorized quarries. Italy was decentralized many years ago and all the competences related to onshore solid minerals are delegated to the Regions or the Provinces. Each of the Regions has different permitting procedures and has the authority to grant exploration and extraction permits within their jurisdictions.

Mineral ownership

First category minerals are state-owned and are those extracted in mines; they encompass energy minerals (except peat), metallic ores, non-metallic ores of significant industrial importance, such as salt and potash, barites and fluorspar, gemstones, garnet, corundum, leucite, fluorite, barium and strontium minerals, talc, asbestos, cement marl, lithographic stones. Rights to marine sand and gravel also belong to the national Italian State. 'Second category minerals' are extracted in quarries and include peat, materials for building, road and hydraulic constructions (except marl for cement), quartz and silica sand, sandstone, igneous rock, limestone, chalk and dolomite, sand and gravel, silica sand, common clay, and other industrial minerals not included in the 'first category minerals'. They are property of the landowner.

Production and Waste generation

Production data

In the next tables the annual production of the main commodities and number of extraction sites in Italy are presented.

Table 1: Italy, Annual mineral production per main commodity (in t or Mt)

Commodity	2015	2016	2017	Average	Reference
Ind minerals					
Bentonite (Mt)	0,013	0,046	0,086	0,048	BGS, WMD
Chalk (Mt)	no data	0,135	no data	-	Eurostat
Feldspar (Mt)	4,700	4,000	3,500	4,067	BGS, Eurostat
Gypsum (Mt)	3,306	2,233	2,085	2,541	iSTAT
Kaolin (China Clay) (Mt)	0,683	0,839	0,847	0,790	WMD
Lime (hydrated, hydraulic, and quicklime) (Mt)	3,500	3,500	3,600	3,533	USGS (2019a; 2021)
Salt (Mt)	2,081	2,085	2,147		iSTAT
Talc (Mt)	0,165	0,165	0,165	0,165	BGS, WMD
Aggregates					
crushed rock (Mt)	88,00	89,00	91,00	89,33	UEPG
sand & gravel (Mt)	63,00	64,00	65,00	64,00	UEPG
Dimension/Ornamental stones					
Dimension stone (Mt)	8,721	9,001	ND*		USGS (2021)
Energy minerals					
Coal (Mt)	0,073	0,059	0,047	0,060	WMD

Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays); (Mt)	2,925	3,684	4,569	3,726	Eurostat Prodcom

Table 1: Italy, Total number of extraction sites per main commodity

Number extraction sites	2015	2016	2017	Reference
Ind minerals				
Bentonite	ND	ND	12 (2018)	ISPRA
Chalk	ND	ND		
Feldspar	ND	ND	14 (2018)	ISPRA
Gypsum	ND	ND	ND	
Kaolin (China Clay)	ND	ND	ND	
Lime (hydrated, hydraulic, and quicklime)	ND	ND	ND	
Salt	ND	ND	8 (2018)	ISPRA
Talc	ND	ND	2 (2018)	ISPRA
Aggregates	2800	2800	2800	UEPG
Dimension/Ornamental stones	ND	ND	ND	
Clays	ND	ND	ND	

**ND No data provided or available*

Extractive waste generation 2015-2017

Estimation of extractive waste from industrial mineral production according to methodology in Annex G is presented in the next Table.

Table 3: Estimation of total minerals excavation and waste in Italy

Italy (Mt)	Production			Average production 2015-2017	Estimations		
	2015	2016	2017		Rock[c]	Tailings from beneficiation[d]	Total excavated material[e]
Bentonite	0,013	0,046	0,086	0,048	0,034	0,000	0,082
Diatomite							
Feldspar	4,700	4,000	3,500	4,067	4,067	0,000	8,133
Gypsum	3,306	2,233	2,085	2,541	1,779	0,000	4,320
Kaolin[a]	0,683	0,839	0,847	0,790	5,528	3,159	9,476
Lime[b]	3,500	3,500	3,600	3,533	1,767	0,000	5,300
Talc	0,165	0,165	0,165	0,165	0,165	0,000	0,330

a China Clay,
b Hydrated, hydraulic and quicklime
c Rock = Average Stripping Ratio * Average Production
d Total Excavated Material = Rock + Average Production + Tailings
e Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Classification of Extractive Waste

Italy does not have a list of waste materials to be regarded as inert according to EWD criteria.

Classification of Chemical Reagents applied in extractive sector

In Italy there is no classification of any chemical agents applied in the extractive sector.

Re-use and placing back of extractive waste material

No information is available or was provided on reuse of extractive waste.

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

Competent authority in charge of issuing and updating EWM permits is the Ministry for the Economic Development (primary minerals) and regions (secondary minerals). A location of a list of permits is not available/was not provided.

Financial guarantees

No information on financial guarantees was provided.

Emergency preparedness

All Category A installations are covered by an emergency plan.

Number of EWMP 2015-2017 (approved, rejected, new applications)

The number of waste management plans approved during the last reporting period was 323. None were rejected.

Extractive waste facilities

Table 4 provides an overview of the Extractive waste facilities in Italy.

Table 4: Italy, Overview EWF & Cat A Facilities from 2015 to 2017

EWF information	2015-2017				
	In Operation	In Operation with permit	In Transition	In Closure phase	Closed or abandoned
Nr. EWF	14	0	0	1	0
Inert waste					
Non hazardous					
Nr. Cat A Facilities	0	2	0	0	219*

*The 219 closed Cat A facilities most probably were erroneously registered as Cat A.

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

Ministry of Environment, land and sea protection, Italy.
Ministry for the Economic Development (first minerals) and regions (second minerals).

Legislation governing mineral exploration and extraction

The primary legal basic of mineral extraction activity in Italy is the Mining Law (Regio Decreto) No. 1443 of 1927, which divides minerals into two categories (Art 2): 'first' and 'second' category. 'First category minerals' are state-owned and are those extracted in mines. 'Second category minerals' are generally extracted in quarries and also include peat, and are property of the landowner.

Other important national laws in Italy are the Presidential Decree 128/59 (Standards of police of mining and quarrying), the Legislative Decree 152/06 (legislative framework applicable to all matters concerning environmental protection including EIA, SEA and IPPC), the Law of 23 December 2000 n. 388, Art. 114, which provides a special plan for remediation and environmental recovery, Legislative Decree no. 624/1996 (health and safety of workers) and the Legislative Decree no. 117/08 (transposing Directive 2006/21/EC and important for the management of extractive waste regulated). In Emilia Romagna, important regional laws (RL) are RL of 18 July 1991, n. 17: rules on mining activities, RL 3/99 delegating to the Province and Municipalities the authority for mines and quarries, RL 9/99 for EIA, and RL 20/2000 on Spatial Planning.

First category minerals are considered of national importance and their permitting procedures are governed by the Ministry for the Economic Development which issues permits for prospecting-exploration and extraction. This Ministry also issues the necessary mining permits for marine sand and gravel. For second category minerals, Italy has a decentralized regime and the permitting competences were transferred to the Regions and Provinces in the 1970s by the Presidential Decrees 2/72 and 616/77. All Regions have delegated the extraction plans to themselves and/or to the Province through the set-up of Regional (or Provincial) Mining plans. These plans contain provisions concerning the identification and demarcation of the areas, the needs, the methods of cultivation, the time of excavation and restoration plans for the quarry. Relevant co-authorities exist in the field of EIA approvals: if the exploration or extraction activity is offshore, the competence is of the Ministry of Environment, if on shore, both of the Ministry of Environment and regional EIA offices.

Administrative arrangements for waste management

Every 3 year a waste management report has been submitted by Italy's Ministry of Environment, land and sea protection to the Commission (2008-2011, 2012-2014, 2015-2017).

Extractive waste management plans and environmental permits

In Italy, the Ministry for the Economic Development (first minerals) and the regions (second minerals) are the competent authorities in charge of verifying and approving the extractive waste management plans proposed by the operators and in charge of issuing and updating EWM permits.

Inspection of waste facilities

The regional offices are the competent authorities in charge of making inspection of the waste facilities.

Closed and abandoned waste facilities

A complete inventory of abandoned and closed sites is available under http://www.isprambiente.gov.it/it/banche-dati/strutture-di-deposito-di-tipo-a and lists 650 sites.

During the last reporting period there was one closure ongoing. There are 5 closed Installations that are regularly monitored in Italy.

Latvia – Country Fact Sheet

Latvia and its minerals industry

Background

The country has a small mineral industry that produces primarily industrial minerals, including cement, clay, dolomite, gravel, gypsum, lime, limestone, pebbles, and sand, silica, and crushed stone.

Peatlands cover about 6,400 square kilometres, or about 10% of the territory of Latvia, and contain about 1.5 billion metric tons of peat. The major deposits are located in the eastern plains and near Riga. in Europe, peat is used for fuel (50%) and for agricultural purposes (47%). According to the Latvian World Energy Council Member Committee, the explored peat deposits were estimated to contain 473 million metric tons (Mt) of peat resources, of which 190 Mt was recoverable.

Mineral ownership

In Latvia mining and quarrying is regulated through Mining Law (“Law on the Subterranean Depths”) No. 13 of 1996 as amended by Law No. 321/322 of 2000. All mineral resources belong to the landowner (Article §3 ML) which might be the State, local authorities, private individuals or legal entities. The State has the right to limit the rights of legal and physical entities regarding the land and the subsoil belonging to them by imposing the limitations of the right to use the property.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Latvia are presented.

Table 1: Latvia, Annual mineral production per main commodity (Mt)

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	11,7	9,0	9,0	9,9	UEPG 2020
Crushed Rock	2,2	2,0	2,4	2,2	UEPG 2020
Industrial Minerals					
Gypsum, incl. anhydrite	0,225	0,224	0,225	0,225	BGS
Dimension stone (dolomite)	ND	615.761	ND		Eurostat Prodcom
Energy Minerals					
Peat (Fuel)	0,049	0,033	0,040	0,041	Krigere (2019)
Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	active excavation, no data* reported (cf. confidentiality)				Eurostat Prodcom

Table 2: Latvia, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Average	Reference
Aggregates	105	105	105	105	UEPG 2020
Energy Minerals					
Peat (Fuel)	ND	96	ND		Krigere (2017)
Dimension stones	ND	ND	ND		
Clays	ND	ND	ND		

Extractive waste generation 2015-2017

An estimation (according methodology in annex G) of extractive waste generated through production of Industrial mineral Gypsum is presented in the next table.

Table 3: Estimation of total minerals excavation and waste in Latvia

Latvia (Mt)	Production			Average production 2015-2017	Estimations		
	2015	2016	2017		Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Gypsum[a]	0,225	0,224	0,225	0,225	0,157	0,000	0,382

a incl. Anhydrite
b Rock = Average Stripping Ratio * Average Production
c Total Excavated Material = Rock + Average Production + Tailings
d Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Extractive waste can be waste resulting from the prospecting, extraction, treatment and storage of mineral resources.
'Treatment' in Latvia means the mechanical, physical, biological, thermal or chemical process or combination of processes carried out on mineral resources, including from the working of quarries, with a view to extracting the mineral, including size change, classification, separation and leaching, and the re-processing of previously discarded waste, but excluding smelting, thermal manufacturing processes (other than the burning of limestone) and metallurgical processes.

Classification of Extractive Waste

Waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health.
The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater, e.g. the content of heavy metals, sulphur etc.

There is not list of inert values, but there are criteria and threshold values.

Classification of Chemical Reagents applied in extractive sector

Risks arising from the processing of minerals with chemical agents are evaluated in the EIA.

The chemical legislation and use of specific chemical agents in Latvia are based on EU legislations (such as REACH).

Re-use and placing back of extractive waste material

No information on reuse of extractive waste was available or was provided.

Waste management and permitting

Approval procedure for Extractive Waste generation/storage

Approval and Review of Extractive Waste Management Plans

According to national legislation, approval and review of extractive waste management plans is carried out by State Environmental Service of the Republic of Latvia. Latvia does not have extractive waste facilities relevant under EWD at this moment. In the period 2014-2017 no plans were submitted or approved.

Permitting procedures EWMP

Financial guarantees

Latvia does not have extractive waste facilities relevant under EWD at this moment.

Emergency preparedness

Latvia does not have extractive waste facilities relevant under EWD at this moment. However, according to regulations on extractive waste management (Ministru kabineta 2011. gada 11. jūnija noteikumi Nr. 470 "Derīgo izrakteņu ieguves atkritumu apsaimniekošanas kārtība" https://likumi.lv/ta/id/232278-derigo-izraktenu-ieguves-atkritumu-apsaimniekosanas-kartiba) the competent authority in charge is The State Fire and Rescue Service of Latvia.

Number of EWMP 2015-2017 (approved, rejected, new applications)

In the last reporting period, no management plans were submitted or approved.

Extractive waste facilities

More information about inventory of all extractive waste facilities in Latvia on this webpage: http://www.vvd.gov.lv/izsniegtas-atlaujas-un-licences/atkritumu-apsaimniekosanas-atlaujas/izsniegtas-atkritumu-apsaimniekosanas-atlaujas/

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

Th Ministry of Environmental protection and Regional Development of the Republic of Latvia is in charge of exploration and extraction issues.

Legislation governing mineral exploration and extraction

Mining Law ("Law on the Subterranean Depths") No. 13 of 1996 as amended by Law No. 321/322 of 2000. All mineral resources belong to the landowner (Article §3 ML) which might be the State, local authorities, private individuals or legal entities. The State has the right to limit the rights of legal and physical entities regarding the land and the subsoil belonging to them by imposing the limitations of the right to use the property.

Administrative arrangements for waste management

No waste management reports has been submitted by Latvia's Ministry of Environment protection and Regional Development to the Commission (2008-2011, 2012-2014, 2015-2017).

Extractive waste management plans and environmental permits

In Latvia, the State Environmental Service of the Republic of Latvia is the competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators and in charge of issuing and updating EWM permits.

Financial guarantee

The competent authority in charge of establishing and updating the financial guarantee is the State Environmental Service of the Republic of Latvia.

Inspection of waste facilities

The competent authority in charge of making inspection of the waste facilities is the State Environmental Service of the Republic of Latvia.

Emergency plans

The competent authority in charge of establishing the external emergency plans for Category "A" installations are the State Fire and Rescue Service of Latvia and the State Environmental Service of the Republic of Latvia.

Closed and abandoned waste facilities

The competent authority in charge of establishing an inventory of closed and abandoned waste facilities is the State Environmental Service of the Republic of Latvia. As Latvia does and did not have extractive waste facilities relevant under EWD, no EWF inspections and closing procedures took place.

Lithuania – Country Fact Sheet

Lithuania and its minerals industry

Background

In Lithuania in 2016 there were 21 companies with rights to carry out non-metallic mineral resources and valuable minerals prospection and exploration. The country has no ore mining and metallurgical industries. The sector mostly dominates in aggregates and less in industrial minerals (dolomite, limestone) and peat extraction. The lack of demand of geological service (exploration) reflects the small number of new permits issuing for such activities.

Mineral ownership

According to the Constitution and the Underground Law all subsurface mineral resources (energy, metals, industrial and construction minerals) in Lithuania are exclusively state owned.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Lithuania are presented.

Table 1: Lithuania, Annual mineral production per main commodity

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	7,5	7,9	11,2	8,9	UEPG 2020
Crushed Rock	3,3	4,9	6,4	4,9	UEPG 2020
Dimension stone	2,647	2,857	1,265	2,256	Eurostat Prodcom
Energy Minerals					
Peat (Fuel)	0,074	0,017	0,024	0,038	USGS (2018)
Oil	0,074	0,063	0,056	0,064	
Common clays and shales for construction use (excluding bentonite, fireclay, expanded clays, kaolin and kaolinic clays);	0,326	0,324	0,340	0,330	Eurostat Prodcom

Table 2: Lithuania, Total number of extraction sites per main commodity

Commodity	Number of extraction sites				Reference
	2015	2016	2017	other	
Aggregates	205	205	210		UEPG
Energy					
Peat	ND	68	ND		Januska (2016)
Dimension stone	ND	ND	ND		
Clay, incl. bentonite	ND	ND	ND		

Extractive waste generation 2015-2017

No information on extractive waste generation was available or provided.

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

The definition of extractive waste in Latvia is based on the EU EWD.

Classification of Extractive Waste

Pursuant to the Order of the Minister of Environment of 16 November 2010 No. D1-922, prepared at the Lithuanian Geological Survey and by the Order No. of 28.01.2011 of the Director of the Service 1-32, a set of generalized values of physical-mechanical properties of Lithuanian soils covering open-cast minerals was approved. The data on the physical and mechanical properties of soils determined during the engineering and geological surveys of soils carried out throughout the territory of the Republic were used. A subsequent meeting stated that these soils did not qualify as mining waste.

Classification of Chemical Reagents applied in extractive sector

No chemical agents for extraction are applied in Lithuania.

Re-use and placing back of extractive waste material

No information on reuse of extractive waste was available or provided.

Waste management and permitting

Approval procedure for Extractive Waste generation/storage

As there were no mining waste facilities in the Lithuanian mining industry during the reporting period, which require a permit, the issues of control of the use of mining waste were not separated into a separate stage but were resolved through a comprehensive inspection of the companies' activities.

In the period from 31 December 2014 to 31 December 2017, 122 prepared projects for the use of solid mineral resources in Lithuania or their supplements were approved, which also include mining waste management plans. There were no unapproved resource use projects. None of the recovery projects examined and approved provided for the storage of extractive waste in extractive waste facilities which complied with the provisions of the Directive and the Commission decisions supplementing it.

Mining waste generated during the fractionation and washing of inert materials extracted in mining enterprises of the Republic of Lithuania is stored in exploited cavities or settling ponds, installed hypometrically below the natural ground surface.

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

Article 14 of the Directive 1 d. The implementation of the established procedure is provided for in the Procedure for Preparation, Coordination and Implementation of the Waste Management Termination Plan, approved by the Order of the Minister of Environment No. 469.
Regional Environmental Departments of the Ministry of Environment are in charge.

Financial guarantees

Article 14 of the Directive 1 d. The implementation of the established procedure is provided for in the Procedure for Preparation, Coordination and Implementation of the Waste Management Termination Plan, approved by the Order of the Minister of Environment No. 469.
No financial guarantees are applied as Lithuania does not have any Cat A Extractive Waste Facilities.

Emergency preparedness

Regional Environmental Departments of the Ministry of Environment are in charge.

Extractive waste facilities

Lithuania has not any extractive waste facilities.

Legislation for exploration, extraction and extractive waste management

The main law is the Underground Law No. I-1034/1995 and its implementing Government Resolutions (No. 1433/2001, No. 198/2002, No. 584/2002), which regulate the exploration and extraction permits. Other important laws regulating other necessary permits and licences for the authorisation of exploration and extraction activities include Environment protection Law I-2223/1992, Proposed economic activity environmental impact assessment Law No. I-1495/1996 (which regulates the EIA process), Environment minister order No. 166/1996 on exploited mining areas rehabilitation, Protected Areas Law No. I-301/1993, Water Law No. VIII-474/1997, Spatial Planning Law No. I-1120/1995 and Environment minister order No. D1-145/2014, both of which regulate spatial planning (and set provisions for the extraction and reclamation plan).

The competent authority granting exploration and extraction permits for the NEEI sector is the Lithuanian Geological Survey (under the sphere of the Ministry of Environment). Other relevant co-authorities include the Environmental Protection Agency in charge of approving EIA studies and issuing permits for surface water use, 60 municipalities, the National Land Service, the State Territorial Planning and Construction Inspectorate (only relevant for the extraction and post-extraction phases), the Directorate General of State Forests, the State Service for Protected Areas and the Cultural Heritage Department.

For exploration activities, an applicant (a qualified natural or legal person) must request a permit for investigating the subsurface, which is usually granted by the Lithuanian Geological Survey in 30 days, after which the applicant obtains the rights and may initiate prospection and exploration works. This may be delayed in the case of coordination problems with landowners and other users who, according to the Land Law No. I-446/1994, are required to allow the subsurface exploration works and must then agree with the developer on the duration, exploration area boundaries, work time and economic compensation. The developer must then prepare a report for resources approval, which is evaluated and approved by the Geological Survey; this often takes between 3 and 5 months.

For extraction activities, the first permit that a developer needs to obtain is the environmental permit granted subject to the approval of an EIA by the Environmental Protection Agency. An EIA (Law No. I-1495/1996) is only required for solid mineral extraction plots which are planned to be bigger than 25 ha. Public consultation is mandatory during the EIA process and the public entities which usually participate involve municipal authorities (municipality councils have a right to veto the EIA process), public health centres, cultural heritage departments, and the interested wider public (local communities). Such participation often causes a significant slowdown of the process, especially when judicial appeals are set against decisions by the competent authority. In Lithuania not only the applicant but also any interested (or concerned) third person or party can set an appeal against the decision of a competent authority of granting a permit. A decision on the EIA study (approval or rejection) takes between 8 and 24 months. A negative decision on the EIA process prevents the possibility to obtain an extraction permit. In addition, until the decision has been made, other applicants are not allowed to plan the same activities in the same area. If the EIA process is approved, the developer asks for a permit to use the subsurface mineral resources (extraction permit), which is usually granted between 1 to 3 months. Finally, in order to start the activity, the developer must prepare and get approval for a Subsurface Plan, which must be agreed upon with local municipalities and which contains a reclamation plan. This last phase lasts between 8 to 12 months. Overall, the time to obtain all approvals to start extracting is between 1 and 4 years; for valuable minerals, metal ores and mono-mineral quartz sand another additional year could be needed for additional procedures of tender.

Administrative arrangements for waste management

No waste management reports has been submitted by Lithuania's Ministry of Environment protection and Regional Development to the Commission (2008-2011, 2012-2014, 2015-2017).

Extractive waste management plans and environmental permits

In Lithuania, the extractive waste management plans and permits are coordinated by the Regional Environmental Protection Departments of the Ministry of Environment.

Financial guarantee

The competent authority in charge of establishing and updating the financial guarantee is the Regional Environmental Departments of the Ministry of Environment of Lithuania.

Inspection of waste facilities

The competent authority in charge of making inspection of the waste facilities is the Regional Environmental Departments of the Ministry of Environment of Lithuania.

Emergency plans

The competent authority in charge of establishing the external emergency plans for Category "A" installations are the State Fire and Rescue Service of Latvia and the Regional Environmental Departments of the Ministry of Environment of Lithuania.

Closed and abandoned waste facilities

The procedures are provided for in the Description of the Mining Waste Management Procedure approved by Order No. 16 of 16 November 2010 of the Minister of Environment. D1-922, Annex 3 "General requirements for the installation, operation, closure and after-care of mining waste facilities".

During the reporting period, there were no extractive waste facilities whose closure procedures would be subject to Article 12 of the Directive. provisions. In mining waste facilities, about which information was submitted to the Environment Directorate of the Commission of the European Communities by the Lithuanian Geological Survey by letter no. 1.7-2038, only uncontaminated pavement soil consisting of sand, sand, loam, etc. is stored. These facilities are formed during the mining process, their parameters are the place and method of pouring, the work safety requirements are detailed in the solutions of the resource use plans of the exploited reservoirs. In view of the above, the above-mentioned pavement landfills also do not qualify as extractive waste facilities meeting the criteria set out in the Annex to the Questionnaire and in the relevant articles of the Directive.

During the reporting period, there were no closed mining waste facilities that would be subject to post-closure supervision, monitoring and control procedures.

Luxembourg – Country Fact Sheet

Luxembourg and its minerals industry

Background

Luxembourg´s mining sector consists of small industrial mineral operations and building materials, mainly for domestic consumption. These minerals include dolomite, limestone, sand and gravel, and slate. Limestone is the main mineral commodity. Luxembourg´s mineral industry includes principally raw-materials processing and mineral trading, with the iron and steel sector being dominant, processing of building materials and manufacturing glass and porcelain, predominantly from imported raw materials. More recently, the Luxembourg Government announced a series of measures to position Luxembourg as a European hub in the exploration and use of space resources.

Mineral ownership

Mineral resources deeper than 6 m are owned by the State. The owner of the land owns mineral resources near the surface. The landowner owns industrial minerals and construction materials, and a potential operator has to reach an agreement with the landowner to extract minerals. The National Government, however, issues a permit for extraction.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Luxembourg are presented.

Table 1: Luxembourg, Annual mineral production per main commodity (10^6 t)

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	0,2	0,2	0,2	0,2	UEPG 2020
Crushed Rock	0,9	0,9	0,9	0,9	UEPG 2020
Dimension Stones (t)	no data reported				USGS

Table 2: Luxembourg, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Average	Reference
Aggregates	13	13	13	13	UEPG 2020

Extractive waste generation 2015-2017

No information on extractive waste in Luxembourg was available or provided.

Waste designation and classification

Luxembourg has currently no waste management facilities subject to the provisions of Directive 2006/21/ EC. In Luxembourg mine waste is almost entirely mixed with ordinary waste and to be sent to a non-mining waste facility (outside the country borders).

Definition of Extractive Waste (and/or Treatment)

The definition of extractive waste in Luxembourg is according the definition of EU Directive 2006/21/EC.

Classification of Chemical Reagents applied in extractive sector

No chemical agents are applied in the extractive sector in Luxembourg.

Re-use and placing back of extractive waste material

No information on reuse of extractive waste was available or was provided.

Waste management and permitting

Extractive waste facilities

Luxembourg has no extractive waste facilities.

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

Authorities that are in charge of mineral exploration and extraction are:
Ministry of Environment, Climate and Sustainable Development, Environmental administration, Labour and Mines Inspectorate, and the Water Management Administration

Legislation governing mineral exploration and extraction

The basics of the legislation related to mineral extraction go back to Mining Laws from the 19th century (e.g. Law of 21 April 1810, of 14 October of 1842 and of 30 April 1890), from the time when low grade iron deposits were discovered, and industrial development was facilitated. Currently, new projects and quarry activities are covered by the Law of May 1990 related to the control of dangerous, dirty, and noxious substances. The Law of 1982 covers the protection of nature and of natural resources. By referring to the Law of 1974, "Green zones" are being defined. In such zones, the permit of the Minister responsible for Water and Forest (Chap. 2, Art. 4) is required to start mining or quarrying operations. The Minister can order an impact study prior to the decision. For the use of explosives, the Inspectorate of Works and Mining (ITM, 'Inspection du Travail et des Mines') published safety regulations on 20 August 2001. These regulations refer to the Law of 17 June 1994 and of 4 November 1994 on the safety and health of workers.

Authorisation for mineral extraction is granted by the National Government. The permit is issued by Inspectorate of Works and Mining (ITM), following consultation with the Ministry of Environment. An important part of the permitting is cooperation with the public. There must be a notice that an application for exploitation has been submitted, e.g. a notice must be simultaneously posted at the town hall and in a very visible location near the proposed site. In areas with more than 5,000 inhabitants, the notice must also be published in four daily newspapers.

Administrative arrangements for waste management

Every 3 year a waste management report has been submitted by Luxembourg's Ministry of Environment, Climate and Sustainable Development to the Commission (2008-2011, 2012-2014, 2015-2017).

Extractive waste management plans and environmental permits

In Latvia, the Ministry of Environment, Climate and Sustainable Development is the competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators and in charge of issuing and updating EWM permits.

Financial guarantee

In theory the financial guarantee has to be sent to the Ministry of Environment, Climate and Sustainable Development (establishing an updating it is done by the operator). However, Luxembourg has no EWFs.

Inspection of waste facilities

In theory the competent authorities in charge of making inspection of the waste facilities are the Environmental administration, Labour and Mines Inspectorate and Water Management Administration. However, Luxembourg has no EWFs.

Emergency plans

In theory, the competent authority in charge of establishing the external emergency plans for Category “A” installations is the Labour and Mining Inspectorate of Luxembourg. However, Luxembourg has no EWFs.

Closed and abandoned waste facilities

The competent authority in charge of establishing an inventory of closed and abandoned waste facilities is the Environmental Administration. As Luxembourg has no EWF, no inspections have been made.

Malta – Country Fact Sheet

Malta and its minerals industry

Background

Malta´s minerals industry is dominated by the extraction of limestone for use in construction. Other minerals, such as phosphate and salt, are not considered economically viable or feasible for environmentally friendly extraction. The industry is characterised by a relatively large number of private operators that earlier underwent a low level of comprehensive controls. Following the establishment of the Malta Environment and Planning Authority in 1992, this has been addressed.

In Malta, the Non-Energy Extractive Industry (NEEI) sector focuses on the quarrying of Lower Globigerina Limestone (commonly referred to as soft stone) and Coralline Limestone (or hard stone). The authorities do not provide a license for exploration but only for exploitation. Malta has a centralised permitting regime and licensing is handled exclusively at the national level. Companies need to express their interest by applying for a permit to the Environment and Resources Authority (ERA), which grants the environmental and planning permit and, subsequently, to the Malta Resources Authority (MRA) which issues the quarry licence.

Mineral ownership

Article §2 Land Acquisition Ordinance (LO) is dealing with "subsoil rights" (i.e. licenses). Subsoil rights means subjection of any land to the restrictive conditions regarding underground works and excavations (i.e. exploration, extraction of minerals).

Production and Waste generation

Production data

In the next tables the annual production and number of extraction sites in Malta are presented.

Table 1: Malta, Annual mineral production (10^6 t)

Commodity	2015	2016	2017	Average	Reference
Crushed rock	1,00	1,00	1,00	1,00	UEPG
Sand & Gravel	0,40	0,40	0,40	0,40	UEPG
Dimension stone	0,18	0,17	0,16	0,17	USGS (2020)

Table 2: Malta, Total number of extraction sites

<table>
<tr><th>Commodity</th><th>2015</th><th>2016</th><th>2017</th><th>Reference</th></tr>
<tr><td>Crushed rock</td><td rowspan="2">10</td><td rowspan="2">10</td><td rowspan="2">10</td><td rowspan="2">UEPG</td></tr>
<tr><td>Sand & Gravel</td></tr>
<tr><td>Dimension stone</td><td>ND</td><td>ND</td><td>ND</td><td></td></tr>
</table>

ND: no data available / provided

Extractive waste generation data metal and non-metal sector 2015-2017

At the aggregates sites excavated extractive waste material (inert) is reused on site (annual reports EUPG), which is presented in Table 3.

Table 3: Malta, On site re-used aggregates (10^6 t)

Commodity	2015	2016	2017	Reference
Crushed rock Sand & Gravel	0,2	0,2	0,2	UEPG

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

As laid down in regulation 3 of S.L. 549.50, the Waste Management Regulations, "extractive waste" is defined as waste resulting from the prospecting, extraction, treatment and storage of mineral resources and the working of quarries, such as tailings (i.e. the waste solids or slurries that remain after the treatment of minerals by a number of techniques), waste rock and overburden (i.e. the material that extractive operations move during the process of accessing an ore or mineral body, including during the pre-production development stage), and topsoil (i.e. the upper layer of the ground). In this context it is to be noted that treatment on mineral resources is not carried out in Malta.

Malta's Environment & Resources Authority (ERA) is not aware of any legacy sites from former mining activities.

Classification of Extractive Waste

Reference is made to the strategy document "Waste management plan for the Maltese Island-2014 - 2020. A Resource Management Approach" (https://msdec.gov.mt/en/document%20repository/waste%20management%20plan%202014%20-%202020%20-%20final%20document.pdf), published in January 2014 by the Ministry for Sustainable Development, the Environment and Climate Change. In Malta this Directive was transposed by The Waste Management (Management of Waste from Extractive Industries and Backfilling) Regulations, 2009 (L.N. 22 of 2009). These Regulations address waste generated from the extraction of limestone from quarries for the construction industry and the placing back of the waste into spent quarries for rehabilitation purposes.

Although there is no list of waste materials to be regarded as inert according to EWD criteria, waste generated by the extractive industry (quarries) is classified as non-hazardous inert waste. There are no national threshold values for inert waste from sites identified as uncontaminated. Such waste can be backfilled in spent quarries for rehabilitation and construction purposes. If a site is identified as contaminated, specific tests are required.

On its website, the ERA provides a list of quarries currently permitted by the Authority to accept waste from external entities and other operational quarries currently permitted (excluding acceptance of inert material) by the Authority (https://era.org.mt/topic/quarries/)

Classification of Chemical Reagents applied in extractive sector

Chemical reagents are not applied in Malta's extractive sector.

Re-use and placing back of extractive waste material

No specific data on reuse of extractive waste were provided, but according to ERA In many sites, the extractive waste is backfilled in the same quarry. However, there are quarries which provide soft stone waste material (generated on site through the mineral extraction process) to third parties, generally for free, to be processed as fine material for use in construction related activities.

Quarry waste is considered inert waste and non-hazardous. Quarries in Malta may have multiple quarry activities at their respective sites. For instance, a quarry may have mineral resource being extracted and at the same time also have had some void space available which was being be backfilled with material, may have to cease the backfilling activity until such time as the mineral resource extraction area is exhausted. There are sites which have uses parallel related to the quarrying industry, such as acceptance of inert waste for recycling through crushing and grading which may take up space which would eventually be available for backfilling once the recycling activity ceases. In the two scenarios mentioned, the site is still open but may be closed temporarily for the acceptance of inert waste.

Waste management and permitting

Approval procedure for Extractive Waste generation/storage

Hard and soft stone excavation operators must submit waste management plans. Inert material is considered as extractive waste. The extracted waste could be reused for backfilling.

Approval and Review of Extractive Waste Management Plans

EWMP

According to ERA in the view that in Malta there are no extractive waste management facilities (Category 1 facilities) that fall within the scope of Directive (2006/21/EC) EWMPs are not requested.

Financial guarantees

There is no legislation on financial guarantees (with regard to the Mine Waste Directive, Article 14).

As laid down in regulation 14 of S.L.549.50, ERA as the competent authority, prior to the commencement of any operations involving the accumulation or deposit of extractive waste in a waste facility, requires a financial guarantee or the equivalent, in accordance with procedures to be decided by the competent authority, so that:

- obligations under the permit issued pursuant to these regulations, including after-closure provisions, are discharged; and
- there are funds readily available at any given time for the rehabilitation of the land affected by the waste facility, as described in the waste management plan.
- The calculation of the guarantee is based on the likely environmental impact of the waste facility and the assumption that independent and suitably qualified third parties will assess and perform any rehabilitation work needed. The size of the guarantee shall be periodically adjusted in accordance with any rehabilitation work needed to be carried out on the land affected by the waste facility. When the ERA approves the closure of the waste facility, the operator is given a written statement releasing him from the guarantee obligation.

ERA confirmed that in Malta, Bank Guarantees are required for all quarries having an Environment Permit.

Emergency preparedness

A location of list of the external emergency plans is not available.

Periodic production/waste reporting
Periodic waste reporting is not applicable since currently in Malta there are no waste facilities that fall within the definition of waste facility as laid down in the Directive on the management of waste from extractive industry.

Number of EWMP 2015-2017 (approved, rejected, new applications)
In the last reporting period, no management plans were submitted or approved.

Extractive waste facilities

Table 6 provides an overview related to Extractive waste facilities in Malta.

Table 6: Malta, Overview EWF & Cat A Facilities

	2015 - 2017
Inventory EWF metal extraction	Not applicable
Inventory EWF non-metal extraction	Not applicable
Nr. Cat A Facilities	Not applicable
Closure EWF	Not applicable

Closure of EWF is not applicable since in Malta there are no waste facilities that fall within the definition of waste facility under Directive 2006/21/EC. However, as per environment permit condition, the operator of a spent quarry permitted for restoration (backfilling), is still fully liable and responsible for managing the site in all its various aspects and to supervise full adherence with all the conditions of the environment permit. A location of inventory of closed and abandoned waste facilities is not available.

Legislation for exploration, extraction and waste generation

Authorities governing mineral exploration and extraction

An overview of authorities governing mineral exploitation and extraction is presented in the next Table.

Table 7: Malta, Overview of authorities governing mineral exploitation & extraction

Authority		**Activity / Responsibility**
ERA	Environment & Resources Authority	Responsible for: - all the thematic environmental areas including waste, water, air quality, biodiversity and nature protection, environmental noise, radiation, marine, genetically modified organisms and biosafety, - environmental assessment - and ozone protection https://era.org.mt/
EWA	Energy & Water Agency	- Formulating and implementing Government's national policies in the energy and water sectors, - Aiming at ensuring security, sustainability and affordability of energy and water supply in Malta https://www.energywateragency.gov.mt/
MRA	Malta Resources Authority	- Regulator of water energy & mineral resources - Promotor of energy efficiency efficiency and the use of renewable energy

		- Responsible for oil exploration and climate change. https://mra.org.mt/
PA	Planning Authority	- Tasked with a national sustainable land use planning system - Responsible for the planning application process and procedures. https://www.pa.org.mt/
SCH	Superintendence of Cultural Heritage	Entrusted with the protection and accessibility of Malta's cultural heritage https://culture.gov.mt/en/culturalheritage

Legislation governing mineral exploration and extraction

Following tables contain the main laws that regulate the mineral extraction in Malta.

Table 8: Malta, Direct legislation governing mineral exploration & extraction

Legal Act		Location
MRA Act	Malta Resources Authority Act	Cap. 423
DPA-Act	Development Planning Act (cf. rehabilitation of disused quarries	Chapter 356
EPA Act	Environment Protecting Act, incl. Waste Management regulations (waste management, management of waste from extractive industries and backfilling) regulations)	Chapter 549; S.L. 549.50
SCH Act	Cultural Heritage Act	Chapter 445

Table 9: Malta, Indirect legislation governing mineral exploration & extraction

Legal Act	Location
Land Acquisition Ordinance	Chapter 88
Strategic Environmental Assessment Regulations	Legal Notice 418 of 2005
Continental Shelf Act	Chapter 194

Licensing procedures for exploration and extraction

In Malta, non-energy sector related mineral extraction focuses on the quarrying of Lower Globigerina Limestone (commonly referred to as soft stone) and Coralline Limestone (or hard stone). The authorities do not provide separate licenses for exploration and exploitation. Companies need to express their interest for any or both two operations by applying for a permit through the ERA and, subsequently, the MRA.

Furthermore, licensing is handled exclusively at the national level. Authorisations and licensing are treated as one procedure for both soft stone and hard stone quarries. There are fundamental differences between the soft stone and hard stone industries. However, their private ownership is an aspect that they share. They are usually run by individual businesses usually comprising single operational units. Many of the hard stone quarries include concrete batching plants and tarmac plants, with some of them being operated by larger industrial concerns.

In the case of Malta the sections on licensing procedures for exploration and extraction have been merged into one because exploitation of minerals in Malta is considered as part of a whole process together with exploration. In other words, the authorities do not provide a license for exploration but only for exploitation. There are no differences between different commodities from a licensing perspective, as the Maltese minerals industry mainly extracts limestone.

Extraction licenses are issued solely by MRA following the approval of the lateral/horizontal extraction by the Planning Authority. MRA issues personal licences to persons to quarry and sell stone. Permission from the Planning Authority and ERA are also required to quarry.

Administrative arrangements for waste management

Every 3 year a waste management report has been submitted by Malta's Environment and Resources Authority (ERA) to the Commission (2008-2011, 2012-2014, 2015-2017).

As from April 2016, the Environment and Resources Authority as established under Chapter 549 of the Laws of Malta oversees:

- Verifying and approving the extractive waste management plans proposed by the operators;
- Issuing and updating EWM permits;
- Establishing and updating the financial guarantee;
- Making inspection of the waste facilities;
- Establishing the external emergency plans for Category "A" installations;
- Establishing an inventory of closed and abandoned waste facilities.

Table 10: Malta, Number of EWF inspections and closing procedures undertaken

	EU reporting period		
	2008-2011	2012-2014	2015-2017
N° inspections inert extractive waste installations for each reporting period	236	149	0
N° inspections Non inert, non-hazardous installations for each reporting period	0	0	0
N° closure procedures undertaken and/or approved during each reporting period	0	0	0

The Netherlands– Country Fact Sheet

The Netherlands and its minerals industry

Background

Mining for non-energy minerals is of little importance in the Netherlands. The only mineral that is mined (and that is covered by the mining law) is rock salt, which is mined in only a few locations. Construction materials (clay, sand, gravel) are extracted extensively in quarries, but this activity is not covered by the Dutch mining law.

Mineral ownership

State-owned minerals include off-shore minerals (shells, gravel, sand and clay of the Continental Shelf - Article §4b Excavation Act) and on-shore non-surface minerals (e.g., salt). On-shore surface minerals (e.g., construction minerals) belong to the landowner.

Production and Waste generation

Production data

In the next table the annual production of main commodities in the Netherlands is presented.

Table 1: The Netherlands, Annual mineral production per main commodity

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	49,70	43,40	43,60	45,6	UEPG 2020
Crushed Rock	0,9	0,9	0,9	0,9	UEPG 2020
Dimension Stones (t)	no data reported				USGS
Energy Minerals					
Oil	2,00	1,56	1,47	1,7	ND
Gas (Mm3)	52177	50373	43915	48822	ND

Table 2: The Netherlands, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Average	Reference
Aggregates	295,00	288,00	295,00	293	UEPG 2020

Extractive waste generation 2015-2017

No information on extractive waste generation was available or was provided.

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In The Netherlands the extractive waste definition according the EWD is applied.

Re-use and placing back of extractive waste material

No information on reuse of extractive waste for filling excavation voids was available or was provided.

Waste management and permitting

Permitting procedures EWMP

The competent authority in charge of issuing and updating EWM permits is the Ministry of Economics and Climate (https://www.rijksoverheid.nl/ministeries/ministerie-van-economische-zaken-en-klimaat)
Furthermore, competent authority in charge of internal advice on permits and safety is **Staatstoezicht op de Mijnen** https://www.sodm.nl/

Extractive waste facilities

The Netherlands has no extractive Waste Facilities.

Legislation for exploration, extraction and waste generation

Legislation governing mineral exploration and extraction

The Dutch mining law is provided at https://wetten.overheid.nl/BWBR0014168/2019-10-01#Opschrift

Poland – Country Fact Sheet

Poland and its minerals industry

Background

Poland is an important producer of hard coal, lignite, coke, steel, copper, zinc, lead, silver, and many industrial minerals, e.g. salt, sulphur, soda ash, limestone, lime, cement, gypsum, mineral aggregates, etc. Poland ranks as the EU´s number one producer of hard coal, coke, copper concentrates, silver, and helium, is 2nd in refined copper, sulphur, and soda ash, 3rd in lignite, zinc and lead concentrates, cadmium, and selenium, 4th in quartz sand, 5th in cement, lime, gypsum, and feldspar raw materials and 6th in zinc, lead, salt, limestone, and mineral aggregates. It is also the only EU´s producer of rhenium.

Mineral ownership

The State Treasury is the owner of all deposits of hard coal, lignite, oil & gas, methane as an accompanying mineral, metal ores (with the exception of bog iron ores), native metals, native sulphur, rock salt, potassium salt, potassium-magnesium salt, gypsum and anhydrite, gemstones, rare earth elements as well as noble gases. Deposits of other minerals (e.g. sand and gravel, limestone, dolomite) belong to the landowner (Art.10 Mining Law http://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20111630981).

Production and Waste generation

Production data

Next tables present the annual production of main commodities and the number of extraction sites in Poland.

Table 1: Poland, Annual mineral production per main commodity (10^6 t)

Commodity	2015	2016	2017	Average	Reference
Metals					
Cadmium (t)	383	319	309	337	BGS
Copper (t) metallic	426196	424000	419000	423065	BGS
Lead (t) metallic	69190	62750	73530	68490	BGS
Zinc (t) metallic	52709	50124	44959	49264	BGS
Gold (kg) recovery in technological process	431	402	572	468	BGS
Silver (kg)	1407000	1482000	1490000	1459667	BGS
Ind minerals					
Bentonite (t)	450	1000	0	483	BGS, USGS (2019a; 2021), WMD
Chalk (Mt)	no data	3,136	3,473	-	Eurostat
Diatomite (t)	600	500	500	533	BGS, WMD
Feldspar (Mt)	0,077	0,088	0,091	0,085	PIG-PIB (2016, 2017, 2018)
Gypsum (incl. anhydrite) (Mt)	1,018	1,043	1,108	1,056	PIG-PIB (2016, 2017, 2018), WMD
Kaoline (Mt)	0,287	0,300	0,285	0,290	PIG-PIB (2016, 2017, 2018), WMD
Magnesite (Mt)	0,096	0,078	0,102	0,092	BGS, WMD
Rock Salt (Mt)	3,468	4,079	4,660	4,069	PIG-PIB (2016, 2017, 2018)
Sulphur (Mt)	0,651	0,645	0,686	0,661	PIG-PIB (2016, 2017, 2018), WMD
Aggregates					

crushed rock (Mt)	64	73	85	74	UEPG
sand & gravel (Mt)	168	173	187	176	UEPG
Clays for ceramic industry (building, refractory, ceramic clays) (Mt)	3,760	3,680	3,600	3,680	PIG-PIB (2016, 2017, 2018)

Table 2: Poland, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Reference
Metals				
Cadmium	*byproduct*			Euromines
Copper metallic	no data	no data	6 (2020)	Euromines
Lead metallic	*byproduct*			Euromines
Zinc metallic	no data	no data	3 (2020)	Euromines
Gold recovery in technological process	*byproduct*			Euromines
Silver	*byproduct*			Euromines
Ind minerals				
Bentonite (t)	1	1	0	PGI geoportal
Chalk				
Diatomite (t)	1	1	1	PGI geoportal
Feldspar	2	2	2	PGI geoportal
Gypsum (incl. anhydrite)	5	4	4	PGI geoportal
Kaoline	2	2	2	PGI geoportal
Magnesite	1	1	1	PGI geoportal
Rock Salt	6	5	5	PGI geoportal
Sulphur	5	5	5	PGI geoportal
Aggregates (total)				
crushed rock	64	73	85	UEPG
sand & gravel	168	173	187	UEPG
Clays	184	224	216	PIG-PIB (2016, 2017, 2018)

More information on individual production data of the principal mines and quarries in Poland is provided in Annexes C to I.

Extractive waste generation 2015-2017

Next tables present estimations of annual generation of extractive waste in Poland. The estimations are made according to methodology of Annex G and H.

Table 3: Poland, Estimated extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Lubin-Malomice[1]	Cu	U	69.000	Ag+Au	354	7.511.000	3.755.500	11.266.500	7.441.646
Polkowice-Sieroszowice	Cu	U	200.000	Ag+Au Salt	91.234.000	12.000.000	6.000.000	18.000.000	11.566.000
Rudna	Cu	U	167.000	Ag+Au	633	10.232.000	5.116.000	15.348.000	10.064.367
Olkusz-Pomorzany	Zn	U	51.000	Pb	13.000	1.710.000	855.000	2.565.000	1.646.000

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4: Estimation of total industrial minerals excavation and waste in Poland

Poland (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Bentonite	0,000	0,001	0,000	0,000	0,000	0,000	0,001
Diatomite	0,001	0,001	0,001	0,001	0,001	0,000	0,002
Feldspar	0,077	0,088	0,091	0,085	0,085	0,000	0,170
Gypsum	1,018	1,043	1,108	1,056	0,740	0,000	1,796
Kaolin	0,287	0,300	0,285	0,290	2,033	1,162	3,486
Magnesite	0,096	0,078	0,102	0,092	0,092	0,055	0,239
Salt	3,468	4,079	4,660	4,069	N/A	0,407	4,476
Sulphur	0,651	0,645	0,686	0,661	N/A	N/A	0,661

a Rock = Average Stripping Ratio * Average Production
b Total Excavated Material = Rock + Average Production + Tailings
c Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Poland the extractive waste legislation is based on EU legislation, "extractive waste" concerns waste from prospecting, exploring, extraction, treatment and storage of mineral from deposit. In Poland, waste from oil & gas extraction is interpreted as extractive waste.

In Poland 'treatment' of mineral resources is not interpreted to include the combustion of energy minerals to produce electricity/heat/energy.

Classification of Extractive Waste

Poland has no list of inert wastes, but a dedicated Regulation of the Ministry of Environment (Ministry of Climate). Thresholds for metals are found in other legislation.

[1] Data were collected from the official website https://kghm.com/en/our-business/mining-and-enrichment/polkowice-sieroszowice

Classification of Chemical Reagents applied in extractive sector

Specific chemical agents are regulated in Poland according REACH.

Re-use and placing back of extractive waste material

Available information on reuse of extractive waste is provided in following table.

Table 5: Poland, Reuse of extractive waste from metallic mining for filling excavation voids (t)

Property Name	Primary Commodity	Mine Type[a]	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management[c]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Lubin-Malomice	Cu	U	7.511.000	3.755.500	11.266.500	7.441.646	7.268.003	2.422.668	use of flotation tailings from copper ore flotation process (waste with code: 01 03 81 - wastes from flotation enrichment of non-ferrous metal ores other than those mentioned in 01 03 80 (01 03 80* wastes from flotation enrichment of non-ferrous metal ores containing dangerous substances)), deposited at the extractive waste disposal facility for expansion thereof, overbuilding dams to a higher damming ordinate as well as for sealing the reservoir bowl.
Polkowice-Sieroszowice	Cu	U	12.000.000	6.000.000	18.000.000	11.566.000			
Rudna	Cu	U	10.232.000	5.116.000	15.348.000	10.064.367			
Olkusz-Pomorzany	Zn	U	1.710.000	855.000	2.565.000	1.646.000	no tailings	1.646.000	no reference in articles that the operator uses tailings for filling excavation voids. There are investigation on waste rock

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD
c no data available, Taking into consideration that the waste stream is estimated to be hazardous then it is estimated that no portion of tailings are returned into the excavation voids
d no data available, here were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.

Table 6: Poland, Reused waste on site from aggregates production

Reused on site	2015	2016	2017	Reference
Aggregates (Mt)	7	6	no data	UEPG

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

Recent opinions sent by the Commission considered the level of implementation incomplete and urged Poland to comply in particular with the requirements to making information available to the public and to other Member States in the event of accidents, as well as concerning the requirement to prepare waste management plans for all waste facilities. To address this concern, the Polish Act on Extractive Waste was amended such that the infringement notice from the European Commission was withdrawn. All producers of extractive waste in Poland must have an "EWMP" and permit approving EWMP. Only some EWFs (those for non-inert extractive wastes) require an Article 7 permit as well.

Financial guarantees

A financial guarantee is only applied for the one Polish Category A EW Facility. Non-Cat A facilities do not need a financial guarantee in Poland.

Emergency preparedness

The list of the external emergency plans in Poland is managed by the Regional Headquarters of the State Fire Service. The list is available publicly available online at http://stara.kwpsp.wroc.pl/zagr/inf_zelmost/info.htm#powr%C3%B3t_1 .

To applications for a permit to operate a extractive waste facility, the waste holder operating a category A extractive waste facility attaches the information necessary for the preparation external emergency plan by the competent Provincial (Regional) Headquarter of the State Fire Service.
The competent authority, transmits immediately the information mentioned above to the competent Provincial (Regional) Headquarter of the State Fire Service.

The competent authority issues a permit to operate a extractive waste facility after an external emergency plan is prepared by the competent Provincial (Regional) Headquarter of the State Fire Service.

Generally, procedures and responsible actors that deal with emergency preparedness of the extractive waste facility follow Directive 2006/21/EC (article 6 and annex 1). These procedures have been transposed into Polish law.

Inspections that were achieved per reporting period are presented in the following table.

Table 7: Poland EWF inspections per reporting period

N° of inspections achieved for each EU COM reporting period	2008-2011	2011-2014	2014-2017	2017-2020
Inert waste installations	9 inert and non inert and non hazardous	105	196	51
Non inert, non hazardous installations		21	23	18

Production/waste reporting

All operators generating extractive waste are required to prepare an EWMP which requires approval by Voivodship Marshall Office, Regional Directorate of Environmental Protection or "Starosta". The

EWMPs are stored also in a cupboard at the relevant Voivodship Inspectorate of environment protection. The EWMPs include estimates of the maximum expected amounts of extractive waste as per the EU Waste Catalogue and required by Annex II (2) of the EWD and Annex I (3) of Commission Decision 2009/360/EC.

During operation, the companies report actual quantities of extractive waste generated to the Voivodship Marshall Office as per the EU Waste Catalogue and required by Annex II (2) of the EWD and Annex I (3) of Commission Decision 2009/360/EC. Such reports do not include quantities of material allocated to non-waste codes.

Companies reported to the Voivodship Marshall offices, who then provided an annual report of actual waste generated to the Ministry of Climate (former Ministry of Environment). The Ministry of Climate (former Ministry of Environment) would then prepare a triennial report and send it to the Polish Permanent Representation to the EU in Brussels. The Permanent Representation forwards the report to the European Commission.

Meanwhile, in a completely separate, parallel process, companies answer annual statistics requests from the National Statistics office, which then forwards them on to Eurostat. Naturally, the “extractive waste” data sent to the Voivodship and the “waste” data sent to the National Statistics office do not fully match due to differences in data collection system.

All steps of the reporting chain are compulsory. The required national reporting frequency is annually by the operators. National reporting takes place every 3 years by the Ministry of Climate - according to directive 2006/21/EC and Commission Decision 2009/358/EC.

The data is processed in accordance with the EU Waste Catalogue, which clearly split out mining waste in group 01. Production and/or waste data are reported as per the EU Waste Catalogue and required by Annex II (2) of the EWD and Annex I (3) of Commission Decision 2009/360/EC, which includes different codes for Hazardous and Non-hazardous categories of waste. Generally, the provided statistics to EU Commission are final, but for example supplementary information for the period 2014-2017 was provided at a later stage.

Poland will implement a new electronic system of data logging and reporting in January 2020, but even this new system will be based on national waste codes and codes for by-products as per the EU Waste Catalogue as required by Annex II (2) of the EWD and Annex I (3) of Commission Decision 2009/360/EC. Some additional Polish codes are also used. In Poland 0101 is used for Waste Rock, 0103 for tailings from metal ores, 0104 for processing waste (other minerals), and 0105 for Exploration (drillings). In Poland there is a separate policy interest in building an inventory of secondary resources & reserves.

The National Waste Management Plan 2022 (KPGO 2022) sets out tasks focused on monitoring compliance with the waste management regulations, involving controls over:
- extractive waste disposal facilities;
- compliance with the regulations on packaging and packaging waste management;
- sludge management;
- entities involved in managing municipal waste.

KPGO 2022 defines the tasks to be implemented by the Inspection of Environmental Protection, the police and the entities competent to conduct tax inspections with regard to:
- recovery organisations, collecting entities and processing WEEE installations;
- installations for processing waste batteries and accumulators;

- vehicle collection points;
- entities that produce medical waste and medical and veterinary waste incineration facilities.

The objective of KPGO 2022 is to specify the waste management policy in line with the waste management hierarchy, to support actions aimed at achieving the objectives and fulfilling the requirements of national and EU law, to establish a framework for proper task planning, including investments in waste management and the resulting decrease in the impact of waste on the environment and people. KPGO 2022 includes an analysis of the current condition of waste management, an identification of problems and a forecast for changes in waste management. It specifies that national objectives and directions, including the directions for arrangements regarding the Voivodship Waste Management Plans - detailed tasks, including investments aimed at the implementation of objectives in the scope of waste management - are set out in the Voivodship Waste Management Plans. It also indicates actions and the entities in charge of their implementation, such as monitoring compliance with waste management regulations, conducting information and education campaigns to improve the level of ecological awareness of waste management, legislative tasks and other organisational tasks, including the development of guidelines for waste management, supporting the construction of the repair network and the vertical use of products, supporting the implementation of research and scientific works in waste management, introducing tasks related to counteracting the production of waste and proper waste management. The objectives and tasks included in KPGO 2022 refer to the period between 2016 and 2022 and the perspective by 2030.

Extractive waste facilities

Category A and non-Category A facilities

Breakdown of data into different mineral types is not prepared in Poland (not even routinely by the 16 Voivodships). Currently, such data is only broken down into EWFs containing Hazardous materials and EWFs containing Non-hazardous materials. All EWFs have an associated EWMP. Only EWFs containing non-inert extractive waste require an Article 7 permit. The total number of EWFs containing inert extractive waste is known from the inspectorates. It is therefore possible to derive a split between EWFs containing inert extractive waste and EWFs containing non-inert extractive wastes.
Table 9 provides an overview of the Extractive waste facilities for in Poland.

Table 8: Poland, Overview EWF & Cat A Facilities from 2015 to 2017

EWF	In Operation without permit	In Operation with permit	In Transition	In Closure phase	Closed or abandoned
Category A		1			
Not Category A:					
Inert waste	119				6
Non hazardous non inert waste		11		4	11
Total	**119**	**12**		**4**	**17**

Every year an inspection of the only Cat A facility ("Żelazny Most”) took place. This Category A facility is used by different mines. The copper mines Lubin, Polkowice-Sieroszowice and Rudna (operator KGHM Polska Miedź SA) send their waste to this waste facility.

The zinc mine Olkusz-Pomorzany is divided in 3 deposits (Olkusz, Bolesławiec and Klucze), as specified in Annex H. The end of their production took place in December 2020.

The mines Głogów Głęboki-Przemysłowy, Radwanice-Gaworzyce, do not have an EWF because Głogów Głęboki-Przemysłowy and Radwanice-Gaworzyce are not mines, but mining areas: Głogów

Głęboki-Przemysłowy of Polkowice-Sieroszowice and Rudna, Radwanice Gaworzyce of Polkowice-Sieroszowice. In both of them mining shafts are under construction.

Closed and abandoned extractive waste facilities

In Poland every closed EWF has an operator. Competent authority may take over temporarily the role of the operator in case that operator does not comply applicable regulations and does not perform obligations imposed by this authority. In special cases the authority instead of the operator performs the obligations and charges the operator for the costs incurred.

Only EWFs for non-inert extractive waste require an Article 7 permit. After closure there is no obligation for operator of those non-inert EWFs to have a permit which requires an Article 7. But there is the obligation to have permission to close the EWFs. Conditions for the closure and remediation of those EWFs are included in the permission.
In case of EWFs for inert extractive waste and unpolluted soil there is no requirement to obtain a permit (concerns in operation phase, closure phase and after closure phase).
An inventory of closed and abandoned waste facilities is published at webpage http://www.gios.gov.pl/bip/zalaczniki/spis_zouow_wrzesien_2012.pdf.
Next table presents the EWF closures during the EU Commission reporting periods.

Table 9: Poland, closures during the EU Commission reporting periods

EWF closures	2008-2011	2012-2014	2015-2017
N° of closure procedures undertaken and/or approved during each reporting period	3	6	0
N° of installations closed and regularly monitored	5	7	20

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

The principal legislation concerning permitting procedures is described in the Geological and Mining Law (unif. text J.L. of 2019, item 868), Prawo Przedsiębiorców Business Law from 6.03.2018, Nature Conservation Law (unif. text J.L. 2018, item 2081), Environmental Protection Law (unif. text J.L. 2019, item 1396), Water Law (unif. text J.L. 2018, item 2268) and Act on Land Use Planning and Space Management (unif. text J.L. 2018, item 1945). The competent authorities and the procedures for obtaining the license are different for state-owned and land-owned mineral deposits, and for exploration and extraction phases, their location, as well as extraction method and size.

For extraction, in order to receive a mining license, it is necessary to obtain the environmental permit ('decision on the environmental conditions' if required by Article 72, par. 1, of the Act on Providing Information about Environment and its Protection, Public Participation in the Environmental Protection and Assessments of the Environmental Impact). The competent authority that grants the environmental permit is the Regional Director for Environmental Protection (in the case of state-owned minerals and in case of investments located at the maritime areas of the Republic of Poland). For land-owned minerals, the competent authority is the Head of the municipality (Wójt), that is, the mayor or city president.

For extraction, the mining license can be obtained after fulfilling four steps: i) amendment or approval of spatial documents, ii) elaborating a deposit development plan, iii) obtaining the environmental permit and iv) the establishment of mining usufruct (in case of state-owned minerals). The procedures for obtaining the extraction license are different for state-owned and land-owned minerals.

Authorities responsible for granting the license, as well as co-authorities (agreeing and expressing opinion), vary depending on the properties of minerals, their location as well as extraction method and size. Before drawing up the application for the extraction license it is necessary to obtain both spatial and environmental decisions. The amendment of spatial documents is achieved when the existing study on the preconditions and directions for the spatial development of the municipality (study) is amended. This requires the modification of the study and/or the local land use plan for using land for mining operations.

For the environmental permit, an applicant/developer needs to evaluate if the project is classified as a 'project that always has significant impacts on the environment' (e.g. extraction of minerals: a) by open cast method from a mining area occupying not less than 25 ha, b) by underground method with an annual extraction amount not less than 100,000 m^3; c) mining waste facility of category A), or as a 'project that could have a significant impact on the environment' (e.g. extraction of minerals: a) by open cast method from a mining area bigger than 2 ha and an annual extraction rate larger than 20,000 m^3, b) by an underground method with an annual extraction amount lower than 100,000 m^3). The environmentally competent authorities granting the permit are the same as previously mentioned. The mining license is granted by the Minister of the Environment in the case of state-owned minerals and in case of a mining area located within the boundaries of the maritime areas of the Republic of Poland, and by the Marshal or District Head (Starosta) for land-owned minerals.

The legal timeframes for authorities to make decisions are defined by the Administrative Proceedings Code, which states that a license should be granted without unnecessary delay. Thus, the time periods for public participation and decision by environmental authorities with respect to the environmental permit are fixed, as is the period to provide feedback on the deposit development plan (14 days). The law determines a legal time frame for deciding on the approval or rejection of building, water, waste, and mining waste permission within 60 days. All such permissions can be granted in parallel. Mining permission is obtained generally with a minimum of 3 months (for very small deposits <2 ha, concession issued by Marshal) and up to 3-5 years (for large deposits, when the mining concession is issued by the Ministry of the Environment or the Marshal´s (head of the provincial-level government) Office.

The main reasons for delays in the permitting of extraction licenses include delays in getting other decisions if they are legally required, e.g. environmental decision, time to complete all required documents, and appeal procedures.

Administrative arrangements for waste management and compentent authorities

The competent authorities in charge of verifying and approving the extractive waste management plans proposed by the operators are the Voivodship Marshall offices for cases requiring obligatory EIA; Regional Directorate of Environmental Protection for cases on closed areas and Starosta (Executive of Poviats) for other cases. Every operator that produces extractive waste must prepare an EWMP.

The competent authorities in charge of issuing and updating EWM permits are as well Voivodship Marshall offices for cases requiring EIA; Regional Directorate of Environmental Protection for cases on closed areas and Starosta (Executive of Poviats) for others cases. Though every operator that produces extractive waste must prepare an EWMP, only EWFs for non-inert extractive waste require an Article 7 permit. The Location of the full list of Article 7 permits is held by the Ministry of Climate (former Ministry of Environment) and is not published.

The competent authority in charge of establishing and updating the financial guarantee is the Voivodship Marshall. Currently, only one case in Poland required a Financial Guarantee.

The competent authority in charge of making inspections of the waste facilities is the Chief Inspectorate of Environmental Protection. They are the controlling body providing support and oversight, whilst actual inspections are performed by the 16 Voivodship inspectorates of environmental protection.

The competent authority in charge of establishing the external emergency plans for Category “A” installations is the Regional Headquarters of the State Fire Service that prepares the plans. The Voivodship Marshal approves it and issues the permit.

The competent authority in charge of establishing an inventory of closed and abandoned waste facilities is the Chief Inspectorate of Environmental Protection, which gathers the necessary information from the 16 voivodships inspectorates of environmental protection.

Portugal – Country Fact Sheet

Portugal and its minerals industry

Background

Portugal is endowed with a complex and diversified geology with a considerable mineral potential, leading to the occurrence of a considerable number of ore, industrial and ornamental stone deposits. In northern Portugal there are tungsten, lithium and tin deposits, and also precious metals; northern-central Portugal has a predominance of granitic rocks; in southern-central Portugal in addition to gabbros, diorites, serpentinites, anorthosites, granodiorites, tonalites and granites, the most important mineral occurrences are base metals. Portugal is an important European producer of tungsten, copper and zinc.

Mineral ownership

Ownership of metallic and industrial mineral rights (e.g. kaolin, quartz, feldspar, special clays, special sands, halite, gypsum, etc.) is assigned to the state. Quarries of construction minerals (e.g. marbles, limestones, clays, granites, aggregates, slates) belong to the landowner.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Portugal are presented.

Table 1: Portugal, Annual mineral production per main commodity (t)

Commodity	2015	2016	2017	Average	Reference
Metals					
Tungsten (t)	474	685	669	609	WMD
Copper (t)	83 081	75 861	63812	63812	WMD
Lead (t)	3 077	4 246	5164	5164	WMD
Lithium (t)	204	314	604	374	WMD
Tin (t)	42	55	81	59	WMD
Zinc (t)	66 871	69 527	71357	71357	WMD
Silver (kg)	41 337	38 631	40186	40186	WMD
Industrial Minerals					
Feldspar (t)	93 789	118878	126211	122545	DGEG, WMD
Gypsum (t)	309 966	310000	152059	231030	BGS, WMD
Kaolin (t)	247 482	261912	307982	284947	BGS, DGEG, WMD
Rock Salt (t)	30 008	15348	7800	11574	BGS, DGEG, WMD
Talc (t)	11 204	11699	13600	12650	BGS, DGEG, WMD
Aggregates (Mt)	32	31,7	35,3	33,0	UEPG
Ornamental stones (Mt)	2,9	2,8	3,2	3,0	DGEG
Clays for ceramic industry (Mt)	3,760	2,345	2,398	2,834	DGEG (2016, 2017); Eurostat Prodcom

Table 2: Portugal, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Reference
Metals				
Tungsten			1	Euromines
Copper			2	Euromines
Lead			Byproduct	Euromines
Lithium			ND*	
Tin			1	Euromines
Zinc			Byproduct	Euromines
Silver			ND	
Industrial Minerals	118	125	127	DGEG (total Ind Minerals)
Feldspar (t)	ND	ND	ND	
Gypsum (t)	ND	ND	ND	
Kaolin (t)	75	83	84	DGEG (Sum Argile and Kaoline)
Salt (t)	2	1	1	DGEG
Talc (t)	ND	ND	ND	
Aggregates	263	261	254	DGEG
Ornamental stones	364	363	344	DGEG
Clays	75	83	84	DGEG (2017)

ND No data available or provided

More information on individual production data of the principal mines and quarries in Portugal is provided in Annexes C to I.

Extractive waste generation 2015-2017

Next table presents estimations of the total average annual generation of extractive waste in Portugal per commodity. The estimations were derived from production data and material flows of mines and quarries per commodity. The methodology applied is given in the report, §2.2 and Annex L.

Table 3: Portugal, Estimated extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Aljustrel	Cu	U	70.000	Pb, Zn	0	1.800.000	900.000	2.700.000	1.730.000
Neves-Corvo	Cu	U	149.043	Zn, Pb	205.909	3.367.881	1.683.940	5.051.821	3.012.929
Panasqueira	W	U	111.910	-	0	559.551	279.775	839.640	447.640

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4: Estimation of total industrial minerals excavation and waste in Portugal (Mt)

Portugal (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Feldspar	0,094	0,132	0,126		0,117	0,000	0,235
Gypsum	0,310	0,255	0,152	0,239	0,167	0,000	0,406
Kaolin	0,252	0,284	0,308	0,281	1,969	1,125	3,376
Salt	0,030	0,006	0,008	0,015	N/A	0,001	0,016
Talc	0,011	0,012	0,014	0,012	0,012	0,000	0,025

a Rock = Average Stripping Ratio * Average Production
b Total Excavated Material = Rock + Average Production + Tailings
c Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Portugal the waste legislation is based on EU legislation. No further information was provided by DGEG.

Classification of Extractive Waste

A list of inert mine waste is described in Annex I on the National Law-Decree No. 10/2010 (04/02/2010). No specific location of actual list was provided by DGEG.

Portugal has developed a national program for the rehabilitation of abandoned mines, which began before the Mining Waste Directive transposition. Although the Annex III criteria (of Directive 2006/21/EC of the European Parliament and of the Council concerning the management of waste from extractive industries for abandoned sites) were not formally followed, namely executing an environment impact study, the best practices principles (BAT) were technically well performed.

The waiver of the Landfill Directive paragraph 3 of Article 3 (MS may declare at their own option, that the deposit of non-hazardous non-inert mine waste, to be defined by the committee established under Article 17 of this Directive can be exempted from the provisions in Annex I, points 2, 3.1, 3.2 and 3.3 (location screening, multiple barriers, leachate collection)) is not applied in Portugal.

Classification of Chemical Reagents applied in extractive sector

The risk arising from the processing of minerals with chemical agents is evaluated in the EIA. According to DGEG there any no restrictions to use of a specific chemical agent according to Portugal's legislative framework.

Re-use and placing back of extractive waste material

Available information on reuse of extractive waste material is provided in Table 5.

Table 5: Portugal, reuse for placing back tailings into excavation voids (t)

Property Name	Primary Commodity	Mine Type[a]	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management[c]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Aljustrel	Cu	U	1.800.000	900.000	2.700.000	1.684.600	no tailings	1.684.600	Wardell Armstrong (2007)
Neves-Corvo	Cu	U	3.367.881	1.683.940	5.051.821	3.012.929	231.000.000		Technical Report (2017)
Panasqueira	W	U	559.551	279.775	839.326	447.640	no tailings	447.640	Grangeia et al (2011)

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

A mine operator should prepare, submit and update (during the mining operation) a mine waste management plan to the mining authority. The operator must comply with his permit (which defines all the conditions related with waste management, monitoring and reporting). On the other hand, the entities with responsibilities for inspecting verify the compliance of the measures imposed by competent authorities and can make their own controls. The National Law-Decree No.10/2010 of February 4, established the legal regime that is subject to waste management for mineral deposits and mineral masses conceptions - mining waste, transposing the Directive no. 2006/21/EC of the European Parliament and the Council of 15 March into national law. The procedures are described in Article 10.

Financial guarantees

In Portugal legislation is available that regulate financial guarantees. The procedures are described in article 31 on the National Law-Decree No. 10/2010 of February 4.
The cost calculation is made by the mining authority. Financial guarantees must be provided by any suitable means, such as a bank guarantee, cash deposit or an insurance bond. However, the legislation does not make any difference between the type of guarantee. There are no minimum or maximum values given in the law. The value range of the accepted financial guarantee can be anywhere between 1 000 and 2 000 000 € as a function of the dimension of the project/mine, type of mineral substance and its remediation costs. Financial guarantees are also required for the exploration phase, with more moderate amounts.

Emergency preparedness

In the reporting period 2014-2017 emergency plans were in progress. No further information was provided. Competent authority in charge of establishing the external emergency plans for Category “A” installations is National Civil Protection Authority with the support of DGEG and Agência Portuguesa do Ambiente (APA). A location of a list of the external emergency plans was not provided.

Extractive waste facilities

Category A and non-Category A facilities

Table 6 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Portugal.

Table 6: Portugal, Overview EWF & Cat A Facilities from 2015 to 2017

EWF information	2015 - 2017	Reference
Nr. Cat A Extractive Waste Facilities (metal extraction)	3	AFW Table (2017), Annex H, DGEG
Nr. Non-Cat A Extractive Waste Facilities inert waste	5	DGEG
Nr. Non-Cat A Extractive Waste Facilities not hazardous non inert waste	1	DGEG

In the 2017 EU study "Assessment of Member States' performance regarding the implementation of the Extractive Waste Directive; appraisal of implementation gaps and their root causes; identification of proposals to improve the implementation of the Directive" (Ref 38054 - Amec Foster Wheeler, 2017) only one Cat A Facility was identified. The DGEG list seems to be more recent.

Closed and abandoned extractive waste facilities

The procedures for closure are described in article 13 on the National Law-Decree No. 10/2010 (04/02/2010).

In Portugal the closing plan of a mine is reviewed every 5 years and includes an update of procedures for all the infrastructures. In Portugal company EDM is responsible for the recovery and inventory of abandoned mining waste facilities. DGEG has an inventory with the active closed facilities (not provided during interviews). The active mining waste facilities are monitored by the competent authority. No additional information was provided about operators for every closed EWF. According to DGEG one EWF was in closure phase.

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

The primary legal basic of mineral extraction activity for state-owned minerals in Portugal (metals and industrial minerals) is currently the Law nº54/2015 which is nowadays the legal framework regime for exploration and use of existing geological resources in the country including those located in the national maritime area. For land-owned (or privately owned) minerals extracted in quarries (construction minerals) the guiding principles relating to their exploration and extraction is regulated by the Decree-Law No. 270/2001 which has been amended by the Decree-Law No. 340/2007 of 12th October. Other relevant laws for the permitting chain involve the Decree-law no. 151-B/2013 which establishes the regulatory framework for Environmental Impact Assessments.

The Portuguese national mining authority for state-owned minerals is the DGEG (under the Ministry of Economy) which acts as a 'one-stop' shop for mining permits in the exploration, extraction and post-extraction phases. Therefore, DGEG is the sole institution granting exploration rights and mining concessions to applicants. For obtaining exploration rights, no environmental impact assessment is required. The granting of extraction rights for state-owned minerals is materialized by means of a Government issued contract. Extraction (mining) activities are subject to a mandatory EIA to be evaluated by both National Environmental Institutions - Portuguese Environmental Agency (APA) and the Regional Coordination and Development Commissions (CCDR)- and the Geological Institutions –

DGEG and LNEG (National Laboratory of Energy and Geology), depending on the location, dimension or type of resource to be mined.

For quarries, the licencing depends on the quarry type: for large quarries the licencing authority is DGEG and for small ones the local municipal chamber. However, any rights granting is subject to a location authorization either by ICNF (the National Forestry and Nature Conservancy Authority), the local CCDR or the local municipal chamber. For offshore activities, the rights for exploration and extraction (e.g. seafloor massive sulphides) are granted by DGEG. However after that, applicants must obtain a maritime area use authorization issued by the Sea Minister. For the exploitation phase, an EIA is also mandatory.

There are no fixed legal timeframes for the authorities to make any decisions. In the practice, and if no appeals or rejections take place, exploration permits and mining concessions are awarded on average in 7 and 11 months respectively. The ‘one-stop’ system is the main responsible for these low timeframes. Likewise, this system allows for a friendly resolution of potential disputes: in the last 30 years only negligible court cases (only relevant at local scale) have been identified. This indicates that judicial measures are not a frequent cause of delay of permitting procedures in the NEEI sector in Portugal.

Authorities governing mineral exploration and extraction

The main responsible authority in Portugal for licencing of exploration and extraction of state-owned mineral deposits (metallic and industrial minerals) is the DGEG (Directorate General of Energy and Geology) in the sphere of the Ministry of Environment and Energetic Transition. The DGEG is then responsible for issuing permits for mineral deposits of mineral occurrences with high economic interest due to their scarcity, high specific value or importance for the application in industrial processes. This refers to those deposits existent within national territory and offshore within the exclusive economic Zone, and includes mineral substances used to obtain metals that contain gold, silver, copper, etc., radioactive substances, coal, talc, kaolin, diatomite, quartz, precious and semiprecious stones, the sands, gravel, and other aggregates that occur on the seabed and or subsoil of the territorial sea and continental platform. In Portugal the DGEG acts as a “one stop shop” for state-owned and private owned minerals. Notwithstanding the above, specific competencies governed by different co- authorities regarding health and safety, nature conservation and cultural heritage may also apply, e.g. the Portuguese Environmental Agency (within the Portuguese Ministry of the Environment, Territory Management and Energy) issues the environmental permit (e.g. the approval of an EIA) during the extraction phase (no environmental permit needed for exploration).

For quarries, the licencing authority depends on the quarry type. For quarries class 1 (with a surface equal or larger than 25 ha) and for quarries class 2 (underground quarries or open pit quarries with less than 25 ha, but which exceed any of class 3 quarries’ limits), the licencing authority is the DGEG. For quarries class 3 (quarries with a surface area < 5 ha and a quarry depth < 10 m and a quarry production < 150.000 t/year and quarry Employees < 15 and explosive consumption < 2.000 kg/year) and class 4 (Small quarries which do not exceed any class 3 quarries limits) the licencing authority is the Municipal Chamber.

Legislation for extractive waste management

Portugal’s Legislation for extractive waste management in force are the following:

- **DL 10/10** (https://dre.pt/application/conteudo/617112) of 4th february, Establishes the legal regime for the management of waste from the exploitation of deposits of minerals and masses of minerals, transposing Directive No. 2006/21/EC, of the European Parliament and of the Council, of 15th March, on the management of waste from extractive industries.

- **DL 102-D-2020** (https://dre.pt/application/conteudo/150908012) approves the general regime for waste management, the legal regime for the disposal of waste in landfills and amends the regime for the management of specific waste streams, transposing Directives (EU) 2018/849, 2018/850, 2018/851 and 2018/ 852.
- **Law 52/2021** (https://files.dre.pt/1s/2021/08/15400/0000500106.pdf) - Amendment, by parliamentary consideration, to Decree-Law No. 102-D/2020, of 10 December, which approves the general regime for waste management, the legal regime for the disposal of waste in landfills and amends the regime for waste management specific waste streams, transposing Directives (EU) 2018/849, 2018/850, 2018/851 and 2018/852.

Administrative arrangements for waste management

In Portugal, DGEG has the main responsibility to issue exploration and extraction permits related to metallic ores, industrial and construction minerals, except in the case of very small quarries in which the permit is granted by the local municipal chamber. DGEG is also in charge of verifying and approving the extractive waste management plans proposed by the operators.

- Competent authority in charge of issuing and updating EWM permits is Direção Geral de Energia e Geologia (DGEG). The location of a list of permits was not provided during interviews.
- Competent authority in charge of establishing and updating the financial guarantee is also DGEG.
- Competent authorities in charge of making inspection of the waste facilities are DGEG and IGAMAOT (General Inspection of Agriculture, Sea, Environment and Spatial Planning).
- No information on number of inspections of EWF was provided.
- Competent authority in charge of establishing the external emergency plans for Category "A" installations is National Civil Protection Authority with the support of DGEG and Agência Portuguesa do Ambiente (APA). A location of a list of the external emergency plans was not provided.
- Competent authority in charge of establishing an inventory of closed and abandoned waste facilities is company EDM (https://edm.pt). A location of an inventory of closed and abandoned waste facilities is provided at https://edm.pt/area-ambiental/inventariacao-de-areas-mineiras/.

Romania – Country Fact Sheet

Romania and its minerals industry

Background

Romania has minerals deposits of lignite, pit coal, brown coal, anthracite, gold and silver ore, poly-metallic ore, copper, salt and non-metallic substances. The country is a producer of lignite, steel, aluminium, uranium and industrial minerals (e.g. salt, limestone, dimension stone, lime, cement, gypsum, mineral aggregates, etc.).

Mineral ownership

All mineral resources (also including coal, mineral water, therapeutic muds and geothermal resources) and hydrocarbon resources are public property of the state (Article §1 ML) and are administered by the National Agency for Mineral Resources (NAMR).

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Romania are presented.

Table 1: Romania, Annual mineral production per main commodity (t or Mt)

Commodity	2015	2016	2017	Average	Reference
Metals					
Manganese (t)	40262	4477	8000	17580	BGS
Copper (t)	3600	7300	7400	6100	BGS
Lead (t)	0	0	900	300	BGS
Zinc (t)	3000	1600	800	1800	BGS
Gold (kg)	500	500	500	500	BGS
Silver (kg)	18000	18000	18000	18000	BGS
Industrial Minerals					
Bentonite (Mt)	0,016	0,025	0,028	0,023	Eurostat, USGS (2021), WMD
Gypsum	0,889	0,754	0,814	0,819	BGS, WMD
Feldspar	0,013	0,005	0,005	0,007	BGS, WMD
Kaoline	0,031	0,031	0,031	0,031	BGS, WMD
Lime	1,907	1,951	2,126	1,995	USGS (2021)
Salt (rock salt)	0,050	0,052	0,052	0,051	USGS (2021)
Aggregates					
crushed rock (Mt)	34,50	34,00	30,00	32,83	UEPG
sand & gravel (Mt)	55,50	53,50	60,00	56,33	UEPG
Dimension stone (Mt)	4,552	2,619	2,373	3,181	Eurostat Prodcom
Energy minerals					
Coal (Mt)	1,419	1,069	0,784	1,091	BGS (2020)
Lignite (Mt)	25,425	22,157	25,232	24,271	BGS (2020)

Table 2: Romania, Total number of extraction sites per main commodity

Number of extraction sites	2015	2016	2017	Reference
Metals				
Manganese		*By-product*		Euromines
Copper	ND*	ND	2	Euromines
Lead		*By-product*		Euromines
Zinc		*By-product*		Euromines
Gold		*By-product*		Euromines
Silver		*By-product*		Euromines
Ind Minerals				
Bentonite	ND	ND	ND	
Gypsum	ND	ND	ND	
Feldspar	ND	ND	ND	
Kaoline	ND	ND	ND	
Lime	ND	ND	ND	
Salt (rock salt)	ND	ND	ND	
Aggregates	1100	1115	1120	UEPG
crushed rock				
sand & gravel				
Dimension stones	4	4	4	NAMR
Energy minerals	ND	ND	ND	

**ND No data available or provided*

In Romania, information referring to polymetallic and radioactive ores is classified as confidential by provisions of the National Mining Law. According to the energy strategy of Romania for 2016-2030, finalized in December 2016, the oil production will slowly decline during 2030-2050.

More information on individual production data of the principal mines and quarries in Romania is provided in Annexes C to I.

Extractive waste generation 2015-2017

In the next tables the estimation of extractive waste generation by metallic mines and total industrial minerals in Romania is presented.

Table 3: Romania, estimation of extractive waste generated by metallic mines (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Rosia Poieni	Cu	O	40.000	-	209	2.750.000	2.062.500	4.800.000	2.710.785
Tulcea – Alumina Refinery	Al		448.154	-	-	941.123	-	941.123	492.969
Manaila Polymetallic Mine	Cu	O&U	480	n.d.	0	12.333	18.500	18.500	11.854

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4: Estimation of total industrial minerals excavation and waste in Romania

Romania (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Bentonite	0,019	0,027	0,034		0,019	0,000	0,046
Diatomite							
Feldspar	0,013	0,005	0,005	0,008	0,008	0,000	0,015
Gypsum	0,889	0,754	0,814	0,819	0,573	0,000	1,392
Kaolin	0,031	0,031	0,031	0,031	0,217	0,124	0,372
Lime	1,907	1,951	2,126	1,995	0,997	0,000	2,992
Salt[a]	0,050	0,052	0,052	0,051	N/A	0,005	0,056

a Rock, brines, marine
b Rock = Average Stripping Ratio * Average Production
c Total Excavated Material = Rock + Average Production + Tailings
d Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Definition from EW Directive was translated in Romanian Gov Decision 856/2008 as is written in the EW Directive.
In Romania, 'treatment' of mineral resources is not interpreted to include the combustion of energy minerals for the production of electricity/heat/energy.

Classification of Extractive Waste

No list of inert waste has been established in Romania. Currently, the extractive waste is classified in compliance with Government Decision No 856/2002 on the records of waste management and approving the list of waste, including hazardous waste, as amended. It was prepared in compliance with Decision 532/2000/EC replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste.

All criteria for extractive waste from EW Directive were translated in Gov Decision 856/2008 as is written in the EW Directive.

Classification of Chemical Reagents applied in extractive sector

In Romania chemical reagents are used for collectors, frothers, modifiers and depressants.

Risks arising from the processing of minerals with chemical agents are in Romania evaluated in the EIA. For the use of a specific chemical agent the REACH Registration (or exemption from Registration) is required.

Re-use and placing back of extractive waste material

Available information on reuse of extractive waste is provided in following table.

Table 5: Romania, Reuse of extractive waste for placing back into excavation voids (t)

Property Name	Primary Commodity	Mine Type[a]	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management[c]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Rosia Poieni	Cu	O	2.750.000	2.062.500	4.800.000	2.710.785	no operation		EWMP. The tailings will be deposited as slurry via pipeline to the TMF. Only waste-rock will be used as a material for filling excavation voids
Manaila Polymetallic Mine	Cu	O&U	12.333	18.500	18.500	11.854	no operation		

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

Waste management plans shall be approved in compliance with the provisions of Joint Order No 2042/2934/180 of 22 November 2010 of the Minister of the Environment and Forests, the Minister of the Economy, Trade and Business Environment, and the President of the National Agency for Mineral Resources on the approval procedure for the management plan for waste from extractive industries and the rules on its contents (Joint Order No 2024/2934/180), Article 4:

- Paragraph (6) "The National Agency for Mineral Resources shall reanalyse the documentation and shall approve or reject the management plan for waste from the extractive industry within a maximum of 30 calendar days from the submission of the amendments."
- Paragraph (8) "The management plan for waste from the extractive industry, as endorsed by the National Agency for Mineral Resources, shall be submitted for approval by the operator/holder, within 10 calendar days from its endorsement to the competent authority for environmental protection within whose jurisdiction the waste installation is located."
- Paragraph (9) "The management plan for waste from the extractive industry shall be approved by the competent authority for environmental protection within a maximum of 30 calendar days from the submission of the documentation.

The approval procedure for the management plan for waste from extractive industries is regulated by Joint Order No 2024/2934/180. The management plan for waste from the extractive industry shall be prepared together with the feasibility study on the mining activity, as an annex thereto.

The management plan for waste from the extractive industry shall be submitted by the operator/holder to the territorial inspection departments of ANRM, which shall analyse it and draw up a findings report. The findings report, together with the management plan, shall be submitted by the operator/holder to ANRM for endorsement, together with the documents referred to in Article

20(1) of Mining Law No 85/2003, as amended. If the documentation submitted does not meet the technical requirements for endorsement, the central structures of ANRM shall require the activity operator/holder to amend it.
The central structures of ANRM shall reanalyse the documentation and shall approve or reject the management plan.

The management plan, as endorsed by the central structures of ANRM, shall be submitted for approval by the operator/holder to the competent authority for environmental protection within whose jurisdiction the waste installation is located. If the documentation prepared does not comply with the provisions of Chapter III of Government Decision No 856/2008, the competent authority for environmental protection shall require the activity operator/holder to amend it. If the competent authority for environmental protection requests the activity operator/holder to amend the documentation, the operator/holder shall resume the ANRM endorsement procedure. The competent authority for environmental protection shall reanalyse the documentation and shall approve or reject the management plan for waste from the extractive industry.

In compliance with the provisions of Article 10(3) of GD No 856/2008, the waste management plan shall be revised every 5 years and shall be modified accordingly if there are substantial changes in the operation of the waste installation or in the characteristics of the stored waste.

Financial guarantees

Until 6 March 2014, the financial guarantees for the extractive activities were established in compliance with the provisions of Order No 58/19 of 2004, approving the technical instructions on the implementation and monitoring of the measures laid down in the compliance programme, the environmental restoration plan and the technical project, and the regulation of the operation with the financial guarantee for the restoration of the environment affected by mining activities, as amended.

On 6 March 2014, Joint Order No 202/2881/2348 of 4 December 2013 approving the technical instructions on the implementation and monitoring of the measures laid down in the environmental restoration plan, in the extractive waste management plan and in the environmental restoration technical project, as well as the operation with the financial guarantee for the restoration of the environment affected by mining activities entered into force, supplementing the regulatory framework in the field of financial guarantees related to extractive activities, in compliance with the provisions of Directive 2006/21/EC and Decision 2009/335/EC on technical guidelines for the establishment of the financial guarantee in accordance with Directive 2006/21/EC of the European Parliament and of the Council concerning the management of waste from extractive industries.

Thus, the financial guarantee related to the environmental restoration, including for extractive waste management installations, shall meet the following conditions, as provided for in Articles 3 and 4 of Joint Order No 202/2881/2348 of 4 December 2013:

- the value of the financial guarantee for the restoration of the environment should be sufficient to cover all works related to the restoration of the environment, greening and after-closure monitoring in any phase of the mining project, including after the closing down of the activities, during the after-closure monitoring period;
- the financial guarantee must be immediately available, to enable covering any greening and environmental restoration costs;
- it must take into consideration the potential environmental impact of the mining activities, including of the extractive waste management installation, particularly with regard to the category of the waste-generating mining activity, the characteristics of the waste and the future use of the rehabilitated land;

- it must take into consideration the closure, greening, environmental rehabilitation and after-closure costs included in the general estimate, which shall be calculated based on the prices practiced at that date on the market for each category of works included in the general estimate by certified natural or legal persons having the appropriate qualifications and experience as required by the complexity of such works.

The financial guarantee may be established in the form of a bank deposit, a bank letter of guarantee and/or in the form of an insurance policy concluded in favor of the holder with a recognized insurer.

Pursuant to Article 2 of Joint Order No 202/2881/2348 of 4 December 2013, the financial guarantee for the restoration of the environment affected by extractive activities may be established as follows:

- in full, if the holder commits to this establishment method, prior to the issuance of the mining activities commence authorization by the relevant authority competent to enforce the provisions of Mining Law No 85/2003 (ANRM), and the value of such guarantee is updated regularly, depending on the performance of the mining activities provided for in the development plan;
- for the first year, prior to the issuance of the mining activities commence authorization by ANRM, and for the subsequent years, prior to the issuance of the annual endorsement for the exploration or operation works.

Emergency preparedness

The drawing up of external emergency plans by the county inspectorates for emergency situations, in compliance with the provisions of Article 16 of GD No 856/2008, is considered essential for limiting the adverse effects on human health and/or the environment.

Table 6 presents the permit for the 2 Romanian Cat A EWF.

Table 6: emergency plans Cat A Facilities

Name operator Cat A facilities Romania	NACE code	Env Permit reference	Type of Cat A EWF
SCSINAROM Mining Group, working point Ciocanesti Municipality, Oita Village, Suceava County	3822	No 272/6 June 2012, valid until 6 June 2022	hazardous waste management installation, NOT SEVESO
National Uranium Company SA Feldioara Branch, Feldioara Village, Number 1, Brasov County	721	No 188/26 June 2012, valid until 26 June 2022	hazardous waste management installation, SEVESO

Latest inventory/inspection(visual) was done in June- September 2017 by a joint inter-ministerial commission(Local EPA, NAMR local branches, CONVERSMIN branches, Civil Protection, Environmental Guard, the results of the visual inspections carried out on site between June 12, 2017 - September 12, 2017 are presented in a report.
An executive summary report in Romanian language is available through web link http://www.economie.gov.ro/images/resurse-minerale/Raport%20Halde%20Iazuri%2012%20sept%202017.pdf.

The aim of the above mentioned report was to present the inventory of the industrial waste storage facilities on the Romanian territory , their general status bases on the field observations and to identify/propose the actions required including a unique database for EW facilities management, risk assessment/ expert evaluation for potentially hazardous facilities, and some immediate mitigation measures to be implemented in case of some EW facilities in order to increase the safety operation of those facilities to ensure compliance with the environmental standards and to minimize the potential risk for nearby communities.

The report shows that there are 13 counties out of 41 that do not have industrial waste or tailings storage facilities on their territory and 29 counties that have submitted the requested reports and appendices. About 108 tailings management facilities and 1101 waste sites / industrial storage facilities were inventoried.

Production/Waste Reporting

Companies report annually to the NAMR. The Ministry of Environment sends a report triennially to the Permanent Representation of Romania to the EU in Brussels. The Permanent Representation of Romania forwards the triennial reports to the European Commission. All steps of the reporting chain are compulsory.

The entity responsible for concessions (mining licence) and EW facilities permitting are the NAMR and Ministry of Environment.

For all mining concessions and the exploration permits the Romanian state is co-owner of all geological (resources & reserves) information with the mining operator. Most of the operators are private entities with the exception of one Copper mine and few state-owned coal mines.

There is no active mining projects remaining in the uranium extractive sector. The National Uranium Company Suceava Branch – Crucea mining site is under reorganization process.

In order to get access to the information required clearance is needed from both the State (NAMR) and the operators (concession owners). Based on the information provided by the representatives of Ministry of Environment, NEPA, NAMR Min of Economy and Min of Energy there is no centralised database for extractive waste streams, the only available information is within/contained by the EWMPs.

EWMPs must be reviewed and re-submitted to the NAMR and the Ministry of Environment/National EPA/ Local EPA at least every 5 years.
Reports of all activities including progress against the EWMPs must be submitted to the NAMR annually. The Ministry of Environment/NAMR must submit a report to the European Commission every 3 years as per the EWD.

There are two completely separate reporting lines. Companies submit waste figures according to the Waste Codes directly to the national statistics office, which then submits aggregated figures to Eurostat. These waste codes do not split out 'extractive waste' – only waste 'from the mining & quarrying sector'.
Meanwhile, data on 'extractive waste' exists within the EWMPs and Progress Reports held and processed, by the Ministry of Environment/National EPA and NAMR .

Production data is reported by commodity and by county (also to the national statistics office).
Data on 'extractive waste' exists within the EWMPs and the Progress Reports, which are held and processed, by the Ministry of Environment/National EPA and NAMR. Final statistics are reported once only to the European Commission (also production figures to BSG and USGS).

Extractive waste facilities

Category A and non-Category A facilities

In the reporting period 2014-2017 in Romania 96 extractive waste installations were operational, for which environmental permits have been issued in compliance with the provisions of Directive 2006/21. The documentation whereby the economic operator applies for the issuance/revision of the environmental permit also mentions how the financial guarantee or an equivalent thereof was established, in compliance with the provisions of Articles 50 to 53.

Out of the 78 settling ponds found in the records of the Settling Pond Supervisory Commission in the Mining Sector, operating within the Ministry of Economy, 12 ponds are authorized and operational, and 66 ponds are in the closing phase.
Out of these 66 settling ponds, 28 were actually closed and for them monitoring programmes have been approved and are in progress. The remaining 38 ponds are classified into two groups, as follows: 20 were in conservation, and for 18 ponds, closing works were in progress.

In the reporting period, 2011-2014, the closing and "greening" works for 8 settling ponds were completed.
As per the data provided by GNM, between 1 May 2014 and 30 April 2017, 69 installations have been identified as closed and regularly monitored.

Table 7 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Romania.

Table 7: Romania, Overview EWF & Cat A Facilities from 2015 to 2017

EWF Romania	Number of EWF	Reference
Category A total	2	GNM
Non-Cat A total	94	GNM
Non-Cat A: inert waste	82	GNM
Non-Cat A: non-hazardous non-inert waste	12	GNM

The Category A facilities are operating installations of metallic mineral operations with a permit satisfying EWD.

Closed and abandoned extractive waste facilities

To meet the relevant environmental requirements provided for by the national legislation, after the closure of a waste installation, the operator has the obligation to check the physical and chemical stability of the installation and to minimise any adverse effect on the environment, in particular with respect to surface and ground water, by ensuring that:

- all the structures pertaining to the installation are monitored and conserved, with control and measuring apparatus always ready for use;
- the water management installations are maintained operational.

The Settling Pond Supervisory Commission in the Mining Sector, operating within MECT, through its specialised operator CONVERSMIN S.A. Bucharest, has prepared and regularly updates the inventory of mining waste installations which have been closed and which are likely to have a serious negative impact on the environment.

The inventory of the waste installations which have been closed was made public prior to 1 May 2012.

For every EWF under the EWD, an 'operator' is clearly identified until Closure is approved. Every closed EWF has a dedicated 'operator'. For the state-owned extractive facilities the competent authority is also the 'operator'.

According with CONVERSMIN reports there are in total 556 mining sites in various stages of rehabilitation and closure as follows:

- for 214 sites closure and rehabilitation program is finalized.
- for 91 sites closure and rehabilitation program is ongoing
- for 251 sites closure and rehabilitation program has not been started from various reasons mostly due to absence of required funds.

The above mentioned information is available at http://www.conversmin.ro/stadiu.html, presenting the status of overall mine closure and rehabilitation program approved through above mentioned governmental decisions. Very limited information is available on rehabilitation and closure of the oil & gas extractive waste facilities.

Inventories of closed and abandoned waste facilities are avilable via web pages:
2012 inventory:
http://www.economie.gov.ro/images/legislatie/Resurse%20Minerale/Inventar_Halde_iulie_2012.pdf and
http://www.economie.gov.ro/images/legislatie/Resurse%20Minerale/Inventar_Iazuri_de_Decantare_iulie_2012.pdf
2016 inventory:
http://www.economie.gov.ro/images/resurse-minerale/Lista%20obiectivelor%20miniere.pdf
2017 inventory:
http://www.economie.gov.ro/images/resurse-minerale/Raport%20Halde%20Iazuri%2012%20sept%202017.pdf

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

The mining activities and the management of mineral resources are regulated by the Mining Law no. 85/2003, whose provisions are detailed by the Norms of application of the Mining Law and technical instructions on specific problems. The Romanian authorization system for permits/licenses approving non-energy mineral developments is of a multi-authorization nature, i.e. up to 6 permits, licenses or approvals are necessary so that exploration or extraction works can be conducted.

Prospecting permits and exploration licenses are issued by the NAMR and up to 4 co-authorities might be involved in the process: the National Agency for Environment Protection (NAEP) approves the environmental rehabilitation plan and participates in the environmental monitoring during the mining and post-mining stages, the National Company Romanian Waters is involved when the mining works are located in the river beds and terraces below the hydrostatic level, the Ministry of Culture is responsible for any archaeological discharge, and the Ministry of Finance is involved in setting the level of taxation. The legal interval for the issuance of a prospecting permit is 30 days. Exploration licenses are granted within 10 months from the submission of the written request.

Extraction licenses are also granted by the NAMR and between 6 and 9 co-authorities may be involved in the process. These include the NAEP, the National Company Romanian Waters, the Ministry of Finance, the Ministry of Economy and the Ministry of Environment (the Minister of Finance, the Minister of Economy and the Minister of Environment, three persons, need to sign the Government

Decisions that approve the extraction licenses so that they become valid), the Ministry of Culture (at times the Minister of Culture's signature is needed too), the Ministry of Justice (sometimes the signature of the Justice Minister is also required to approve the government decision) and the local public administration (in cases when the transport of the extracted material causes degradation to roads and buildings). Environmental permits (both for exploration and extraction) are granted within 5½ months.

The permitting success rate for exploration is high. If exploration licenses requested by investors are considered (as opposed to exploration licenses tendered by the NAMR, which may not match the interest of investors), the success rate is close to 100%, as the licenses only require the signature of the President of the NAMR. In the case of extraction licenses, the approval needs the official signatures from 6 public entities: NAMR, General Secretariat of the Government, Ministry of Environment, Ministry of Economy, Ministry of Finance and Ministry of Justice. This process is very slow. If one of the official persons who signed the approval is removed from the official position in the meantime, the list of signatures must be modified and signed again. Because of this, in the period 2013-2015 there was only one tender for extraction and that was initiated by NAMR. All extraction licenses in the period 2013-2015 were negotiated directly with the titleholders of exploration licenses who had finished their programmes and had the right to get the extraction license. On the NAMR website, in the case of solid non-energetic substances, there are 304 approved licenses and 361 licenses waiting for approval. There are extraction licenses issued several years ago that have not yet been approved. Many extraction licenses approved by NAMR are waiting for Government approval.

In order to obtain mining concessions (extraction permits), the extraction license needs the official signatures from 7 public entities: the NAMR (the main mining authority), the General Secretariat of the Government, the Ministry of Environment, the Ministry of Economy, the Ministry of Transport, the Ministry of Finance and the Ministry of Justice. This process is very slow. And, furthermore, if one of the official persons who signed the approval is removed from the official position, the list of signatures must be modified and signed again. As a result of this inefficient permitting process, in Romania there are 361 licenses waiting for approval, many issued years ago.

In case of mineral resources the status (active/ under approval) exploitation permits, exploration & exploitation license a is presented on the NAMR page http://www.namr.ro/resurse-minerale/licentepermise-active/. The information is structured on type of license: permits, exploration and exploitation, on mineral substances (in total 68 minerals and 10 licenses for CO2, mineral and geothermal water,) and also the number of licenses issued for every county. The spreadsheet includes the name of perimeter, type of mineral resources, location, county, title holder including contact details. Similar information including maps with approved licenses/perimeters are available on NAMR page in the oil& gas section http://www.namr.ro/resurse-de-petrol/acorduri-petroliere/.

Competent authorities involved with extractive waste management

The National Agency for Mineral Resources- CO2 Storage and Environmental Protection Department and Ministry of Environment is in charge of:

- verifying and approving the extractive waste management plans proposed by the operators;
- issuing and updating EWM permits
- establishing and updating the financial guarantee

Competent authority(ies) in charge of making inspection of the waste facilities are National Agency for Mineral Resources and Ministry of Environment - National Environmental Guard. For facilities closed by government decree between 1997 and 2008, a different state-owned enterprise called CONEVRSMIN, that reports to the Ministry of Economy, is responsible.

Local Civil Protection Agencies are in charge of establishing the external emergency plans for Category A installations and managing/providing the list of the external emergency plans.

Competent authority(ies) in charge of establishing an inventory of closed and abandoned waste facilities are:

- Ministry of Economy is in charge for rehabilitation and closure, including the state-owned historical mines through one entity: CONVERSMIN. This entity acts on behalf of Ministry of Economy for closure and rehabilitation: organizing bidding processes, project management and inspections of rehabilitation and closure works. There were 14 Government Decisions (13 GD before 2008 and 1 post 2008) for closure of different types of mining sites published and implemented since 1998.
- For Uranium facilities, the same state-owned enterprise CONVERSMIN is responsible and the Ministry of Economy through National Company Metale Rare - is the competent authority.

Slovakia – Country Fact Sheet

Slovakia and its minerals industry

Background

Even though Slovakia is known for its metal mining tradition, currently metal mining activities are reduced to only 1 ore deposit (gold and silver) under extraction. The mineral deposits which closed operations after the 1980s include 9 antimonite deposits with previous active mining, 9 deposits of iron ore, 10 of copper ore, 1 of mercury, 4 of base metals, 1 of tungsten ore, and 12 deposits of gold and silver ores. The extraction of non-metallic deposits in Slovakia is well developed, and it encompasses 231 deposits, 28 deposits with attenuated mining and 31 deposits in the stage of opening.

Mineral ownership

According to the Mining Law No. 44/1988 Coll. on mineral protection and exploitation as amended by regulations, minerals are divided into 'reserved' and 'non-reserved'. Natural or artificial (anthropogenic) accumulations of minerals form mineral deposits. Deposits of 'reserved minerals' (reserved deposits), together with natural rock structures and underground spaces, suitable for gases and liquids storage and the use of geothermal energy represent the state´s mineral wealth. According to the Article 4 of the Slovak Constitution, mineral wealth, underground water, natural medicinal springs, and waterways are in the ownership of the Slovak Republic, i.e. are state-owned.

Production and Waste generation

Production data

Next tables present the annual production of main commodities and number of extraction sites in Slovakia.

Table 1: Slovakia, Annual mineral production per main commodity (Mt, t and Mm^3)

Commodity	2015	2016	2017	Average	Reference
Metallic minerals					
Siver (kg)	532	466	447	482	BGS
Gold (kg)	603	466	447	505	BGS
Aggregates					
Sand and gravel	10,50	9,40	10,30	10,07	UEPG 2020
Crushed Rock	18,30	15,60	17,60	17,17	UEPG 2020
Industrial Minerals					
Baryte	0,020	0,025	0,016	0,020	BGS, USGS (2021)
Bentonite	0,205	0,158	0,226	0,196	BGS
Dolomite	1,630	1,715	no data	-	SGIDT (2018)
Feldspar	0,004	0,008	0,016	0,009	BGS, USGS (2021)
Gypsum, incl. anhydrite	0,067	0,053	0,046	0,055	BGS, USGS (2021), WMD
Kaoline	0,006	0,011	0,021	0,013	BGS, WMD
Magnesite, Mine production	0,773	0,598	no data	-	SGIDT (2018)
Perlite	0,025	0,019	0,048	0,031	BGS, USGS (2021), WMD
Talc	0,001	0,007	0,014	0,007	BGS

Dimension - Ornamental Stones (t)					
Dimensione stone (dolomite) (Mt)	0,819	0,827	0,844	0,830	Eurostat Prodcom, USGS (2021)
Energy Minerals					
Lignite	1,733	1,817	1,675	1,742	BGS (2020)
Oil	0,010	0,010	0,010	0,010	BGS (2020)
Gas (Mm3)	104	87	88	93	
Ceramic clays	0,023	0,011			SGIDS (2018)

Table 2: Slovakia, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Reference
Metallic minerals				
Silver	ND	ND	1	Euromines
Gold	ND	ND	1	Euromines
Aggregates	270	260	270	UEPG 2020
Industrial Minerals				
Baryte	1	2	ND	SGIDT (2018)
Bentonite	10	11	ND	SGIDT (2018)
Dolomite	9	9	ND	SGIDT (2018)
Feldspar	1	1	ND	SGIDT (2018)
Gypsum, incl. anhydrite	1	2	ND	SGIDT (2018)
Kaoline	1	1	ND	SGIDT (2018)
Magnesite, Mine production	3	4	ND	SGIDT (2018)
Perlite	1	2	ND	SGIDT (2018)
Talc	1	1	ND	SGIDT (2018)
Energy Minerals				
Coal	8	8	7	CGS (2019
Lignite	9	10	10	CGS (2019)
Dimension stones	ND	ND	ND	
Clays	4	3		SGIDS (2018)

ND No Data available or provided

Extractive waste generation 2015-2017

Table 3 & Table 4 present estimations of extractive waste generation according to methodology of described in the report, §2.2 and Annex L.

Table 3: Slovakia, Estimated extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Kremnica mine	Au	U	2	Ag	6	593.333	296.667	890.000	593.325

ND: no data available / provided
a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4: Estimation of total minerals excavation and waste in Slovakia (Mt)

Slovakia (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[b]	Tailings from beneficiation[c]	Total excavated material[d]
Baryte	0,020	0,025	0,016	0,020	0,022	0,004	0,047
Bentonite	0,205	0,158	0,226	0,196	0,137	0,000	0,334
Diatomite							
Feldspar	0,004	0,008	0,016	0,009	0,009	0,000	0,019
Gypsum[a]	0,067	0,053	0,046	0,055	0,039	0,000	0,094
Kaolin	0,006	0,011	0,021	0,013	0,088	0,051	0,152
Magnesite	0,773	0,598	N/A	0,686	0,686	0,411	1,782
Perlite	0,025	0,019	0,048	0,031	0,015	0,005	0,051
Talc	0,001	0,007	0,014	0,007	0,007	0,000	0,015

a incl. Anhydrite
b Rock = Average Stripping Ratio * Average Production
c Total Excavated Material = Rock + Average Production + Tailings
d Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Waste legislation in Slovakia is based on EU legislation. The Manual No. 1/8 refers the General requirements for the implementation of Directive 2006/21/EC in the Slovak Republic.

Definitions are provided in the Government regulation on:

- Act No. 514/2008 Coll., on the management of waste from the mining industry and on amendments and additions to certain acts.
- Decree No. 255/2010 Coll. that implements the Act on the Management of Waste from the Mining Industry and on amendments and additions to certain acts
- Supportive Measures of the Ministry of the Environment of the Slovak Republic and the Ministry of Economy of the Slovak Republic for smooth Implementation of the Directive.

Classification of Extractive Waste

According to Section 2 of Implementing Decree of the Ministry of the Environment No 255/2010 implementing the Act on the Management of Waste from Extractive Industries and Amending Certain Acts, as Amended, extractive waste is considered inert if it meets the criteria defined by a special regulation (Commission Decision 2009/359/EC). The content of substances in the waste that are potentially harmful to the environment or human health is considered sufficiently low to be of insignificant human and ecological risk provided that threshold values for contamination, national natural background levels, and soil contamination indicators and norms established for assessments of an undertaking's environmental protection obligations as part of its privatisation project are not exceeded.

Annex 1 to Implementing Decree No 255/2010 lists inert extractive waste for which no specific testing is required.

List of inert extractive waste for which no specific testing is required

- Waste from the extraction of reserved minerals
  - Extractive waste from the extraction of magnesite.
  - Extractive waste from the extraction of diatomite, glassmaking and foundry sands and bentonite.

- Extractive waste from the extraction of granite, granodiorite, diorite, gabbro, volcanic basalt (diabase), serpentinite, dolomite and limestone, if they can be extracted as blocks and polished, and travertine.
- Extractive waste from the extraction of halloysite, kaolin, ceramic and refractory clays and claystone, perlite and zeolite.
- Extractive waste from the extraction of limestone, dolomite, marl, basalt and alkali basalt – basanite, if these minerals are suitable for chemical and technological processing or smelting.
- Extractive waste composed of rock from layers of coal and lignite.

- Waste from the extraction of unreserved minerals
  - Extractive waste from the extraction of building stone, including stone for coarse stonework.
  - Extractive waste from the extraction of aggregates and sand, including mortar sand.
  - Extractive waste from the extraction of raw materials for bricks.
  - Extractive waste from the extraction of cement additives.
  - Extractive waste from the extraction of ceramic additives.

Classification of Chemical Reagents applied in extractive sector

No information was provided on chemical reagents.

Re-use and placing back of extractive waste material

In Slovakia's metallic mine Kremnica extractive waste is deposited, not placed back into excavation voids (Table 5).

Table 5: Slovakia, reuse of extractive waste for flling excation voids

Property Name	Primary Commodity	Mine Type[a]	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management[c]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Kremnica mine	Au	U	593.333	296.667	890.000	593.325	0	593.325	According to pre-feasibility study (Available here: https://www.sec.gov/Archives/edgar/data/1271199/000120445907001067/exh991.htm) "The principal objectives of the pre-feasibility design for the tailings storage facility (TSF) are to provide storage for all tailings, PR rock, and site water, while ensuring the protection of the regional groundwater and surface waters both during operations and in the long-term (after closure), and to achieve effective reclamation at mine closure." So all the amount of waste will be deposited. Non-reactive (NR) mine waste rock will be used to construct the TSF embankment

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

In the last reporting period (2014 – 2017), 3 EWM plans were submitted and approved.

Permitting procedures EWMP

The extractive waste management plans (EWMP) are included in the environmental permit, which are licensed by the Regional State Administrative Agencies (AVIs). The operator is responsible to check the EWMP in every five years minimum and make a notice of the checking to the supervising authorities (Centre for Economic Development, Transport, and the Environment (ELYs)). If the EWMP contains significant changes, it will require a permit change (AVI).
More detailed information on procedures is given under paragraph administrative arrangements for waste management.

Financial guarantees

Slovakia has well developed legislation dealing with the financial guarantees related to the mine waste storage and treating - Law No. 514/2008 Coll. on the management of waste from extractive industry, including the amendments Nos. 563/2009 Coll., 255/2011 Coll., 180/2013 Coll., 79/2015 Coll., § 14: (1) The operator before and during the operation of the mine waste deposit is obliged to create the financial reserve, which finances will be used for the closing of the waste dump, its further monitoring, recultivation, as well as recultivation of the area influenced by this waste dump. The operator of several waste dumps is obliged to create the financial reserve for each dump separately. (2) The special purpose financial reserve is created annually, being charged to expenditure in the amount of determined proportion of the total cost for the closing of the storage site, monitoring of this storage site after its closure and land recultivation. The amount of the special purpose financial reserve is updated every five years, or at each change of the deposition plan according to § 5, section 9. (3) The calculation of the purpose financial reserve is based on the proposed plan of closure of the storage site, being approved as an integral part of the deposition plan according to § 5. The annual amount of the purpose financial reserve is calculated by the formula: R = CN : Ž, where "R" represents the annual sum for the purpose financial reserve in EUR, "CN" represents suggested investment and operating costs stated in the project, being adjusted by the annual rate of inflation, and "Ž" represents the planned life span of the repository at the beginning of the purpose financial reserve according to this law (514/2008 Coll.). Because the cost calculation is determined by the law, its correctness is guaranteed, and in any moment, it can be checked by independent experts ("the third party").

Emergency preparedness

The Slovak government Handbook 3/8 refers to the Prevention of major accidents in management of waste from mining industries.

Under Act No 514/2008 on the management of waste from extractive industries and amending certain acts, as amended, extractive waste management authorities do not have the option of checking up on the production of external emergency plans. They can only check that operators have provided underlying documentation to produce these plans.

For the reporting period 2014-2017 checks revealed that two operators of Category A facilities provided all the underlying documentation required to produce external emergency plans. In 2015, unscheduled checks covered the implementation of external emergency plans in relevant municipalities (14-15 December 2015, Jelšava, Markušovce).

One operator of a Category A facility (Nižná Slaná) is in insolvency proceedings and has not complied with any of the obligations under Sections 5, 6, 7 and 11 of Act No 514/2008.

Number of EWMP 2015-2017 (approved, rejected, new applications)

In the last reporting period, 3 plans were submitted and approved.

Extractive waste facilities

In Slovakia, for the period 2014-2017 the following installations were reported (table 6).

Table 6: EWF Slovakia

Category	In operation	In operation with permit	In transition	In closure phase	Closed or abandoned
Category A	3	2	-	-	-
Category A - of which SEVESO installations	-	-	-	-	-
Not Category A	106	106	-	1	7
Inert waste	104	104	-	1	7
Non-hazardous, non-inert waste	2	2	-	-	-
Total	**109**	**108**	**-**	**1**	**7**

The three Category A facilities are Jelšava (extractive waste limestone mining), Nižná Slaná (extractive waste iron mining), and Markušovce (extractive waste Barytes mining). The Category A facility Nižná Slaná is in insolvency proceedings and has not complied with any of the obligations under Sections 5, 6, 7 and 11 of Act No 514/2008.

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

The number of co-authorities varies considerably from the case to case. Besides the main authorities, the standpoints also of local authorities are inevitable, encompassing the standpoints of the county and municipality offices (their number changes according to the extent of the territory, covered by the exploration or mining area), as well as all subjects of the nature protection. Next the standpoint of the State Geological Institute of Dionýz Štúr (Division of Geofond) is often requested as well as the standpoint of the holder of the exploration area for other purpose if there is any overlap (if the new one requested is located partly or fully within it). It must be taken into account that the exploration and exploitation could be in conflict also with **interests protected by special regulations**. In such case there is a need to receive permits of a larger number of subjects (total number up to 27):

1) Competent District Environmental Office (nature and landscape protection)
2) Competent District Environmental Office (State Water Management - requested in special cases)
3) Competent County Environmental Office (State Water Management) according to § 28 sect. 2 letter d) of the Law No. 364/2004 Coll. about water and the amendment of the Law No. 372/1990 Coll. on offenses as amended by the later regulations (Water Law)
4) State Geological Institute of Dionýz Štúr, Geofond, Bratislava
5) Competent District Mining Office
6) Ministry of Health of the Slovak Republic - Inspectorate of Spas and Springs, Bratislava
7) Ministry of Defence of the Slovak Republic, Property and Building Management
8) Competent District Land Office
9) Competent Forest Office
10) Competent District Memorials Office
11) Slovak Road Administration, Bratislava
12) Národná diaľničná spoločnosť, a. s. (National Highway Comp.), Bratislava
13) Slovak Railways, Directorate General, Expertise Division, Bratislava

14) Slovak Water Management Company (competent branch)
15) Relevant water supply company
16) Slovak Electricity Transmission System, Bratislava
17) Relevant Slovak Energy Comp.
18) Slovak Telekom, Comp., Bratislava
19) Towercom, a. s., Bratislava
20) Relevant company, which manages telecommunication networks and equipment (e.g.: Orange Slovakia, Comp., Bratislava; Telefónica Slovakia, Ltd., Bratislava; SITEL, Ltd., Košice; eventually others)
21) Eustream, Comp., Bratislava
22) SPP - Distribution, Comp., Bratislava
23) Transpetrol Comp., Bratislava
24) Organization that has already designated mining area (if it is located in suggested exploration area)
25) Organization, registering and protecting the reserved deposit (if it is located in suggested exploration area)
26) The owner of exploration area, who has assigned the exploration area for other purpose (if it is located in suggested exploration area)
27) Municipalities and relevant higher land territorial unit (in the case of the deposit geological survey for radioactíve minerals)

Legislation governing mineral exploration and extraction

The legal framework relevant for permitting procedures comprises mainly the Mining Law (Law No. 44/1988 Coll.[1] with amendments) and the Geological Law (Law No. 569/2007 Coll. with amendments). Other important laws are Law No. 543/2002 Coll. on nature and landscape protection, Law. No. 24/2006 Coll. on the environmental impact assessment, Law No. 39/2013 Coll. on integrated prevention and environmental pollution control, and the Water Law (Law No. 364/2004 Coll.). Competent authorities are the Ministry of Environment of the Slovak Republic, Ministry of Economy of the Slovak Republic, Main Mining Office and the Regional (or District) Mining Offices.

A geological licence is required in Slovakia to conduct geological prospection or exploration for 'reserved minerals' (defined by Mining Law No. 44/1988 Coll.). The licence can be granted to a physical or legal person by the Ministry of Environment. A geological licence is not required for surface prospecting of 'non-reserved minerals' performed by landowners. The authorisation for mining of 'reserved minerals' is conditional upon the granting of a Mining licence and the assignment of the Mining Area—both granted by the competent Regional (District) Mining Office, the relevant Nature Protection Agency statement (including an EIA) and the mandatory approval of the Building Authority. The extraction activities can start after the Regional Mining Office has granted a Mining Activity Permission.

The number of authorities and permits involved in the permitting procedure varies widely for the exploration and extraction of 'reserved minerals' (they are state-owned and include minerals for industrial metals production, magnesite, rock salt, potassium, boron, graphite, barites, gemstones, quartz, limestone, among others), ranging between 1 and 27. For exploration and extraction the competent authorities are the Ministry of Environment and the Regional (District) Mining Office, respectively. Then, besides the main authorities, the standpoints of local authorities must be consulted, encompassing the standpoints of the county and municipality offices (their number changes according to the extent of the territory covered by the exploration or mining area), as well as all subjects of nature protection, the standpoint of the State Geological Institute of Dionýz Štúr (Division of Geofond) and the standpoint of the holder(s) of the exploration area for other purposes. It is necessary to take into account that the exploration and exploitation could be in conflict also with

[1] Coll. is an abbreviation for 'collection of laws' used in Slovakia as each Law must be added and published within a collection.

interests protected by special regulations. In such a case it is necessary to receive permits from a larger number of co-authorities (up to a maximum of 27). In the case of 'non-reserved minerals' (landowned, especially building stone, gravel sands and brick clays) , only the permit by the District Mining Office is required for their extraction.

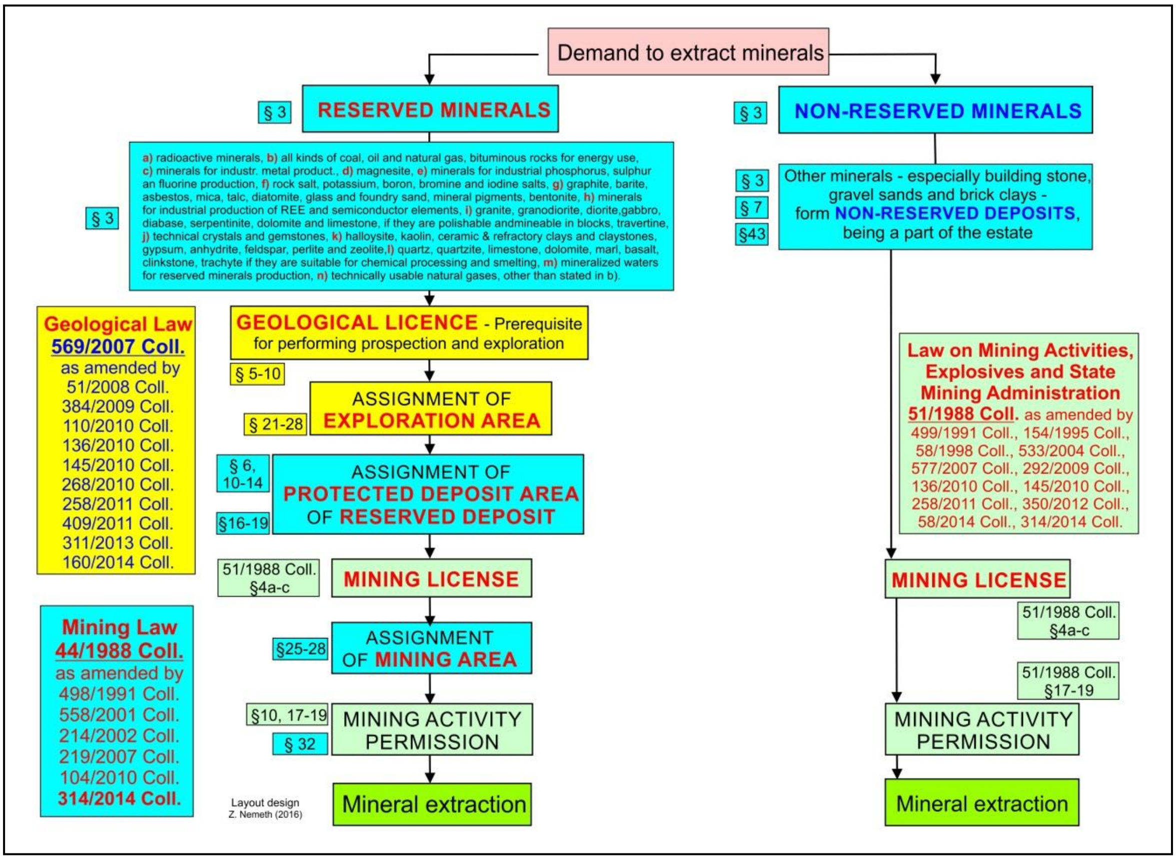
The average duration for the mining authority to make a decision on a permit application (from application date to final decision) is on average between 3 and 6 months for the granting of the geological licence for exploration of 'reserved minerals' and around 2 months for the granting of the Mining Licence. For the extraction of 'non-reserved' minerals, the average duration for granting the Mining Licence is around 2 months. However, the granting of the Mining Activity Permission (necessary to start extracting) is often delayed, as the EIA studies take longer to be approved: the approval of an EIA, subject to many co-authorities, can take several months or even years. In contrast, the IPPC licence is often granted in a period between 2 and 5 months. The main obstacle in obtaining exploration permits is the veto right, frequently applied by the authorities of the village/town and county offices, which renders the application for exploration permits unpredictable. Further, prolongation of the approval procedures for exploration and mining is primarily caused by negative public opinion. 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 grounded on the public interest.

List of reserved minerals:

- radioactive minerals,
- all kinds of coal, oil and natural gas, bituminous rocks for energy use,
- minerals for industrial metal production,
- magnesite,
- minerals for industrial phosphorus, sulphur, and fluorine production,
- rock salt, potassium, boron, bromine and iodine salts,
- graphite, barite, asbestos, mica, talc, diatomite, glass and foundry sand, mineral pigments, bentonite,
- minerals for industrial production of REE and semiconductor elements,
- granite, granodiorite, diorite, gabbro, diabase, serpentinite, dolomite and limestone, if they are polishable and mineable in blocks, travertine,
- technical crystals and gemstones,
- halloysite, kaolin, ceramic and refractory clays and claystones, gypsum, anhydrite, feldspar, perlite and zeolite,
- quartz, quartzite, limestone, dolomite, marl, basalt, clinkstone, trachyte if they are suitable for chemical processing and smelting,
- mineralized waters for reserved minerals production,
- technically usable natural gases, other than stated in b).

Other minerals (i.e. minerals not included in the list of reserved minerals above) are non-reserved, and their deposits belong into category of non-reserved deposits. They are part of the land and belong to owner of the estate.

The Scheme of permitting procedures for exploration and exploitation in Slovakia, is presented in the Figure below.



For exploration of reserved minerals, the main authority is Ministry of Environment of the Slovak Republic (SR).

Timeframes

This section refers to the legal timeframes for the Ministry of Environment of the SR (authority for permitting exploration; Geological Law No. 269/2007 Coll. as amended by later regulations; Law on Administrative Procedure 71/1967 Coll. as amended by later regulations) to take into account the completeness of the documents submitted by the applicant. In most cases applications are missing some items which are additionally requested during the active decision making process on the Ministry of Environment of SR, so as a rule **the permitting process for exploration in the case of reserved minerals lasts between 3 and 6 months**. The deposits of non-reserved minerals are part of the land (§7 of Mining Law), so their exploration by the owner of the land does not require an approval by the Ministry of Environment of SR.

Licensing procedures for exploration and extraction

According to the Geological Law 569/2007 Coll., incl. later amendments, the mineral prospecting (exploration) can be executed on the exploration area only. The allocation of an exploration area to an applicant (physical or legal person possessing the geological license) belongs to competency of the Ministry of Environment of the Slovak Republic. Concerning raw materials, the selected geological works executed on an exploration area encompass the deposit geological survey of (1) reserved minerals, excluding the geological survey performed directly in the exploitation area, (2) natural rock structures and underground spaces for the purpose of stowage, and (3) natural rock structures and underground spaces for the purpose of setting up and operation of the underground gasses and liquids reservoirs.

Administrative arrangements for waste management

Extractive waste management plans and environmental permits

In Slovakia, the Ministry of the Environment is the competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators.
Furthermore, the Mining Inspectors of the Main Mining Office represent competent authorities for permitting, as well as having the on-site inspections of the exploration or extraction equipment. The inspection is comprehensive and detailed, undoubtedly encompassing also the check of the CE marks. The mining authority has a regulatory/supervision right for safety/market surveillance. The related acts: The NR SR Law No. 51/1988 on mining, explosives and the State mining administration as amended with validity from 01. 01, 2015, Law No. 124/2006 Coll. on safety and health protection at work and on change and amendment of several laws.

Inspection of waste facilities

In theory the competent authority in charge of making inspection of the waste facilities is the Ministry of the Environment in Slovakia.

Closed and abandoned waste facilities

In Slovakia, according with the Registry of mining waste facilities, there are 338 closed or abandoned in total.
According with the Registry of mining waste facilities closed pursuant to Act No. 514/2008 Coll., on the management of mining waste, there are 13.

Slovenia – Country Fact Sheet

Slovenia and its minerals industry

Background

Slovenia´s non-energy minerals industry consists of extraction of non-metals, i.e. industrial minerals and aggregates for the construction and the manufacturing industry and other uses. Such minerals include bentonite, chert, quartz sand, calcite, tuff, industrial dolomite, ceramic clay, brick clay, natural stone (limestone, tonalite, other natural stones), raw materials for the lime and cement industry (limestone and marl for industrial purposes), crushed limestone, dolomite, magmatic and metamorphic rocks, gravel and sand, sea salt. No metals are extracted.

Mineral ownership

All mineral resources in Slovenia are a state property and owned by the government, i.e. by the Slovenian state.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Slovenia are presented.

Table 1: Slovenia, Annual mineral production per main commodity (t, Mt, Mm^3)

Commodity	2015	2016	2017	Average	Reference
Aggregates					
Sand and gravel	2,80	1,80	2,10	2,23	UEPG 2020
Crushed Rock	8,30	7,50	8,60	8,13	UEPG 2020
Industrial Minerals					
Bentonite (t)	232	182	147	187,000	BGS, GSS (2018), USGS (2020), WMD
Calcite	0,269	0,256	0,221	0,248	GSS (2018)
Chert	0,021	0,020	0,016	0,019	GSS (2018), USGS (2020)
Dolomite (industrial)	0,173	0,151	0,173	0,165	GSS (2018)
Lime	1,103	1,046	1,174	1,108	GSS (2018), USGS (2020)
Quartz Sand	0,343	0,338	0,359	0,347	GSS (2018)
Raw materials for Cement	1,191	1,149	1,319	1,220	GSS (2018)
Dimension - Ornamental Stones					
Dimension stone (Mt)	0,136	0,136	0,142	0,138	GSS (2018), USGS (2020)
Energy Minerals					
Lignite	3,168	3,349	3,356	3,291	BGS (2020), WMD
Oil	0,000	0,000	0,000	0,000	BGS (2020)
Gas (Mm3)	3	5	8	5	
Clays for ceramic industry	0,202	0,203	0,173	0,195	GSS (2018); USGS (2020)

Table 2: Slovenia, Total number of extraction sites per main commodity

Commodity	2015	2016	2017	Reference
Aggregates	154	138	153	UEPG 2020
Industrial Minerals				
Bentonite (t)	1	1	1	SGIDT (2018)
Calcite	2	1	1	SGIDT (2018)
Chert	1	1	1	SGIDT (2018)
Dolomite (industrial)	1	1	1	SGIDT (2018)
Lime	5	5	5	SGIDT (2018)
Quartz Sand	7	7	7	SGIDT (2018)
Raw materials for Cement	5	4	4	SGIDT (2018)
Energy Minerals				
Coal	8	8	7	CGS (2019
Lignite	1	1	1	Statista website
Dimension stone	30	29	25	GSS (2018)
Clays	9	11	10	GeoZS (2018)

Extractive waste generation 2015-2017

Next table presents estimation of extractive waste generated by industrial mineral production. Estimation was done according to the methodology described in the report, §2.2 and Annex L.

Table 3: Estimation of total industrial minerals excavation and waste in Slovenia (Mt)

Slovenia (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Lime	1,103	1,046	1,174	1,108	0,554	0,000	1,662

a Rock = Average Stripping Ratio * Average Production
b Total Excavated Material = Rock + Average Production + Tailings
c Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

Classification of Extractive Waste

In Slovenia all waste from quarries and open pits (aggregates, industrial minerals) are treated as "non-hazardous waste" that can be used for later remediation of open pits. No list of inert waste according to EWD criteria has been established.

Slovenia has not applied the waiver of the Landfill Directive paragraph 3 of Article 3: "MS may declare at their own option, that the deposit of non-hazardous non-inert mine waste, to be defined by the committee established under Article 17 of this Directive can be exempted from the provisions in Annex I, points 2, 3.1, 3.2 and 3.3 (location screening, multiple barriers, leachate collection)" because all metal mines were closed several decades ago.

The Ministry responsible for environment supported by GeoZS experts prepare and maintain a list and record of ancient or abandoned sites.

Classification of Chemical Reagents applied in extractive sector

No chemical reagents are applied in the extractive sector of Slovenia.

Re-use and placing back of extractive waste material

No information was available or was provided on reuse of extractive waste for filling voids.

Waste management and permitting

Permitting procedures EWMP

In Slovenia, the operator must produce an extractive waste management plan covering measures to minimize, treat, recover, or dispose of extractive waste, having regard to the principle of sustainable development.

Extractive waste management plans must be submitted by the operator as part of the application for an environmental permit. The extractive waste management plan is verified as part of the administrative procedure for obtaining an environmental permit pursuant to the Decree on the management of waste from the extractive industries (Uradni List RS (Official Gazette of the Republic of Slovenia; UL RS) Nos 43/08 and 30/11) http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED4693.

The operator of a facility intended for inert waste or unpolluted soil arising from the exploration, extraction, enrichment and storage of mineral resources and from quarrying must produce an extractive waste management plan as an integral part of the extraction project and the project for the cessation of extraction, in accordance with the act governing extractive industries.

The ministry, ex officio, periodically and at least every three years, checks compliance with the requirements and conditions from the environmental permit, and updates the permit where there are substantial changes in the operation of the facility or to the type or quantity of the extractive waste deposited, where the results of the annual reporting or the results of the findings of inspections require the updating of the environmental permit, and where information exchange on substantial changes in best available techniques requires the updating of the environmental permit.

Financial guarantees

An operator must, for a facility in operation on 1 May 2008, meet all the requirements and conditions for its operation referred to in this [sic] Decree no later than by 1 May 2012, except for the requirements referred to in the first paragraph of Article 14 of the Decree on the management of waste from the extractive industries (UL RS Nos 43/08 and 30/11).

An operator must, prior to the commencement of any operations involving the accumulation or depositing of extractive waste in a facility, submit a financial guarantee to the ministry in the form of a financial deposit, including industry-sponsored mutual guarantee funds, or an equivalent guarantee, in an amount that is sufficient for the ministry and readily available for.

The ministry calculates the size of the financial guarantee based on an assessment of the likely environmental impact of the facility, considering the category of the facility, the characteristics of the extractive waste and the future use of the rehabilitated land, and an assessment of the extent of rehabilitation work after closure of the facility on the land at the extractive waste management site and the land in the area affected by the facility. An independent and suitably qualified third party chosen by the ministry must draw up the assessment of the extent and implementation of rehabilitation work, with the costs of production of the assessment being borne by the operator.

The ministry periodically adjusts the size of the guarantee in accordance with new requirements concerning the extent of any rehabilitation work needed to be carried out on the land affected by the facility, in accordance with the waste management plan.
Where the ministry decides on closure of a facility, it provides the operator with a written statement releasing it from the financial guarantee obligation in relation to all obligations relating to operation of the facility, except for the after-closure obligations.

Bank guarantee is needed for final reclamation of any mine/open pit (the other option is to pay the financial contribution for estimated reclamation annually during the extraction period). The allowance is calculated by the individual mining site, it is estimated by the company itself, and depends of course on the type and extension of the extraction site.

Emergency preparedness

Before putting a facility classified as Category A into service, the operator must draw up and adopt an environmental-accident prevention policy in accordance with the elements set out in Annex 1 to the Decree on the management of waste from the extractive industries (UL RS Nos 43/08 and 30/11).

Extractive waste facilities

There are no extractive waste facilities in Slovenia.
Slovenia does not have any Class A facility.

Legislation for exploration, extraction and extractive waste management

Authorities governing mineral exploration and extraction

In Slovenia the main responsible authority for mining is the Energy Directorate within the national Ministry of Infrastructure. The Energy Directorate competencies include conferring mining rights for exploration and extraction of mineral resources. The inspection of the implementation of the provisions of the Mining Act has to be performed by the Mine Inspector. The Mine Inspector's office has to co-operate in its activities with other inspection offices as well as with expert organisations in mining (Article 85 ML).

The Energy Directorate performs tasks relating to the efficient use of energy and to the provision of renewable sources of energy, energy supply, sources of energy and mining. Its key activities among others include:

- ensuring rational economic management of raw mineral resources and conferring mining rights for exploration and extraction of raw mineral resources.
- management of the energy sector database information system for the needs of the sectoral ministry and elaboration of economic analyses for the energy sector; and
- drawing up legislative and other acts for the energy and mining sectors (Mining Law, National Program of Mineral Resource Management).

In general, the concession agreement (there is no "permit" in Slovenia) cannot be denied if the ownership, which is checked along with the application, is clear and allowed. In Slovenia the state is the owner of all mineral resources, and the local municipality is obliged to give consensus on the extraction area with spatial planning documents. An appeal can be made. Whether the appeal is successful or not is decided by the Constitutional Court which considers complains. Supreme Court has no role in this subject because all appeals are governed by the Constitutional Court.
A part of the Geological Survey of Slovenia is dedicated to tasks and obligations of the Public Mining Service (PMS) in a scope of a public service in national interest (according to the current Mining Act

(ZRud - UL RS 61/10, 62/10-pop., 76/10 in 57/12)), controlled and funded by Ministry in charge of mining (Ministry of Infrastructure, Energy Directorate). PMS provides expert basis in a process of preparation of local spatial plans. Ministry in charge of spatial planning in Slovenia, as well as for the Environment is the Ministry of Environment and Spatial Planning.

Legislation governing mineral exploration and extraction

The primary legal basic of mineral extraction activity is the Slovenian Mining Act No. 56/1999, as amended subsequently (Law 68/2008 Law No. 61/10 62/2010 corr., 76/2010, 57/2012, 111/2013, 14/2014), which defines the conditions for the exploration activities and extraction of minerals. Other important laws are the Environmental Protection Act and the Spatial Planning Act. In Slovenia the competent authority for granting exploration and extraction rights for mineral resources is the Energy Directorate (within the national Ministry of Infrastructure). The local municipalities are an important co-authority as they are responsible for the municipal spatial plans. All areas with a mining concession (or with mining rights) need to be included in the municipal spatial plans and designated as “mineral extraction areas”.

Slovenia´s permitting procedures in general work well. No judgment can be made about exploration permitting procedures since now no “exploration rights” have been granted. Concerning the time duration to obtain a mining concession, it takes on average, about a year. The main problems faced by developers are the time duration during the permitting/licencing procedure, difficulties until the municipality incorporates the mineral extraction area in the respective spatial plan and obtaining the necessary “environmental protection guidelines”. The latter represent a set of measures for the conservation of nature which are prepared by the institution responsible for nature protection.

Slovenia is yet another example of a highly centralized mining permitting structure. The main responsible authority for mining is the Ministry of Infrastructure, Energy Directorate. The Energy Directorate competencies include conferring mining rights for exploration and extraction of raw mineral resources in the whole country.

Other important laws are the Environmental Protection Act and the Spatial Planning Act. The Environmental Protection Act is strategically important in setting long-term directions and goals of the Ministry concerning environmental protection aimed at preventing or mitigating adverse impacts presenting a threat to sustainable development. It constitutes the regulatory framework for the environment in Slovenia. Moreover, the Resolution on the National Environmental Protection Programme brings forward the following four key areas: climate change, nature and biodiversity, quality of life, and waste and industrial pollution. The Spatial Planning Act regulates spatial planning as part of physical planning so that it lays down types of spatial planning document, their content and mutual relations, and procedures for their drafting and adoption. Furthermore, it regulates the provision of utility services to building sites and the setting-up and functioning of a spatial information system. The Spatial Planning Act also transposes into the legislation of the Republic of Slovenia the requirements of Directive 2001/42/EC.

Administrative arrangements for waste management

Every 3 year a waste management report has been submitted by Slovenia’s Ministry of Environment and Spatial Planning to the Commission (2008-2011, 2012-2014, 2015-2017).

Extractive waste management plans and environmental permits

In Slovenia, the Ministry of the Environment and Spatial Planning is the competent authority in charge of verifying and approving the extractive waste management plans proposed by the operators and for issuing and updating EWM permits.

Financial guarantee

In theory the financial guarantee must be sent to the Ministry of the Environment and Spatial Planning in Slovenia.

Inspection of waste facilities

In theory the competent authority in charge of making inspection of the waste facilities is the Ministry of the Environment and Spatial Planning in Slovenia.

Emergency plans

Emergency Plans are not applicable.

Closed and abandoned waste facilities

In theory the competent authority in charge of establishing an inventory of closed and abandoned waste facilities is the Ministry of the Environment and Spatial Planning in Slovenia.

The ministry decides on the commencement of procedures for the closure of a facility and the method and timetable of closure in the environmental permit.

The procedure for the closure of a facility commences when the conditions for closure of the facility stated in the environmental permit have been met, when closure of the facility is requested by the operator, if the ministry finds that the facility no longer meets the conditions under the environmental permit, or if the operator of the facility fails to take the measures it has been ordered to take by the competent inspection body as a result of incorrect waste management. The procedure for the closure of such a facility commences pursuant to a final decision issued by the competent inspection body.

Prior to the closure of the facility, the competent inspection body carries out an inspection of the extractive waste management site; assesses all the reports on the closure of the facility submitted by the operator, certifies that the land adversely affected by the facility has been rehabilitated and issues a report on fulfilment of all the requirements prescribed in relation to the closure of the facility.

Spain – Country Fact Sheet

Spain and its minerals industry

Background

Spain has a long mining tradition, particularly in the production of gold and other metals, and has a large mineral potential. Spain is the only European producer of sodium sulphate and hosts 70 % of the world sepiolite resources; it is was the main fluorspar producer in Europe, the world's fifth largest gypsum producer and first in Europe, and the world's second largest and only European producer of celestine. It also possesses the largest European feldspathic sand reserves for the production of feldspar. Spain is the second largest European producer of nickel, third in tungsten and fourth in copper and zinc.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Spain are presented.

Table 1: Spain, Annual mineral production per main commodity (Mt)

Commodities	2015	2016	2017	Average	Reference
Metals					
Nickel (t)	7.213	0	0	2.404	BGS
Tungsten (t)	835	699	711	748	BGS
Copper (t)	112.690	167.736	198.353	159.593	BGS
Lead (t)	1.598	4.946	3.258	3.267	BGS
Tin (t)	0	7	23	10	BGS
Zinc (t)	49.216	76.342	70.451	65.336	BGS
Gold (kg)	2.128	1.291	1.605	1.675	BGS
Silver (kg)	27.300	17.600	98.600	47.833	BGS
Industrial minerals					
Attapulgite[a]	0,026	0,029	0,059	0,038	BGS, IGME (2017), SMS (2017), USGS (2019)
Bentonite[a]	0,101	0,155	0,178	0,144	BGS, Eurostat Prodcom, IGME (2017), SMS (2017), WMD
Chalk	0,525	0,519	0,483	0,509	BGS
Diatomite	0,692	0,694	0,701	0,696	Eurostat Prodcom, SMS (2017)
Industrial Dolomite	0,048	0,048	0,071	0,055	BGS, IGME (2017), WMD
Feldspar	6,796	6,016	7,404	6,739	IGME (2017), SMS (2017)
Fluorspar	0,558	0,635	0,819	0,671	BGS, IGME (2017), SMS (2017)
Gypsum[b]	0,157	0,163	0,155	0,158	BGS, IGME (2017), SMS (2017)
Kaolin[c]	7,404	8,936	9,545	8,628	BGS, Eurostat Prodcom, WMD, IGME (2017), SMS (2017)
Magnesite	0,392	0,347	0,475	0,405	BGS, Eurostat Prodcom, IGME (2017), SMS (2017)
Potash(total)	0,465	0,584	0,789	0,612	BGS, IGME (2017), SMS (2017), WMD
Quartz	1,709	1,839	ND	-	IGME (2017), SMS (2017)
Rock Salt	1,102	1,136	1,005	1,081	IGME2017; SMS (2017)
Sepiolite[a]	2,437	2,526	2,870	2,611	BGS, IGME (2017), SPM (2017)
Sulphur	1,510	1,455	1,518	1,494	IGME (2017), SMS (2017)
Talc	no production		0,012	-	BGS, Panorma Minero (2017)
Aggregates[d]					
Crushed rock	73,00	72,00	85,00	76,67	UEPG
Sand & gravel	21,00	20,00	25,00	22,00	UEPG

Dimension stones	6,270	5,968	6,159	6,132	IGME (2017),SMS (2015; 2016; 2017)
Coal	3,042	1,832	2,995	2,623	BGS (2020), Panorama Minero (2017
Common Clay	9,107	9,342	9,626	9,358	IGME (2017), SMS (2017), USG (2019)

Table 2: Spain, Total number of extraction sites per main commodity

Number of extraction sites	**2015**	**2016**	**2017**	**Reference**
Metals				
Nickel		By-product		Euromines
Tungsten			2	Euromines
Copper			5	Euromines
Lead		By-product		Euromines
Tin			1	Euromines
Zinc		By-product		Euromines
Gold			1	Euromines
Silver		By-product		Euromines
Industrial minerals				0
Attapulgite[a]	12	11	11	Panorama Minero (2017), SMS (2017)
Bentonite[a]	12	11	11	Panorama Minero (2017), SMS (2017)
Chalk	6	6	6	
Diatomite	3	3	ND	Panorama Minero (2017), SMS (2017)
Industrial Dolomite	54	56	54	Panorama Minero (2017, SMS (2017)
Feldspar	6	8	8	Panorama Minero (2017), SMS (2017)
Fluorspar	6	7	6	Panorama Minero (2017), SMS (2017)
Gypsum[b]	88	89	92	Panorama Minero (2017), SMS (2017)
Kaolin[c]	ND	ND	8	SMS (2017)
Magnesite	3	3	3	Panorama Minero (2017)
Potash(total)	2	2	ND	Panorama Minero (2017)
Quartz	18	19	20	Panorama Minero (2017)
Rock Salt	6	6	6	Panorama Minero (2017)
Sepiolite[a]	12	11	11	Panorama Minero (2017)
Sulphur	4	4	2	Panorama Minero (2017)
Talc	No production		1	Panorama Minero (2017)
Aggregates[d]	1830	1795	1874	UEPG
Dimension stones	550	527	492	SMS (2015,2016,2017)
Coal	ND	ND	ND	
Clay	199	197	198	IGME (2017), SMS (2017)

ND: no data available / provided
a total number of extraction sites for attapulgite, bentonite & sepiolite
b incl. anhydrite
c China clay, not calcined / washed
d aggregates: crushed rocks an sand & gravel

More information on individual production data of the principal mines and quarries in Spain is provided in Annexes C to I.

Extractive waste generation 2015-2017

Next tables present estimations of the extractive waste generated by metallic mines and total industrial minerals production. The estimations were derived from production data and material flows of mines and quarries per commodity. The methodology applied is described in the report, §2.2 and Annex L.

Table 3: Spain, Estimated extractive waste per metallic (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Las Cruces	Cu	O	72.445	Zn,Pb,Ag,Au	58.142	1.552272	4.656.816	6.209.088	1.421.685
Los Santos	W	O	99.603	-	0	522.402	1.567.206	2.089.608	422.799
MATSA Aguas Tenidas, Magdalena, Sotiel	Cu	U	289.000	Zn, Pb	161.333	4.303.333	2.151.667	6.455.000	3.853.000
Minera del Duero (Barruecopardo)	W	O	260.000	-	0	1.363.635	4.090.905	5.454.541	1.103.635
Orovalle (El Valle-Boinás/Carlés ("EVBC") and former Kinbauri mine)	Au	U	2	(Ag, Mb)	54	504.451	252.226	756.677	504.395
Penouta zone B (reprocessing old tailings)	Sn	-	31	(Tn+Nb)	20	40.000	0	40.000	39.949
Rio Tinto	Cu	O	21.055	Cu, Ag	135.386	5.266.667	15.800.000	21.066.667	5.110.226
San Cipria	Al	-	1.500.000	-	0	2.500.000	0	2.500.000	1.000.000

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)
c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Table 4: Estimation of total industrial minerals excavation and waste in Spain

Spain (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[c]	Tailings from beneficiation[d]	Total excavated material[e]
Bentonite	0,101	0,155	0,178	0,145	0,101	0,000	0,246
Diatomite	0,048	0,048	0,071	0,056	0,111	0,000	0,167
Feldspar	0,558	0,635	0,819	0,671	0,671	0,000	1,342
Fluorspar	0,157	0,163	0,155	0,158	0,475	0,317	0,950
Gypsum[a]	7,404	8,936	9,545	8,628	6,040	0,000	14,668
Kaolin[b]	0,392	0,347	0,475	0,405	2,833	1,619	4,856
Magnesite	0,465	0,584	0,789	0,613	0,613	0,368	1,593
Potash	1,709	1,839	N/A	1,774	N/A	7,096	8,870
Sulphur	1,510	1,455	1,518	1,494	N/A	N/A	1,494
Talc	0,000	0,000	0,012	0,004	0,004	0,000	0,008

a incl. Anhydrite
b Kaolin, not calcined / washed
c Rock = Average Stripping Ratio * Average Production
d Total Excavated Material = Rock + Average Production + Tailings
e Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

The Spanish National Framework for waste is described at webpage:
http://www.magrama.gob.es/es/calidad-y-evaluacion-ambiental/planes-y-estrategias/pemaraprobado6noviembrecondae_tcm7-401704.pdf

The Royal Decree 975/2009 from 12 June http://www.boe.es/buscar/pdf/2009/BOE-A-2009-9841-consolidado.pdf transposes the EU Directive into national legislation and states that one of the objectives of the extractive waste management plan is to encourage the recovery of extractive waste through recycling, reuse or recovery. There are provisions detailing the conditions for this reuse (see art 36).

Classification of Extractive Waste

A list of inert mine waste is described in Royal Decree No 975/2009 of 12 June 2009, on the management of waste from extractive industries and the protection and rehabilitation of areas affected by mining activities (as amended by Royal-Decree No 777/2012, of 4 May 2012). The Annex I contains a list of inert mining waste materials for Spain, according to Article 1(1) of Commission Decision C (2009)3012. The Annex I (pages 36 to 40) is located at: http://www.boe.es/buscar/pdf/2009/BOE-A-2009-9841-consolidado.pdf

Spain has applied the waiver of the Landfill Directive paragraph 3 of Article 3: "MS may declare at their own option, that the deposit of non-hazardous non-inert mine waste, to be defined by the committee established under Article 17 of this Directive can be exempted from the provisions in Annex I, points 2, 3.1, 3.2 and 3.3 (location screening, multiple barriers, leachate collection)".

Classification of Chemical Reagents applied in extractive sector

No information was provided on classification of chemical reagents.

Reuse and placing back of extractive waste material

Available information on reuse of extractive waste material is provided in following table.

Table 5: Spain, reuse of extractive waste for placing back into excavation voids (t)

Property Name	Primary Commodity	Mine Type [a]	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management [c]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Las Cruces	Cu	O	1.552.272	4.656.816	6.209.088	1.421.685	0	1.421.685	According to a technical report only inert waste from mining are sending back to excavation voids
Los Santos	W	O	522.402	1.567.206	2.089.608	422.799	422.799	0	According to "Technical Report on the Los Santos Mine Project" There is no tailings discharge from the process and no tailings dam: all plant waste is dewatered and transported back to the mine waste dumps for disposal. Available here https://almonty.com/wp-content/uploads/2019/06/Los_Santos_43-101_Tech_Rep_Oct15_SEDAR.pdf
MATSA Aguas Tenidas, Magdalena, Sotiel	Cu	U	4.303.333	2.151.667	6.455.000	3.853.000	1.926.500	1.926.500	From 0022: González Vázquez, Estela. Minas de Aguas Teñidas (MATSA)
Minera del Duero (Barruecopardo)	W	O	1.363.635	4.090.905	5.454.541	1.103.635	0	1.103.635	According to https://www.mining-technology.com/projects/barruecopardo-tungsten-project-castilla-y-leon/ "The project began operations in August 2018 with the first successful trial of waste rock through the primary crusher". So during the period 2015-2017 there were no amounts of tailings that could be used for filling excavation voids
Orovalle (El Valle-Boinás/Carlés ("EVBC") and former Kinbauri mine)	Au	U	504.451	252.226	756.677	504.395	0	504.395	According to a Orovalle Operation 2020 Technical Report (available here: https://s2.q4cdn.com/372236871/files/doc_downloads/elvalle/RPA-Orovalle-Operation-NI-43-101-FINAL-Report-Dec-29-2020.pdf) only waste rock is used for fillings excavation voids and the whole amount of tailings are disposed into a TSF
Penouta zone B (reprocessing old tailings)	Sn	-	40.000	0	40.000	39.949	39.949	0	According to the presentation The Penouta Project: Strategic and Sustainable Mining (Available here https://www.phytosudoe.eu/wp-content/uploads/2016/11/10_Strategic-Minerals_Penouta-Project_PhytoSUDOE-workshop-2017.pdf) the historical tailings will be reprocessed the extractive waste that will be generated will go for further processing in an industrial minerals plant. The stream that is not marketable will be used for restoration purposes.
Rio Tinto	Cu	O	5.266.667	15.800.000	21.066.667	5.110.226	2.555.113	2.555.113	According to the Technical Report "The coarse tailings (sands) are separated by cycloning and deposited as underflow to form the dam walls, while the overflow consisting of the fine tailings fraction (slimes) is deposited within the basin area. The ponded water is also located away from the dam walls." It was estimated that 50% of total amounts of tailings are the coarse portion. Available at: https://atalayamining.com/wp-content/uploads/2018/07/RioTinto-July-2018-Complete-Report-Rev-6.pdf
San Cipria	Al	-	2.500.000	0	2.500.000	1.000.000	0	1.000.000	Bauxite is imported

a Mine type: O = open pit; U = underground mining

b Rock = Stripping Ratio x Average Ore Production

Total Excavated Material = Rock + Average Ore Production

Tailings = Average Ore Production – Concentrate – By-Products (process)
c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

In Spain a mine operator must prepare and submit both a general waste management plan and a mine waste management plan. The review of the EWMP during the last period is presented in the following table.

Table 6: Review EWMP period 2014-2017

Review of EWMP	2014-2017
Number of EWMP approved	47
Number of EWMP temporarily rejected	52
Number of EWMP definitively rejected	1

Financial guarantees

In Spain there is a Royal Decree 975/2009 on the management on the waste management of extractive industries and on the protection and reclamation of the areas affected by mining activities (last revision made by Royal Decree 777/2012) which establishes that the cost calculation of a guarantee must be done by the operator. The Mining Administration must check the calculation regarding the real needed works and the real cost at market prices, before approving it.

Financial guarantees are established in the Mining Law regarding reclaiming costs exclusively. The cost is only established in the reclamation plan and the guarantee must cover full costs. As a general rule, it is a percentage of the budget for the restoration plan submitted by the developer.

Emergency preparedness

All facilities are required to have an Emergency Plan in compliance with Royal Decree 975/2009. But the review of existing or missing plans and the concrete procedure for establishing these plans is not included in the Decree as the mining competencies have been transferred to the autonomous communities. Therefore, the autonomous communities have to ensure that all facilities have approved emergency plans, according to the Royal Decree 975/2009.

According to Royal Decree 975/2009 both the Internal emergency plan (Article 39) and the external emergency plan (Article 40) must assure that "in the event of a major accident, the operator shall immediately provide the competent authority with all the information necessary to help minimise the consequences for human health and to assess and minimise the actual or potential extent of environmental damage".

Information on safety measures and on action required is provided to the public. This is required by Royal Decree 975/2009 in Article 39 (Internal emergency plan) and Article 40 (external emergency plan): "The internal emergency plan to be developed by the operator shall have the following objectives: c) To Communicate the necessary information to the public and to the relevant services or authorities in the area".

Information provided by the operator is forwarded to the other Member State in case of installation with a potential transboundary impact.
In case of a serious accident the operator shall promptly provide the competent authority with all the information needed to help minimize the consequences for the health of individuals and to assess and minimize the magnitude, real or potential damage environment.

Emergency plans are available for:

- Corta del Valle reservoir - El Valle-Boinás mine
- Cobre Las Cruces external emergency plan (http://www.juntadeandalucia.es/boja/2016/110/BOJA16-110-00051-10228-01_00092740.pdf)
- Aguas Teñidas external emergency plan (www.juntadeandalucia.es/export/drupaljda/02%20PLAN%20MATSAfeb15.pdf)
- Agua Blanca being processed.

Extractive waste facilities

Category A and non-Category A facilities

Table 7 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Spain.

Table 7: Spain, Overview EWF & Cat A Facilities from 2015 to 2017

EWF Spain	Number of EWF	Reference
Category "A" facilities	3	Subdirectorate-General for Waste
Inert waste installations	777	
Non inert, non hazardous installations	128	

In the 2017 EU study "Assessment of Member States' performance regarding the implementation of the Extractive Waste Directive; appraisal of implementation gaps and their root causes; identification of proposals to improve the implementation of the Directive" (Ref 38054 - Amec Foster Wheeler, 2017) 10 Cat A Facility were identified. Probably the difference with the more recent list of Spanish Subdirectorate-General for Waste is related to the operational phase: fully closed facilities seem not to be included anymore in the reports.

Closed and abandoned extractive waste facilities

For the reporting period 2014-2017 62 closure procedures were ongoing. 144 inspections had been conducted on these facilities.
The competent authority in charge of establishing an inventory of closed and abandoned waste facilities is the Ministry for the Ecological Transition and the Demographic challenge. An inventory of closed and abandoned facilities has been ongoing since the year 2012. Last updated version (November 2015) is accessible via webpage:
http://www.minetad.gob.es/energia/mineria/Mineria/Paginas/Mineria.aspx.

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

Mining operations are governed by the Spanish Mining Law 22/1973, of 21 July, and its regulations were approved by Royal Decree 2857/1978 and Law 21/2013 on Environmental Assessment. These laws are applicable to the whole country. As of today (July 2016), since Act 25/2009, there are no special rules or requirements applicable to foreign applicants for authorizations or concessions governed by mining laws. Each of the 17 Spanish Autonomous Regions may enact additional mining rules provided the basic mining system governed by national provisions is respected. According to the Mining Law, all mineral deposits and geological resources within Spain are public domain goods, thus mining activity must be preceded by the corresponding permit/concession. The permit/concession allowing mining activity depends on the type of mineral commodity ("mineral section"). The competent authorities governing mineral exploration and extraction are: the General Directorate of Energy and Mines Policy (Ministry of Industry, Energy & Tourism), Ministry of Agriculture, Food and Environment, Ministry of Education, Culture and Sports and the Ministry of Public Works, Departments of Industry, Environment, Culture and Public Works of each of the 17 Autonomous Regions.

Permits required for exploration and extraction depend on the type of mineral section (A, B, C or D, non-energetic minerals are A, B and C):

- Section A resources
  Authorization of use
- Section B resources
  Authorization of use of mineral or thermal waters, of mining waste or of use of underground structures
- Section C and D resources
  Exploration permits, investigation permits, mining concessions

Spain is highly decentralized in permitting with the Regional Directorates taking over the responsibility of issuing all permits (except for permits affecting two or more Autonomous Communities, in that case the resolution is taken by the central mining authority).

Besides the multi-authorisation system, another problem in the permitting chain is the environmental permit, which depends on the environmental authorities of the different Autonomic Communities.

Authorities governing mineral exploration and extraction

The permit/concession allowing mining activity depends on the type of mineral commodity ("mineral section").

The competent authorities governing mineral exploration and extraction are: General Directorate of Energy and Mines Policy (Ministry of Industry, Energy & Tourism), Ministry of Agriculture, Food and Environment, Ministry of Education, Culture and Sports and the Ministry of Public Works, Departments of Industry, Environment, Culture and Public Works of each of the 17 Autonomous Regions.

Legislation for extractive waste management

The Spanish National Framework for waste is described at webpage:
http://www.magrama.gob.es/es/calidad-y-evaluacion-ambiental/planes-y-estrategias/pemaraprobado6noviembrecondae_tcm7-401704.pdf

Chapter 17 of the National Plan focuses on extractive waste. It encourages the recycling and valorization of waste and promotes research on new use for waste from extractive industry.

The Royal Decree 975/2009 from 12 June http://www.boe.es/buscar/pdf/2009/BOE-A-2009-9841-consolidado.pdf 1 – The Decree transposes the Directive into national legislation and states that one of the objectives of the extractive waste management plan is to encourage the recovery of extractive waste through recycling, reuse or recovery. There are provisions detailing the conditions for this reuse (see art 36).

Administrative arrangements for waste management

The relevant authority in the autonomous community is in charge of:

- verifying and approving the extractive waste management plans proposed by the operators;
- issuing and updating EWM permits
- establishing and updating the financial guarantee
- making inspection of the waste facilities
- establishing the external emergency plans for Category "A" installations.

Sweden – Country Fact Sheet

Sweden and its minerals industry

Background

The Swedish mining industry is one of the largest in Europe. Sweden is the largest producer and exporter of iron ore in Europe and hosts the world´s largest underground iron ore mine in Kiruna. Sweden is among the leading nations in the production of base and noble metals (copper, zinc, lead, gold, silver) and has a large mineral potential, especially in the northern region, but also in the Bergslagen district in south central Sweden.

Mineral ownership

The ownership of mineral deposits is not defined in Swedish law. However, in Sweden, the right to grant exploration permits for concession minerals and permits to exploit mineral deposits (exploitation concessions) is reserved to the state (The Mining Inspectorate of Sweden). The concession minerals are legally defined and listed in the Minerals Act (1991:45) and comprise most metallic ores, a wide range of industrial minerals (andalusite, apatite, barite, brucite, refractory clay or clinkering clay, coal, fluorspar, graphite, kyanite, magnesite, nepheline syenite, pyrite, pyrrhotite, rock salt or other similar salt deposits, sillimanite and wollastonite), oil, gaseous hydrocarbons and diamonds. Non-concession minerals (other minerals not mentioned in the definition of concession minerals) belong to the landowner. If the developer does not own the land in question, the right to explore and extract must be regulated by a contract with the landowner. Also, an environmental permit according to the Environmental Code (1998:808) is required for extraction.

Production and Waste generation

Production data

In the next tables the annual production of main commodities and number of extraction sites in Sweden are presented.

Table 1: Sweden, Annual mineral production per main commodity (Mt, t or kg)

Commodity	2015	2016	2017	Average	Reference
Metals					
Iron (Mt)	29,861	31,843	31,763	31,156	BGS
Copper (t)	75.125	78.992	104.450	86.189	BGS
Lead (t)	79.354	75.830	71.112	75.432	BGS
Zinc (t)	246.983	258.264	251.244	252.164	BGS
Selenium, refined (t)	20	20	20	20	BGS
Tellurium, refined (t)	33	39	35	36	BGS
Gold (kg)	6.028	6.463	7.858	6.783	BGS
Silver (kg)	479.686	4986.86	467.500	481.957	BGS
Industrial Minerals					
Diabase (Mt)	0,265	0,344	0,156	0,255	SGU (2018)
Dolomite (Mt)	0,393	0,344	0,473	0,403	SGU (2018)
Feldspar (Mt)	0,029	0,022	0,022	0,024	BGS, SGU (2018), WMD
Graphite (Mt)	0,009	0,000	0,000	0,003	SGU (2018)
Kaolin (Mt)	0,122	no data	0,085	-	Eurostat
Quartz / Quartzite (Mt)	0,072	0,021	0,056	0,050	SGU (2018)

Quartz (sand) (Mt)	0,638	0,656	0,716	0,670	SGU (2018)
Shale (Mt)	0,008	0,008	0,009	0,008	SGU (2018)
Other (Mt)	0,003	0,002	0,003	0,003	SGU (2018)
Aggregates					
crushed rock (Mt)	73,00	74,00	83,20	76,73	UEPG
sand & gravel (Mt)	13,00	12,00	12,50	12,50	UEPG
Dimension stone (Mt)	1,005	0,888	1,424	1,106	SGU (2017;2018)

Table 2: Sweden, Total number of extraction sites per main commodity

Commodity	2015	2016	2016	Reference
Metals				
Iron (t)	ND*	ND	5	Euromines
Copper (t)	ND	ND	1	Euromines
Lead (t)	ND	ND	6	Euromines
Zinc (t)	ND	ND		
Selenium (t)		*Byproduct*		Euromines
Tellurium (t)		*Byproduct*		Euromines
Gold (kg)	ND	ND	2	Euromines
Silver (kg)		*Byproduct*		Euromines
Ind Minerals				
Diabase	2	2	2	SGU (2016, 2017, 2018)
Dolomite	4	4	4	SGU (2016, 2017, 2018)
Feldspar	1	1	1	SGU (2016, 2017, 2018)
Graphite	ND	ND	ND	SGU (2016, 2017, 2018)
Kaolin	ND	ND	ND	
Quartz / Quartzite	3	2	3	SGU (2016, 2017, 2018)
Quartz (sand)	4	3	3	SGU (2016, 2017, 2018)
Shale	1	1	1	SGU (2016, 2017, 2018)
Other	2	2	2	SGU (2016, 2017, 2018)
Aggregates	1391	1391	1391	UEPG
Dimension stone	52	56	56	SGU (2017;2018)

ND: No data available or provided

More information on individual production data of the principal mines and quarries in Sweden is provided in Annexes C to I.

Extractive waste generation 2015-2017

The next tables present an estimation of extractive waste generated by metallic mines and total industrial minerals production. Estimations are made according to the methodology described in the report, §2.2 and Annex L.

Table 3: Sweden, Estimated extractive waste per metallic mine (t)

Property Name	Primary Commodity	Mine Type[a]	From the data collection process				Estimates		
			Concentrate Average 2015-2017 (t)	By-product from process	By-product from process (t)	Average ore production 2015-217 (t)	Rock[b] (t)	Total Excavated Material[c] (t)	Tailings[d] (t)
Aitik	Cu	O	340.058	Au, Ag	372	37.152.461	28.956.420	66.108.881	36.812.031
Bjorkdal	Au	O& U	6	Ag	13	1.284.667	1.927.001	3.211.668	1.284.648
Boliden Area (4 mines)	Zn	O& U	118.333	Cu, Pb	32.333	2.027.333	1.013.667	3.041.000	1.876.667
Garpenberg	Zn	U	199.000	Cu, Pb	61.333	2.541.000	1.270.500	3.811.500	2.280.667
Kiruna	Fe	O& U	13.450.000	-	0	26.166.667	39.250.001	60.000	1.2716.667
Leveäniemi (Svappavaara)	Fe	O	3.500.000	-	0	5.900.000	17.700.000	1.808.493	2.400.000
Lovisa	Zn	U	2.734	Pb, Ag	0	40.000	20.000	65.416.668	37.266
Zinkgruvan	Zn	U	153.490	Cu, Pb	49.944	1.205.662	602.831	23.600.000	1.002.228
Malmberget	Fe	U	9.180.000	-	0	15.300.000	7.650.000	22.950.000	6.120.000

a Mine type: O = open pit; U = underground mining
b Rock = Stripping Ratio * Average ore production
c Total Excavated Material = Rock + Average Ore production
d Tailings = Average Ore Production – Concentrate – By-Products (process)

Table 4: Estimation of total industrial minerals excavation and waste in Sweden (Mt)

Sweden (Mt)	Production				Estimations		
	2015	2016	2017	Average	Rock[a]	Tailings from beneficiation[b]	Total excavated material[c]
Feldspar	0,029	0,022	0,022		0,024	0,000	0,049
Graphite	0,009 0	0,0000	0,0000	0,0030	0,0060	N/A	0,0090
Kaolin	0,122	N/A	0,085	0,104	0,725	0,414	1,242

a Rock = Average Stripping Ratio * Average Production
b Total Excavated Material = Rock + Average Production + Tailings
c Tailings = Ratio * Average production

Waste designation and classification

Definition of Extractive Waste (and/or Treatment)

In Sweden national legislation 'extractive waste' is defined under Section 4 of the Extractive waste ordinance (2013:319) (unofficial translation from Swedish): "For the purposes of this Regulation, extractive waste means waste that has emerged as a direct result of prospecting, extraction or treatment or as a direct result of storage of extracted material before treatment of the material is completed."

In Sweden 'treatment' of mineral resources is not interpreted to include the combustion of energy minerals to produce electricity/heat/energy, according to Section 2 of the Extractive waste ordinance (SFS 2013:319) (unofficial translation from Swedish): "treatment: operation aimed at through a mechanical process, a chemical process, a biological process or a thermal or other physical process or a combination of such processes separate or concentrate substances or material from extracted material or from earlier disposed extractive waste, but not smelting or other heating processes other than burning of lime stone and no metallurgical processes."

Classification of Extractive Waste

In Sweden there is no waste materials to be regarded as inert according to EWD criteria. There are no national threshold values for sites identified as not contaminated, or relevant national natural background levels.

For classification as hazardous/not hazardous the following provision is used: Section 5 of the Extractive waste ordinance (SFS 2013:319) (unofficial translation from Swedish): "hazardous waste: substance or object that is waste and that is marked with an asterisk (*) in Appendix 4 to the Waste Ordinance (2011:927) or as per regulations notified by section 12 of the Waste Ordinance is hazardous waste".

Classification of Chemical Reagents applied in extractive sector

In Sweden's extractive sector chemical agents are used as collectors, frothers and depressants.

There is not any restriction to use of a specific chemical agent according to Swedish legislative framework. Any risks arising from the processing of minerals with chemical agents are evaluated in the EIA.

Re-use and placing back of extractive waste material

Available information on reuse of extractive waste is provided in Table 5.

Waste management and permitting

Approval and Review of Extractive Waste Management Plans

Permitting procedures EWMP

From the Swedish Environmental Protection Agency's guidance on the Extractive waste ordinance (unofficial translation):

"The issue of the extractive waste management plan´s compliance with the requirements in the Extractive waste ordinance is foremost raised in the environmental permitting process of the operation. This is a consequence of the fact that extractive operations must have authorization according to environmental law.

In connection with an environmental permit application according to Chapter 9 or 11 of the Environmental code (1998:808) for an operation covered by the Extractive waste ordinance, the applicant of the permit (the operator) shall inform the permitting authority about the contents of the waste management plan. By contrast, from section 28 of the Extractive waste ordinance follows that a waste management plan is then, examined by the permitting authority. The requirement stated in Section 64 of the Extractive Waste ordinance also applies when applying for a permit to change environmentally hazardous activities, so-called amendment permit.

In addition, regarding both an application for an environmental permit and an application for an exploitation concession, the basis for the application relating to extractive waste management depends on, or corresponds to, the information that shall be included in an extractive waste management plan. To carry out an environmental impact assessment, which is a requirement for both environmental permits and for exploitation concessions, the information that shall be included in the waste management plan in the application for an environmental permit is required. This includes, for example, the properties of the waste and the design, location, and closure of the extractive waste facilities. Furthermore, the information in the extractive waste management plan is needed to meet the requirements of what an environmental permit application must contain, including the content of what is often referred to as the technical description. In addition, a waste management plan must be included in an environmental permit application. Corresponding information also needs to be included to the extent and in the degree of detail that is reasonable with regard to prevailing knowledge of what the operation shall look like, in the basis for the examination of the environmental impact assessment in an application for an exploitation concession."

"Since the requirements of a waste management plan was introduced 2008 through the Extractive waste ordinance, most of the extractive operations have been examined by the permitting authority. By that, most of the waste management plans also have been examined.

If a waste management plan has not been examined during a permitting process, the supervisory authority shall examine whether the plan meets the requirements of the extractive waste ordinance. This is evident from section 28 of the extractive waste ordinance. However, the content of a complete waste management plan is included in the authorization procedure and is examined by the permitting authority as a part of the process. Since the supervisory authority is unable to examine matters that are subject to the legal force of the permit, the supervisory authority's examination of the waste management plan is mainly in regard to changes of an extractive activity that are not subject to a permit but is examined through a notification procedure.

In accordance with section 29 of the extractive waste ordinance, the operator must review the waste management plan as soon as there is reason to do so and at least every five years, and in connection with this, the plan may need to be updated or otherwise changed. This means that the supervisory authority's examination of the waste management plan then is updated. Even in cases where there has been no change in the extractive operation itself, the operator can make changes to the plan, e.g. in conjunction with its reviewing of the plan to be up to date. It is also important to note that the operator must report changes to the waste management plan to the supervisory authority as soon as possible. This is stated in Section 29 of the Extractive Waste Ordinance.

The examination of the extractive waste management plan by the supervisory authority relates to the question of whether the waste management plan meets the requirements of the Extractive Waste Ordinance. If the plan is defective, the supervisory authority shall order the operator to remedy it according to section 28 of the Extractive waste ordinance. In the examination, the supervisory authority must ensure that a change in a waste management plan is not caused by a change in the operation that is subject to a permit. If that is the case, the revised waste management plan is part of the environmental permit application, and the plan must then be examined by the permitting authority."

During the last reporting period 11 waste management plans were approved during the reporting period. One plan was rejected definitively by the permitting authority.

Table 5: Sweden, Reuse of extractive waste for placing back into excavation voids (t)

Property Name	Primary Commodity	Mine Type[a]	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management[c]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Aitik	Cu	O	37.152.461	28.956.420	66.108.881	36.812.031	0	36.812.031	According to available data only the waste rock is recovered/recycled. The CAF has been classified for Major Accident Risk
Bjorkdal	Au	O&U	1.284.667	1.927.001	3.211.668	1.284.648	0	1.284.648	According to a report (Available here: https://minedocs.com/20/Mandalay_AIF_2019.pdf) There are currently two active waste dump areas; the North and South waste dumps. In the new operating permit application received in 2018, the capacity of the waste rock dumps has been expanded to over 53 million t. This capacity is sufficient to cover the needs of the current mine life. The TMF is located in an area of gently undulating relief approximately 1.5 km north of the processing plant. Approximately 31 million t of tailings have been deposited since mining began at Björkdal in 1988. No data available for using tailings as material for filling excavation voids
Boliden Area (4 mines)	Zn	O&U	2.027.333	1.013.667	3.041.000	1.876.667	0	1.876.667	According to a report published by the company (Available here: https://www.boliden.com/globalassets/sustainability/our-responsibilities/in-focus/tailings_safety_disclosure_response_boliden.pdf) the Boliden Area has the Hötjärn TMF that is CAF (Boliden Area) that is active (the Gillervattnet TMF (Boliden Area) is closed and the Kristineberg TMF (Boliden Area) is in care and maintenance). The tailings are deposited in the CAF
Garpenberg	Zn	U	2.541.000	1.270.500	3.811.500	2.280.667	752.620	1.528.047	EWMP (2017), The EWF Ryllshyttemagasinet accepts the tailings from the enrichment plant in Garpenberg which is asseigned under the waste code 01 03 05* (hazardous waste). According to EWMP: it is estimated that about 25-35% of the tailings are used for the refilling of broken excavation rooms in the mine (chapter 8.1)

a Mine type: O = open pit; U = underground mining

b Rock = Stripping Ratio x Average Ore Production

Total Excavated Material = Rock + Average Ore Production

Tailings = Average Ore Production – Concentrate – By-Products (process)

c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Property Name	Primary Commodity	Mine Type[a]	Average Ore production 2015-2017 (t)	Estimates[b]			Tailings Management[c]		
				Rock (t)	Total Excavated Material (t)	Tailings (t)	Tailings for filling excavation voids or other uses in the mine	Tailings (t) for deposit	Source
Kiruna	Fe	O&U	26.166.667	39.250.001	65.416.668	12.716.667	0	12.716.667	According to the official website of LKAB (Available here: https://www.lkab.com/en/sustainability/environment/waste-and-landfill/) "All mining and processing generates waste products in the form of waste rock and tailings that have to be sent to landfill and stored in as sustainable a way as possible – in accordance with the laws and guidelines contained in the Swedish Environmental Code. Tailings from LKAB's activities are disposed of, together with water, in what are known as tailings dams. These contain large quantities of water and tailings that have to be stored over a prolonged period and so dam safety is a priority issue in terms of sustainability."
Leveäniemi (Svappavaara)	Fe	O	5.900.000	17.700.000	23.600.000	2.400.000	0	2.400.000	According to the official website of LKAB (Available here: https://www.lkab.com/en/sustainability/environment/waste-and-landfill/) "All mining and processing generates waste products in the form of waste rock and tailings that have to be sent to landfill and stored in as sustainable a way as possible – in accordance with the laws and guidelines contained in the Swedish Environmental Code. Tailings from LKAB's activities are disposed of, together with water, in what are known as tailings dams. These contain large quantities of water and tailings that have to be stored over a prolonged period and so dam safety is a priority issue in terms of sustainability."
Lovisa	Zn	U	40.000	20.000	60.000	37.266	0	37.266	There were no available data for the production 2015-2017. During this period 2015-2017 perhaps the mine did not operate. As a consequence, no tailings have been generated, in order to be used as a material for filling excavation voids.
Zinkgruvan	Cu	U	1.205.662	602.831	1.808.493	1.002.228	350.780	651.448	According to technical report (Available here: https://www.lundinmining.com/site/assets/files/3642/zm-techreport-113017-sedar.pdf) "The annual production of tailings is approximately 1.1Mtpa with 35% used as mine backfill and 65% disposed at the Enemossen Tailings Storage Facility (TSF)
Malmberget	Fe	U	15.300.000	7.650.000	22.950.000	6.120.000	0	6.120.000	According to the official website of LKAB (Available here: https://www.lkab.com/en/sustainability/environment/waste-and-landfill/) "All mining and processing generates waste products in the form of waste rock and tailings that have to be sent to landfill and stored in as sustainable a way as possible – in accordance with the laws and guidelines contained in the Swedish Environmental Code. Tailings from LKAB's activities are disposed of, together with water, in what are known as tailings dams. These contain large quantities of water and tailings that have to be stored over a prolonged period and so dam safety is a priority issue in terms of sustainability."

a Mine type: O = open pit; U = underground mining

b Rock = Stripping Ratio x Average Ore Production
Total Excavated Material = Rock + Average Ore Production
Tailings = Average Ore Production – Concentrate – By-Products (process)

c Amounts of tailings calculated taking into consideration (a) communication with companies, (b) desk research trough technical reports and (c) when no data were available some estimations have been done according to the principles EWD

Financial guarantees

In Sweden financial guarantees are set according following sections:

- Section 64 of the Extractive Waste Ordinance (unofficial translation from Swedish): "Section 64: Anyone applying for a permit referred to in Chapter 9 or Chapter 11 of the Environmental code in respect of an operation covered by this regulation shall in connection with the application inform the permit authority about (…)
  4. the security required for an extractive waste facility according to an independent qualified assessment in accordance with Chapter 15 Section 35 of the Environmental Code and the consideration that has been taken of any unplanned or premature closure of the facility and the additional costs that such closure may entail, and (…)"
- Chapter 15 Section 35 of the Environmental Code (unofficial translation from Swedish): "Section 35: A permit for an activity that includes the disposal of waste may only be granted if the operator, for the fulfillment of the obligations that apply to the landfilling activity, lodges a security pursuant to Chapter 16. Section 3 or take any other appropriate measure for such a guarantee. The size of the security is usually determined in a condition in the permit and the security is submitted for trial by the court at a specified later time."

Emergency preparedness

The Swedish Civil Contingencies Agency (https://www.msb.se/en/) is revising since spring 2019 the supervisory authorities' experiences in their supervision of the prevention and management of serious accidents (safety management system, internal contingency plan, information to the public and external emergency plans).

The municipalities are responsible for the external emergency plans according to article 6.3 EWD, which were to be drawn up by 1 May 2012. Under the Accident Prevention Act (2003:778), one of the county administrative boards' supervisory tasks is to follow up on this.

According to the supervisory authorities, external emergency plans are in place in the municipalities of:

Hedemora	one extractive waste facility
Gällivare	three extractive waste facilities
Kiruna	two extractive waste facilities
Skellefteå	four extractive waste facilities
Lycksele	one extractive waste facility

One external emergency plan was still being drawn up during the last period. An external emergency plan was missing for one operation with a category A-facility.

Waste reporting

Swedish waste statistics for mining and quarrying are available via webpage http://www.statistikdatabasen.scb.se/pxweb/en/ssd/

Responsibility for reporting according to the Extractive waste directive (2006/21/EC) can be found in Sections 90-92 of the Extractive Waste Ordinance. The Swedish Environmental Protection Agency sends the questions to the county administrative boards about the information to be reported and then compiles the submitted information and reports to the EU-commission. Obvious doubts in the information are double checked. After that, the Swedish Civil Contingencies Agency sends the questions about the information to be reported in accordance with EWD to the supervisory authorities and then compiles the information submitted and reports to the EU-commission.

Sections 90-92 of the Extractive waste ordinance (unofficial translation from Swedish):

"Section 90 The Swedish Environmental Protection Agency shall fulfil the reporting obligation according to article 18.1 in Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC, changed by regulation (EG) nr 596/2009 of the European Parliament and of the Council.

Section 91 The Swedish Civil Contingencies Agency shall fulfil the reporting obligation according to article 18.2 in directive 2006/21/EC.

Section 92 At the fulfilment of the obligations according to sections 90 and 91 The Swedish Environmental Protection Agency and the Swedish Civil Contingencies Agency shall follow the Commission decision 2009/358/EC of 29 April 2009 on the harmonization, the regular transmission of the information and the questionnaire referred to in Articles 22(1)(a) and 18 of Directive 2006/21/EC of the European Parliament and of the Council on the management of waste from extractive industries."

Authorities are obliged to cooperate in their area of activity with other authorities in accordance with § 8 of the Administrative Law Act (2017: 900). Therefore, all steps of the reporting chain are compulsory.
Reporting periods are stipulated in the Directive 2006/21/EC and Commission decision 2009/358/EC and these time frames are followed in Sweden. Reporting of 'extractive waste' and "waste statistics" are split (two different reports).
The first reporting to EU Commission was finally done in October 2012 with previous partial reporting. Second reporting took place on 2015-06-01. The third reporting took place on 2018-02-19 and was final even though there were some county boards that had not reported data.

Extractive waste facilities

Category A and non-Category A facilities

The classification of waste facilities according to EWD and Commission Decision 2009/337/EC is implemented in the extractive waste ordinance sections 10 and 44-54. The ordinance shall not be applied on waste facilities closed by 31 August 2008. In the EWD abandoned waste facilities are mentioned in preamble 30 and article 20 as included in closed facilities. The identification of closed, or abandoned, waste facilities according to the extractive waste ordinance section 80-81 is carried out according to the regular contaminated site inventories by the County authorities. Sweden has not applied the waiver of the Landfill Directive paragraph 3 of Article 3.

In summary, 47 extractive waste facilities were in operation in Sweden in the last reporting period, of which 10 are inert waste facilities and 14 Category A-facilities ("Riskanläggningar").

Table 6 provides an overview of the Extractive waste facilities for metallic and non-metallic extractive sector in Sweden.

Table 6: Sweden, Overview EWF & Cat A Facilities from 2015 to 2017

EWF Sweden	Number of EWF			Reference
	construction minerals	metallic minerals	industrial minerals	
N° of extractive waste facilities in operation, after 2008-09-01, covered by Extr Waste Ordinance	11	35	1	Naturvårdsverket
N° of operating installations containing inert waste	4	5	1	Naturvårdsverket
N° of operating installations containing non-inert and non–hazardous waste	ND	22		Naturvårdsverket
Cat A		14		Naturvårdsverket

Closed and abandoned extractive waste facilities

In Sweden every closed EWF has an 'operator' with an exception if an operator no longer exists (has gone bankrupt or similar).
The supervisory authority itself can never become an operator, but responsibility can be transferred from the operator to the supervisory authority. For example, under section 75 of the extractive waste ordinance the supervisory authority may take over the operator´s responsibility for the waste facility after the facility is closed as specified in section 74.
In general Sweden requires 'operators' of closed EWFs to hold a valid permit meeting all requirements of the EWD. An environmental permit that is not time-limited applies "forever" provided that the operator remains existing.

Competent authority in charge of establishing an inventory of closed and abandoned waste facilitiesis the Swedish Environmental Protection Agency. Swedish EPA keeps a list of closed and abandoned facilities in accordance with section 80 of the extractive waste ordinance. The supervisory authority shall identify such extractive waste facilities as referred to in section 80 in accordance with section 81 of the extractive waste ordinance.
Websites with an inventory of closed and abandoned waste facilities are located at:
http://www.naturvardsverket.se/Stod-i-miljoarbetet/Vagledningar/Gruvor-takter-och-markavvattning/Gruvor/Efterbehandling-av-omraden-med-nedlagda-gruvor/ and at:
http://www.naturvardsverket.se/upload/sa-mar-miljon/mark/avfall/Inventering-av-gruvor/forteckning-nedlagda-gruvor-2019-06-26.pdf

Table 7 presents EWF closures during the last three EU reporting periods.

Table 7: EWF closures in Sweden during the last three EU reporting periods

Closures, Sweden	2008-2011	2012-2014	2015-2017
N° of closure procedures undertaken and/or approved during each EU reporting period.	2	0	0

Legislation for exploration, extraction and extractive waste management

Legislation for mineral exploration and extraction

Links to reports in English on the Swedish Environmental in English is provided through:
http://www.swedishepa.se/Guidance/Laws-and-regulations/The-Swedish-Environmental-Code/
http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6790-8.pdf?pid=21184

A translation of the Swedish Minerals Act and Ordinance and a brief description is provided by the Geological Survey of Sweden at webpage: https://www.sgu.se/en/mining-inspectorate/legislation/

A brief description of the regulatory framework surrounding exploration and mining activities are also provided by the Geological Survey of Sweden: https://www.sgu.se/en/mineral-resources/legislation-and-guidance/ .

The main responsible authority for mining is the Mining Inspectorate, headed by the Chief Mining Inspector (a government appointee), which issues permits for mineral exploration (exploration permits) and mines (exploitation concessions) associated with the Minerals Act. The Inspectorate also carries out inspections of mines and provides information on mineral legislation and prospecting in Sweden. The Mining Inspectorate is part of the Geological Survey of Sweden (SGU), the agency for issues relating to bedrock, soil and groundwater in Sweden. The SGU is under the jurisdiction of the Swedish Ministry of Enterprise and Innovation.

An application for the granting of an exploration permit or extraction concession is in general considered by the Chief Mining Inspector who may determine an application for the granting of an exploration permit without any affected party other than the applicant having had the opportunity to express their opinion. However, often, in order to obtain an exploration permit, an application as well as a work plan has to be submitted to and approved by the Mining Inspectorate. The relevant municipality, County Administrative Board and, in reindeer herding areas, the Sámi Parliament of Sweden, have the right to be informed and express their opinion on the application. When considering an application for the granting of an exploitation concession, the Chief Mining Inspector shall, with regard to the application of Chapters 3, 4 and 6 of the Environmental Code, mandatorily consult the County Administrative Board of the county or counties in which the concession area is situated.

Permits required under the Swedish Environmental Code (e.g. Chapter 9 and 11, EIAs) are issued by the regional Land and Environmental Courts or the County Administrative Boards, and decisions under the Planning and Building Act are handled by the local municipalities. The Environmental Code can also apply for situations and/or measures taken during the exploration phase, thus requiring certain approvals, permits or dispensation from nature protection rules or off-road driving according to the Off-Road Driving Act (1975:1313). If there is a risk that the exploration, mining or other related activities may affect a protected area, such as Natura 2000 areas, or protected species, separate permits or approvals may be required. A permit under the Cultural Heritage Act may also be mandatory.

A permit must be obtained from the County Administrative Board for the quarrying of rock, stone, gravel, sand, clay, soil, peat or other types of soil. Nevertheless, landowners may take such measures without a permit for their own personal use. Quarrying permits may only be granted if a security is furnished for fulfilment of the conditions attached to the permit. In special circumstances, the County Administrative Board may waive the requirement to furnish a security.

Legislation for extractive waste management

Swedish guidance on Extractive waste is provided via the website of the Swedish EPA: http://www.naturvardsverket.se/Stod-i-miljoarbetet/Vagledningar/Gruvor-takter-och-markavvattning/Utvinningsavfallsforordningens-tillampningsomrade/ .

Administrative arrangements for waste management

Websites where the Swedish waste statistics are published:

- National waste publication: https://www.scb.se/en/finding-statistics/statistics-by-subject-area/environment/waste/waste-generated-and-treated/ (National publication)
- Eurostats waste database: https://ec.europa.eu/eurostat/data/database?p_p_id=NavTreeportletprod_WAR_NavTreeportletprod_INSTANCE_nPqeVbPXRmWQ&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_pos=1&p_p_col_count=2
- English documents relevant for statistics collection: https://ec.europa.eu/eurostat/documents/3859598/5926045/KS-RA-13-015-EN.PDF/055ad62c-347b-4315-9faa-0a1ebcb1313e (manual for the collection waste statistics)
- Swedish pollutant register (PRTR): http://www.swedishepa.se/State-of-the-environment/Data-databases-and-applications/The-Swedish-PRTR/

The extractive waste management plan is examined by the permitting authority (the Land and Environmental Court or the environmental permitting delegation at the county administrative board) when applying for a permit for the operation. The extractive waste management plan is included in the application for a permit. No authority verifies the plan. The operator is required to provide correct information.

EWM permits are granted by the Land and Environmental Court or the environmental permitting delegation at the county administrative board. Updated extractive waste management plan is examined by the supervisory authority for notified changes and for changes requiring permit by the Land and Environmental Court or the environmental permitting delegation, depending on the level of examination for the operation.

The permits for mining operations granted by the Land and Environmental Court and are located there. All notified permits are entered in the Environmental Book at the court. (Dvfs 2011: 2). The supervisory authority has these and should be able to inform about which facilities are in each county.

The competent authority in charge of establishing and updating the financial guarantee is the Land and Environmental Court or the County Administrative Board.
The competent authority in charge of making inspections of the waste facilities is the County Administrative Board or Committee of the municipality.
The competent authorities in charge of establishing the external emergency plans for Category “A” installations are the Municipality fire and rescue services. The counties are competent authorities for evaluating the plans.

Annex R: Example of “inventory” of commonly used chemicals for the concentration of metals

Annex R: Example of "inventory" of commonly used chemicals for the concentration of metals

Reagent	Typical Dosage lbs/tn	Uses	Treated ore	Environmental fate	Relevant substances	CAS no	EC no	Hazard properties according to CLP	Properties of concern
Aerofloat A	0.05-0.2	Frother and promoter	Au and Ag/Cu/Pb/Zn Sulfides	product	o-cresol o-Cresylic acid	95-48-7	202-423-8	Acute Tox. 3-H301 Acute Tox. 3-H311 Skin Corr. 1B-H314	None identified
			Au and Ag/Cu/Pb/Zn Sulfides	product	diphosphorus pentasulfide phosphorus pentasulfide	1314-80-3	215-242-4	Flam. Sol. 1-H228 Water-react. 1-H260 Acute Tox. 4-H302 Acute Tox. 4-H332 Aquatic Acute 1-H400 EUH029	None identified
Aerofloat B	0.05-0.2	Promoter and frother	Galena Oxidised Au ores Ag sulfides	product	o-cresol o-Cresylic acid	95-48-7	202-423-8	Acute Tox. 3-H301 Acute Tox. 3-H311 Skin Corr. 1B-H314	None identified
			Galena Oxidised Au ores Ag sulfides	product	diphosphorus pentasulfide phosphorus pentasulfide	1314-80-3	215-242-4	Flam. Sol. 1-H228 Water-react. 1-H260 Acute Tox. 4-H302 Acute Tox. 4-H332 Aquatic Acute 1-H400 EUH029	None identified
Aerofloat C	0.05-0.2	Promoter	Au/Ag/Cu/Zn Sulfides	product	Dialkyl Dithiophosphate Dialkyl Monophosphate	NA	NA	Acute Tox. 4-H332 Acute Tox. 4-H302 Skin Corr. 1C-H314 Eye Dam.1-H318 Acute Tox.4-H332	None identified

Reagent	Typical Dosage lbs/tn	Uses	Treated ore	Environmental fate	Relevant substances	CAS no	EC no	Hazard properties according to CLP	Properties of concern
Aerofloat D	0.02-0.15	Promoter	Au/Ag/Cu Sulfides pyrite	product	Sodium O,O-di-sec-butyl dithiophosphate	33619-92-0	251-598-7	Skin Corr. 1C-H314	None identified
Caustic Soda	0.5-3.0	pH regulator and dispersing agent	Sulfide and non-sulfide minerals	effluent/tailings ?	Sodium hydroxide	1310-73-2	215-185-5	Skin Corr. 1A-H314	None identified
Creosote Hardwood	0.1-0.3	Frother and collector	Sulfide minerals Au	product	Creosote	8001-58-9	232-287-5	Carc. 1B-H350	Carcinogenicit y
Dichromate	1.0-5.0	Depressan t	galena Cu, Pb, Zn	effluent/tailings ?	Chromate	10588-01-9	234-190-3	Ox. Sol. 2-H272 Acute Tox. 3-H301 Acute Tox. 4-H312 Skin Corr. 1B-H314 Skin Sens. 1-H317 Acute Tox. 2-H330 Resp. Sens. 1-H334 Muta. 1B-H340 Carc. 1B-H350 STOT RE 1-H372 Aquatic Acute 1-H400 Aquatic Chronic 1-H410 Repr. 1B- H360FD	Carcinogenic Mutagenic Toxic to Reproduction Skin 295ft he295a295ed Respiratory sensitising
Thiocarbanilid e	0.05-0.10	Promoter	Sulfides Pb/Zn/Cu/Ag ores	product	1,3-diphenyl-2-thiourea	102-08-9	203-004-2	Acute Tox. 2-H300	None Very high acute toxicity

Annex R: Example of "inventory" of commonly used chemicals for the concentration of metals

Reagent	Typical Dosage lbs/tn	Uses	Treated ore	Environmental fate	Relevant substances	CAS no	EC no	Hazard properties according to CLP	Properties of concern
Xanthate A	0.01-0.20	Collector	arsenopyrite and sulfide minerals	product	Potassium O-pentyl dithiocarbonate	2720-73-2	220-329-5	Flam. Sol. 1-H228 Acute Tox. 4-H302 Acute Tox. 4-H312 Skin Irrit. 2-H315 Eye Irrit. 2-H319 STOT SE 3-H335 EUH018	None identified
Xanthate B	0.05-0.30	Collector	Pb/Zn/Fe sulfide ores	product	Proxan-potassium	140-92-1	205-441-4	Acute Tox. 4-H302 Skin Irrit. 2-H315 Eye Irrit. 2-H319 STOT SE 3-H335	None identified

Prioritisation Color Coding of Cells according their hazard properties and expected risk:	Low Risk	Medium Risk	High Risk

ANNEX S: IDENTIFIED SVHCS THAT ARE RELEVANT WITH THE CONCENTRATION OF METALS

Annex S: Identified svhcs that are relevant with the concentration of metals

Substance name	EC No.	CAS No.	Entry No.	Latest application date	Sunset Date	Intrinsic property(ies) referred to in Art. 57	Treated ore
Sodium dichromate	234-190-3	10588-01-9, 7789-12-0	18	21/3/2016	21/09/2017	Carcinogenic (Art. 57a) Mutagenic (Art. 57b) Toxic for reproduction (Art. 57c)	Used as depressant for Sulfide minerals
Potassium dichromate	231-906-6	7778-50-9	19	21/3/2016	21/9/2017	Carcinogenic (Art. 57a) Mutagenic (Art. 57b) Toxic for reproduction (Art. 57c)	Used as depressant for Sulfide minerals
Potassium chromate	232-140-5	7789-00-6	21	21/3/2016	21/9/2017	Carcinogenic (Art. 57a) Mutagenic (Art. 57b)	Use as a depressant in sphalerite flotation
Sodium chromate	231-889-5	7775-11-3	22	21/3/2016	21/9/2017	Carcinogenic (Art. 57a) Mutagenic (Art. 57b) Toxic for reproduction (Art. 57c)	Use as a depressant for galena
Formaldehyde, oligomeric reaction products with aniline	500-036-1	25214-70-4	23	22/02/2016	22/08/2017	Carcinogenic (Art. 57a)	Used in the mixture Quebracho that is produced for depression of iron sulfides and sphalerite
1,2-dichloroethane (EDC)	203-458-1	107-06-2	26	22/05/2016	22/11/2017	Carcinogenic (Art. 57a)	Uses in ore flotation of pyrrhotite

ANNEX T: CANDIDATE SVHCS THAT ARE RELEVANT WITH THE CONCENTRATION OF METALS

Annex T: Candidate svhcs that are relevant with the concentration of metals

Substance Name	EC Number	CAS Number	Hazard properties according to CLP	Treated ore	Use
Acetic acid, lead salt, basic	257-175-3	51404-69-4	Toxic to Reproduction	Ag, Cu, and Zn metals Sn–Cu–Ag	Collector
Ammonium 2,3,3,3-tetrafluoro-2-(heptafluoropropoxy)propanoate	700-242-3	62037-80-3	Under assessment as Persistent, Bioaccumulative and Toxic	Cu, Ni, Zn, Pb, Sulfide ores	Depressant
Bis(pentabromophenyl) ether	214-604-9	1163-19-5	Persistent, Bioaccumulative and Toxic	Alumina?	Collector
Cobalt dinitrate	233-402-1	10141-05-6	Carcinogenic Suspected to be Mutagenic Toxic to Reproduction Skin sensitising Respiratory sensitising	Nickel-cobalt laterite	Activator
Lead di(acetate)	301-04-2	206-104-4	Toxic to Reproduction	Antimony sulfide minerals	Depressant

ANNEX U: TERMINOLOGY

Term	Explanation and Comments
Abandoned	‘Abandoned’ is not defined, but for the purposes of the EWD, is limited to EWFs that cause serious negative environmental impacts or have the potential of becoming in the medium or short term a serious threat to human health or the environment.
Best available techniques	‘Best available techniques’ is as defined in Article 2(11) of Directive 96/61/EC, repealed by Directive 2010/75/EU.
Benefication	Beneficiation is concentration or enrichment, generally applied to the preparation of iron ore for smelting, e.g., by magnetic concentration
By-product	A substance or object, resulting from a production process, the primary aim of which is not the production of that item, may be regarded as being a by¬product only if further use of the substance or object is certain and the substance or object can be used directly without any further processing other than normal industrial practice and the substance or object is produced as an integral part of a production process and further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts (Article 5(1) of the Waste Framework Directive 2008/98/EC (EC, 2008a))
Cause	element which alone or in combination has the potential to give rise to risk. (also referred to as "source"). A hazard can be considered to be a cause
Closed	‘Closed’ means the competent authority has carried out a final on-site inspection, assessed all the reports submitted by the operator, certified that the land affected by a waste facility has been rehabilitated and communicated to the operator its approval of the closure.
Competent authority	‘Competent authority’ means the authority or authorities which a Member State designates as responsible for performing the duties arising from its regulatory requirements.
Competent person	‘Competent person’ means a natural person who has the technical knowledge and experience, as defined by the national law of the Member State in which the person operates, to perform the duties arising from this Directive;
Concentrate	Marketable product after separation in a mineral processing plant with an increased grade of the valuable mineral
Consequence	Outcome of an event affecting objectives Note 1: A consequence can be certain or uncertain and can have positive or negative direct or indirect effects on objectives. Note 2: Consequences can be expressed qualitatively or quantitatively. Note 3: Any consequence can escalate through cascading and cumulative effects.
Control	Measure that maintains and/or modifies risk Note 1 to entry: Controls include, but are not limited to, any process, policy, device, practice, or other conditions and/or actions which maintain and/or modify risk. Note 2 to entry: Controls may not always exert the intended or assumed modifying effect.
Dam (pond)	‘Dam’ means an engineered structure designed to retain or confine water and/or waste within a pond (see there).

Dimension stone	Dimension stone is a technical / commercial term that includes all natural stones that can be quarried in blocks of different dimensions. Dimension stones are processed by cutting or splitting and possess specific technical (width, length, shape and thickness) and esthetic properties (colour texture, pattern,…) for use in the building and construction industry as well as in internal decoration and landscaping projects (Cosi M., 2015). Although a variety of igneous, metamorphic, and sedimentary rocks are used as dimension stone, the principal rock types are granite, limestone, marble, sandstone, and slate. Other varieties of dimension stone that are normally considered to be special minor types include alabaster (massive gypsum), soapstone (massive talc), and various products fashioned from natural stone. https://www.usgs.gov/centers/nmic/dimension-stone-statistics-and-information
Disposal	The permanent disposition of materials, including extracted materials, for which no further beneficial use can be foreseen
Exploration	'Exploration' is drilling into a prospect and all related oil and gas operations necessary prior to production-related operations according to MWEI BREF.
Extractive industries	'Extractive industries' means all establishments and undertakings engaged in surface or underground extraction of mineral resources for commercial purposes, including extraction by drilling boreholes, or treatment of the extracted material;
Extractive waste	
Extractive waste influenced water (EWIW)	Any water whose chemical or biological composition has been affected by coming into contact with extractive waste. It includes water contained in or stemming from extractive waste deposition areas (including extractive waste facilities) (Garbarino et al, 2018).
Extractive waste management	The management of extracted materials for which no further beneficial use can be foreseen (see EWD, 2006)
Event	occurrence or change of a particular set of circumstances Note 1: An event can have one or more occurrences, and can have several causes / sources and several consequences. Note 2: An event can also be something that is expected which does not happen, or something that is not expected which does happen. Note 3: An event can be a risk source / cause.
Extractive waste management plan	Defined by EWD (2006)
Hazard	Source of potential harm Note: Hazard can be a risk source or a cause
Hazardous chemical	'Hazardous chemical' is a substance or a mixture that fulfils any of the criteria that render it hazardous set by Regulation (EC) No 1272/2008 (CLP Regulation)
Hazardous waste	'hazardous waste' is a waste which displays one or more of the hazardous properties listed in Commission Regulation (EU) No 1357/2014 and Council Regulation (EU) 2017/997
Heap	'heap' means an engineered facility for the deposit of solid waste on the surface;
Inert waste	'Inert waste' means waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to

	environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater.
Leachate	'Leachate' means any liquid percolating through the deposited waste and emitted from or contained within a waste facility, including polluted drainage, which may adversely affect the environment if not appropriately treated.
Likelihood	Chance of something happening Note 1: In risk management terminology, the word 'likelihood' is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency over a given time period). Note 2: The English term 'likelihood' does not have a direct equivalent in some languages; instead, the equivalent of the term "probability" is often used. However, in English, 'probability' is often narrowly interpreted as a mathematical term. Therefore, in risk management terminology, 'likelihood' is used with the intent that it should have the same broad interpretation as the term 'probability' has in many languages other than English.
Major accident	'Major accident' means an occurrence on site in the course of an operation involving the management of extractive waste in any establishment covered by this Directive, leading to a serious danger to human health and/or the environment, whether immediately or over time, on-site or off-site.
Metallurgy	Metallurgy is the various methods of preparing metals for use by separating them from ores. Also the studies of properties and uses of metals.
Mine	Mine Area under the control of an operator where mining occurs (see "mining"), including common related infrastructure and waste management activities. Examples of mines include but are not limited to the extraction of coal, iron, copper, zinc, silver and gold
Mineral resource	'mineral resource' or 'mineral' means a naturally occurring deposit in the earth's crust of an organic or inorganic substance, such as energy fuels, metal ores, industrial minerals and construction minerals, but excluding water.
Mine site	
Mine waste	
Mining	Any activity involved in the prospecting, extraction, treatment and storage of solid mineral resources originating from deposits in the earth's crust, other than construction minerals.
Operator	'operator' means the natural or legal person responsible for the management of extractive waste, in accordance with the national law of the Member State in which waste management takes place, including in respect of temporary storage of extractive waste as well as the operational and the after-closure phases. MS shall ensure that the operator takes all measures necessary to prevent or reduce as far as possible any adverse effects on the environment and human health brought about as a result of the management of extractive waste. This includes the management of any waste facility, also after its closure [Article 4§2, EWD, 2006]. Approval of closure shall not in any way reduce the operator's obligations under the conditions of the permit or otherwise in law.

Ore	Mineral or variety of accumulated minerals of sufficient value as to quality and quantity that it/they may be mined at a profit. Most ores are mixtures of extractable minerals and extraneous rocky material described as gangue
Ore grade	Dimensionless proportion of any constituent in an ore, expressed often as a percentage, grams per tonne (g/t) or parts per million (ppm)
Pond	'pond' means a natural or engineered facility for disposing of fine-grained waste, normally tailings, along with varying amounts of free water, resulting from the treatment of mineral resources and from the clearing and recycling of process water.
Primary commodity	
Probability	See 'likelihood'
Prospecting	'Prospecting' means the search for mineral deposits of economic value, including sampling, bulk sampling, drilling and trenching, but excluding any works required for the development of such deposits, and any activities directly associated with an existing extractive operation;
Public	'The public' means one or more natural or legal persons and, in accordance with national legislation or practice, their associations, organisations or groups;
Rock	The Rock stream for the purposes of this study is the extractive residues that are left over after accessing and extracting the Ore stream.
Receiving body of water	'Receiving body of water' means surface waters, groundwater, transitional waters and coastal water as defined in Article 2(1), (2), (6) and (7) of Directive 2000/60/EC, respectively.
Rehabilitation	Any measures that may be carried out to reduce the risk from existing extractive facilities or extractive waste management facilities with a view to minimise environmental contamination or risks to humans and the environment. The measures may be applied to contamination itself (the source) or to the exposure pathways to humans. According to EWD (2006) 'rehabilitation' means the treatment of the land affected by a waste facility in such a way as to restore the land to a satisfactory state, with particular regard to soil quality, wild life, natural habitats, freshwater systems, landscape and appropriate beneficial uses;
Remediation	See rehabilitation
Restoration	See rehabilitation
risk	Effect of uncertainty on objectives Note 1: An effect is a deviation from the expected. It can be positive, negative or both, and can address, create or result in opportunities and threats. Note 2: Objectives can have different aspects and categories, and can be applied at different levels. Note 3: Risk is usually expressed in terms of risk sources, potential events, their consequences and their likelihood.
Risk appetite	The amount of risk an organisation or individual is willing to accept
Risk displacement	The involuntary and unforeseen moving of exposures to risk to unconsenting receptors or to different environmental compartments by a risk management measure
Risk management	See 'risk treatment' for definitions

Risk tolerance	The amount of risk an organisation or individual can accept
Risk source	Element which alone or in combination has the potential to give rise to risk. (also referred to as "cause"). A hazard can be considered to be a source of risk
Rock	The extractive residues that are generated in order to access and extract valuable mineral resources
Stripping ratio	The unit amount of waste-rock or overburden that must be removed to gain access to a unit amount of ore, generally expressed in cubic metres of wasterock/overburden to raw tonnes of ore.
Tailing	The *Tailings*: that is the beneficiation residues that are left over after accessing and extracting Concentrates and By-products from Ore
Total excavated material	The *Total excavated material* is the volume generated in order to access and extract valuable mineral resources, which was assumed to equal the sum of the streams *Rock* and *Ore*

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