Funded by
the European Union

# Optimizing quality of information in RAw MAterial data collection across Europe

# Deliverable 1.4
# Draft good practice guidelines for harmonisation of resource and reserve data

| | |
|---|---|
| Title of the project: | Optimizing quality of information in RAw MAterial data collection across Europe - ORAMA |
| Grant Agreement number: | 776517 |
| Funding Scheme: | H2020 – SC5-15-2017 – CSA |
| Start date: | 01.12.2017 |
| Duration: | 24 months |
| Document title: | Deliverable 1.4: Draft good practice guidelines for harmonisation of resource and reserve data |
| Work Package: | 1 |
| Author(s): | Tom Bide, Teresa Brown, Gus Gun, Richard Shaw, Carolin Kresse and Eimear Deady (BGS), Pedro Delgado (IGME), Zoltan Horváth (MBFSZ), Špela Bavec and Duška Rokavec (GeoZS), Taina Eloranta (GTK) and Kari Aasly (NGU) |
| Date of delivery: | 30/4/2019 |
| Dissemination level: | PU[1] |
| Reviewed by: | |
| Status of the document: | **Final** |
| Document location: | Tiimeri: Documents / Deliverables |
| Project web site: | http://www.orama-h2020.eu |

[1] PU=public, PP= Restricted to other programme participants (including the Commission Services), RE= Restricted to a group specified by the consortium (including the Commission Services), CO= Confidential, only for members of the consortium (including the Commission Services)

## Publishable abstract

The EU is highly dependent on mineral raw materials, which are essential for European industries, jobs and growth. Part of the strategy for assessing issues on security of supply of raw materials is to improve the quality and harmonisation of raw materials data. This is essential not just for investigating supply vulnerability at the European level, but also for facilitating information sharing at different levels within the EU. A key requirement of this data is to understand the resource potential of Europe, by evaluating known 'geological stocks' of raw materials using statistics for mineral resources and reserves.

This document aims to provide background information as to the issues around the difficulties to date in compiling a harmonised dataset for primary mineral reserve and resource data in Europe, such as d`ata being complied in a variety of non-comparable systems. It then aims to provide a potential solution to the lack of harmonised data at a European level via the use of the United Nations Framework Classification (UNFC) system as a standard way of classifying mineral resources. This report outlines the initial findings and will be superseded by a final report due to be delivered upon completion of the project.

Use of UNFC overcomes the issue of multiple non-comparable resources and reserves reporting codes and standards in use across Europe by producing data that is harmonised for resources and reserves data at the EU level. It is not suggested that individual countries should change their currents systems of working, many of which have a legal foundation. At the national level, all countries would be able to continue with other systems of reporting to suit their internal purposes, but when figures are reported to a central point for EU level compilation (e.g. European Minerals Yearbook) and in order for them to be consistent and comparable they would need to be converted to a harmonised system such as UNFC.

A simplified guide to the use of UNFC is presented here, along with a range of case studies from European countries that have worked towards producing a harmonised reserve and resource dataset using UNFC.

It is hoped that these resources can act to provide organisations, such as geological surveys and national statistical agencies, who are responsible for the collation of mineral statistical data at a national level, with the required tools to convert existing data to UNFC for the compilation of pan-European resource and reserve estimates.

# TABLE OF CONTENTS

1 Introduction and background to Statistical data for mineral resources and reserves in Europe ..... 5
2 Mineral reserve and resource codes ..... 5
3 The Issues facing statistical data for mineral resources and reserves in Europe. 7
4 Potential solutions for harmonization of European resource and reserve data .. 10
CRIRSCO Template ..... 11
CRIRSCO summary: ..... 11
UNFC ..... 12
UNFC summary ..... 13
5 Using UNFC ..... 14
The UNFC axes ..... 15
6 Bridging, between different codes and classifications ..... 17
Bridging between UNFC and CRIRSCO ..... 18
Bridging between UNFC and the Russian system ..... 20
7 UNFC as a tool for harmonisation ..... 21
Data gaps in European reserve and resource data ..... 23
8 National resource and reserve reporting in Europe ..... 24
National case studies ..... 26
Case studies from countries with a national reporting code ..... 26
Hungary ..... 26
Slovenia ..... 29
Poland ..... 30
The Nordic countries UNFC work ..... 32
Norway ..... 33
Finland ..... 35
Case studies from countries without a national reporting code ..... 37
UK ..... 37
Spain ..... 38
9 Commodity specific issues ..... 42
10 Conclusions ..... 43
11 Useful sources for further information ..... 44
Annex 1: Country summaries for national legal and regulatory frameworks for resource and reserve data ..... 46

# 1 Introduction and background to Statistical data for mineral resources and reserves in Europe

The aim of the ORAMA project is to improve the provision of raw materials information across Europe, for all data types, for both primary and secondary raw materials. These type of data are critical for informing long term planning for industrial strategy and raw materials supply

Many aspects of how data provision can be improved and how national level data can be harmonised at a European level have been outlined in D1.1 and D1.2 for primary raw materials and D2.1 and D2.2 for secondary raw materials. This deliverable report deals with the specific issue of harmonisation of data pertaining to mineral resources (and where appropriate reserves). This report outlines the initial findings and will be superseded by a final report due to be delivered upon completion of the project. This particular subject has been singled out as it has been identified in other H2020 projects, such as Minerals4EU and Minventory, as a major concern hindering the provision of important minerals data. These data are required in order to support the planning and decision making required to ensure the sustainable supply of raw materials. This issue was considered in detail by the Minventory project, which produced a roadmap of how harmonisation of mineral resource data can be achieved. This roadmap and the Minventory project are discussed in more detail in D1.2. The Minerals4EU project attempted to compile an inventory of mineral resources and reserves across Europe, for the first time. Although this project succeeded in compiling a wealth of data at a national level for many European countries, no pan-European totals could be calculated for the reasons discussed below. This prompted further discussion to determine how a consistent, internationally recognised system of reporting for these data could be implemented across Europe.

The European Commission has specifically requested pan-European resource and reserve statistics. However, these currently cannot be provided because these data are collected using different systems of reporting with varying levels of detail and confidence. Consequently the available data are not directly comparable and cannot be aggregated. This report aims to explore the issues around different standards of reporting mineral resource information and suggests that the United Nations Framework Classification (UNFC) could be a method for producing harmonised figures and should be adopted for pan-European reporting. This will require tools to bridge existing data, that are reported in other systems, to the UNFC. This report provides case studies from different countries for a range of different data to show how this can be achieved.

# 2 Mineral reserve and resource codes

How mineral resources and reserves are defined is the key issue for harmonisation. Different systems, codes and standards of resource reporting all use different definitions; these differences can often be subtle but can have significant implications on the data reported. A comprehensive review of different types of systems of reporting, their definitions, background and purpose can be found in the Minventory final deliverable[2] and to minimise repetition only a brief summary of the definitions and different reporting systems are given here.

[2] Parker, D, Petavratzi, E, Mankelow, J, Waugh, R, and Bertrand, G. 2015. Minventory: EU raw materials statistics on resources and reserves. European Commission. https://ec.europa.eu/docsroom/documents/10224/attachments/1/translations/en/renditions/pdf

A commonly used definition is that a mineral resource is a natural concentration of material in such form and quantity that economic extraction of a commodity is potentially feasible[3,4]. Reserves are that part of an identified resource that could be economically extracted at the time of the assessment, taking into account the 'modifying factors' (these will vary by reporting system but could include, for example, the issuance of mining and environmental permits, the establishment of legal ownership or royalty agreements, etc.). Consequently mineral resources and reserves are of fundamental importance to the global mining industry because they identify deposits that are currently economically and legally extractable (reserves) and those where economic and legal extraction of a commodity is potentially feasible (resources).

Reserves can be regarded as working inventories at a particular point in time, determined by numerous variables including discovery and extraction rates, technologies for extraction, processing and use, and various political, legal, economic and social factors that influence their accessibility. As a result of their dynamic nature and the inherent uncertainties in global and national totals, published reserve estimates should not be regarded as reliable indicators of the future availability of mineral commodities[6,5].

The size of mineral resources and reserves are critically dependent on the commodity price prevailing at a particular time. If the commodity price rises, then a greater proportion of the deposits containing that mineral will become economically profitable to extract and these could be added to the figures for resources (providing there are no other factors to prevent this). Conversely, if the commodity price falls, then some deposits previously considered as resources may become uneconomic and these would no longer be included within that term.

The various reporting systems set out minimum standards, recommendations and guidelines for the public reporting of exploration results, mineral resources and ore reserves. For example, in Australia companies listed on the Australian Securities Exchange are required to use the code of the JORC. Companies that report their results on stock exchanges in Canada are required to follow the rules and guidelines of National Instrument (NI) 43-101. Various professional bodies have worked hard to harmonise definitions and reporting standards but substantial differences remain between many commonly used systems of reporting[6].

Different jurisdictions have very different ways of measuring and reporting mineral resources and reserves. For example there are the many international standards that use the CRIRSCO template (Committee for Mineral Reserves International Reporting Standards). This is a grouping of representatives of organisations that are responsible for developing mineral reporting codes and guidelines. These comprise:

- Joint Ore Reserves Committee (JORC) Code (Australia)
- Canadian Institute of Mining (CIM) Code (Canada)
- Certification Code for Exploration Prospects, Mineral Resources and Ore Reserves (Chile)

[3] CRIRSCO. 2016. Committee for Mineral Reserves International Reporting Standards. [cited June 2016]. http://www.crirsco.com/welcome.asp

[4] US Geological Survey. 2018. Mineral Commodity Summaries 2018. (Reston, VA)

[5] P. A. J. Lusty, and A. G. Gunn. 2015. Challenges to global mineral resource security and options for future supply. 265–276 in *Ore Deposits in an Evolving Earth*. McDonald, I (editor). Special Publications 393. (London: Geological Society.)

[6] P. C. F. Crowson. 2011. Mineral reserves and future minerals availability. *Mineral Economics*, Vol. 24, 1-6

- South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves (SAMREC) Code (South Africa)
- Society for Mining, Metallurgy and Exploration (SME) Guide (United States)
- Russian Code for the Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves (NAEN Code) (post 2011) (Russia)
- Pan European Reserves and Resources Reporting Committee (PERC) Reporting Standard (Europe)
- National Resources and Reserves Reporting Committee (UMREK Code) (Turkey)
- Indonesian Committee for Mineral Reserves (KCMI Code) (Indonesia)
- Mongolian Resource Committee Code (MRC Code)(Mongolia)
- The Code of the Republic Kazakhstan n subsoil and subsoil use (KAZRC) (Kazakhstan)
- Comisión Colombiana de Recursos y Reservas Mineras (CCRR) (Columbia)
- Guide for Reporting Exploration Results, Mineral Resources, and Mineral Reserves (CBBR) (Brazil)

More details of these reporting standards can be found at http://crirsco.com/national.asp.

There are also many European countries that use their own resource code. This is commonly for use in national resource management as opposed to financial or stock exchange reporting, which frequently require use of a CRIRSCO compliant code. In many cases these National Reporting Codes are adapted from CRIRSCO compliant codes, but in others they have been developed independently. A detailed description of the resource codes used by individual European countries can be found in Appendix 1 of this report.

In addition, there is also the United Nations Framework Classification (UNFC), a method of classifying mineral resources developed by the UN. This classification scheme is aimed to be used at a national level to build global energy and mineral studies, analyse government policies, plan industrial processes and allocate capital efficiently. UNFC has been designed to be an interoperable scheme between different commodities such as petroleum, minerals, renewable energy, nuclear fuel and anthropogenic resources.

# 3 The Issues facing statistical data for mineral resources and reserves in Europe

Europe is highly dependent on mineral raw materials, which are essential for European industries, jobs and growth. Part of the strategy to ensure security of supply of mineral raw materials is to improve the quality and harmonisation of statistical data. This is essential not just for investigating supply vulnerability at the European level, but also for facilitating information sharing at different levels within Europe. A key requirement is to understand the resource potential of Europe, by evaluating known ‘geological stocks’ of mineral raw materials using statistics for resources and reserves. Without some level of interoperability for mineral raw materials data between different European countries, it is very difficult to compare data, to assess the quantities and locations of mineral resources across Europe and to develop a coherent industrial strategy and raw materials policy.

A significant amount of work was undertaken by the Minerals4EU[7] project in collecting figures for mineral resources and reserves from official sources across European countries. This was the first time that statistics on mineral resources and reserves were collected at the European level and they became publicly available through the electronic European Minerals Yearbook. However, it is apparent that no pan-European resource and reserve estimates can be obtained from those numbers due to serious issues relating to data availability, quality and harmonisation.

The main issues with using the M4EU dataset for this purpose are:

1. For many countries there are either no data or data for only certain commodities.
2. Data were compiled according to a wide variety of systems of reporting across Europe. A total of 19 different systems were used in data collected by Minerals4EU and more are known to exist that were not reported. These codes are not comparable and cannot be summed.
3. Some countries use their own unique national reporting systems, while others use a number of different codes.
4. The ages of the datasets vary considerably. Some are undated 'historical' estimates, while others are modern estimates based on current international reporting systems.

The fundamental issues with the resource data from the Minerals4EU project is illustrated in Figure 1. This shows the large array of different reporting schemes and classification systems for one commodity, gold. Each separate coloured box in Figure 1 represents a reported data point that uses the same definition. Although there may be established methods to bridge between some of the codes and classifications listed in the diagram no effort has been made to convert between them. For some data points there are no examples of how data can be bridged across to other internationally recognised ways of reporting, such as UNFC or CRIRSCO.

Any national or pan-European totals that could be derived from summing reserve and resource estimates obtained by these projects would be incomplete and fundamentally flawed. Furthermore, they would provide no indication of the current availability of a commodity within Europe nor of the potential for future discovery. They would be incompatible with the global resource and reserve data published annually by the USGS with which they would inevitably be compared to provide an indication of their significance relative to those in the rest of the world[4]. However, it is important to note that the reserve estimates published by the USGS do not always meet the specified ideal situation such that the information would be derived from "comprehensive evaluations that apply the same criteria to deposits in different geographic areas and report the results by country"[4] as set out by USGS.

The inability to easily produce reliable statistics about resources and reserves of raw materials is a major concern for the European Commission. Some level of agreement on which of the internationally recognised systems of reporting should be adopted at a pan-European level is essential for improving the situation. Procedures for data collection and accessibility at specified time intervals are also required to ensure consistent and continuous reporting

[7] Minerals Intelligence Network for Europe. 2016. http://www.minerals4eu.eu/

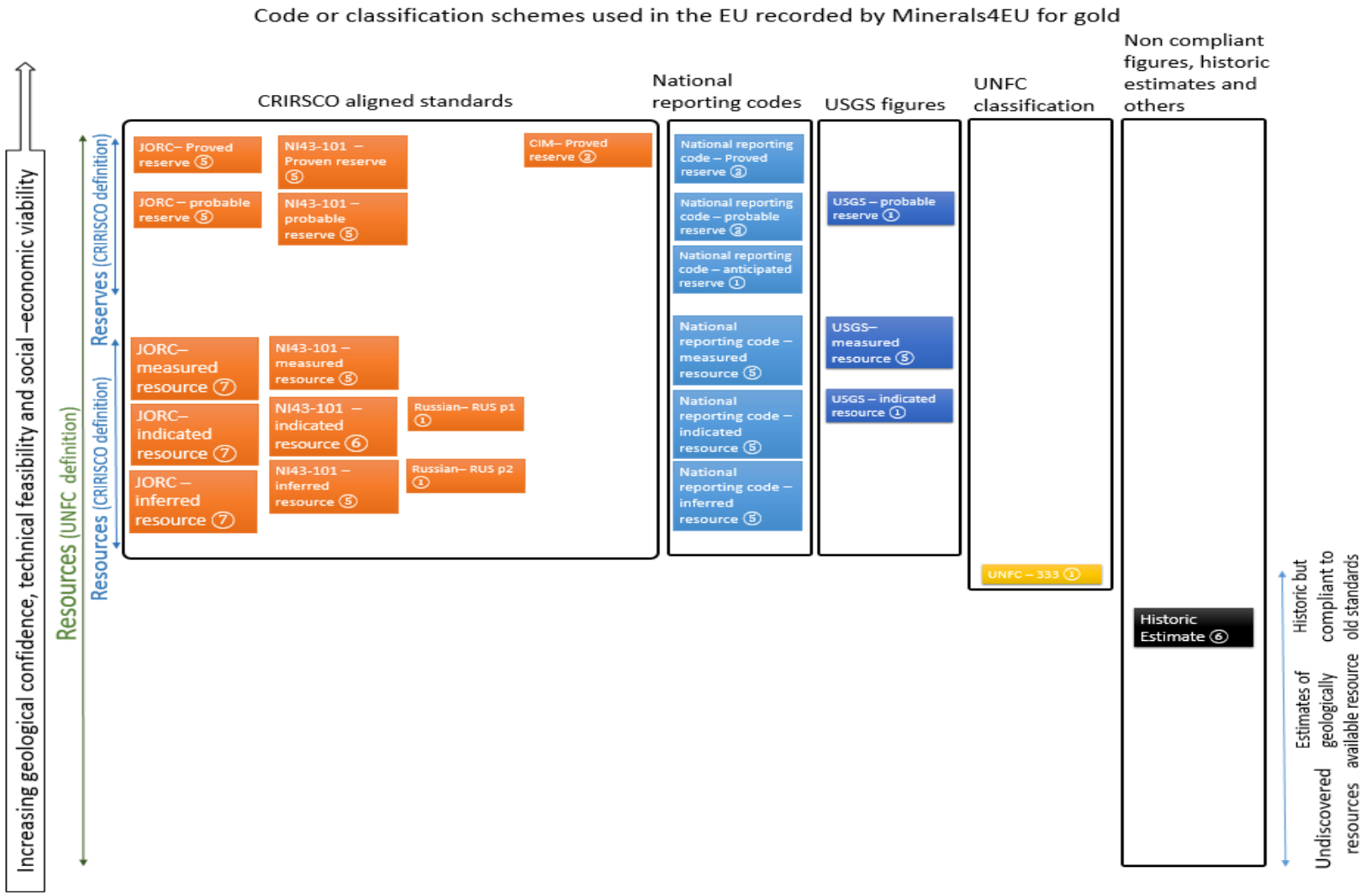


*Figure 1: Codes and classification schemes used in Europe recorded by Minerals4EU for gold. Text indicates: name of code, standard or classification scheme used for reporting, number encircled and box size indicates the number of figures reported using this for the Minerals 4EU project.*

# 4 Potential solutions for harmonization of European resource and reserve data

One solution to the issue of multiple non-comparable resources and reserves reporting codes and standards in use across Europe would be harmonisation of resources and reserves data at the European level. It is not suggested that individual countries should change their currents systems of working, many of which have a legal foundation. At the national level, all countries would be able to continue with other systems of reporting to suit their internal purposes, but when figures are reported to a central point for European level compilation (e.g. the electronic European Minerals Yearbook) they would need to be converted to a harmonised system in order for them to be consistent and comparable. This approach has been described in the Minventory project final report[2] and was also recommended in the Minerals4EU deliverable 4.3 report[8].

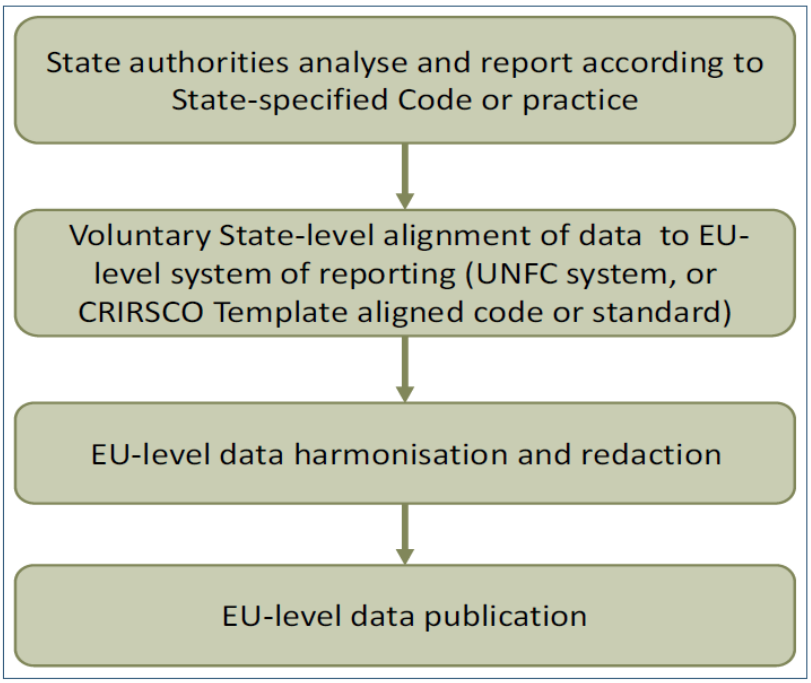


*Figure 2. A potential road map for resource data harmonisation outlined by the Minventory project for data harmonisation, source: Minventory final report.*

It is acknowledged that this will require clear guidance and instructional documents to enable the transposition of existing data to agreed systems. These sorts of documents have been referred to as mapping or bridging documents by previous projects, the term bridging document has been used here for clarity. Training of appropriate personnel to enable this to be done at a national level is also essential.

The use of a single system of reporting should be agreed by European nations in order to move forward with the European level harmonisation of mineral resources and reserves statistical data. The chosen system of reporting should be internationally recognised, widely accepted across Europe, be fit for purpose for national reporting and have the capacity for other reporting standards and codes to be bridged to it. There are two routes that fit these criteria, systems of reporting adhering to the CRIRSCO template, or the adoption of the UNFC classification

[8] Brown, T, and Petavratzi, E. 2015. Report on the availability of mineral statistics. Minerals 4EU WP4 Deliverable 4.3. https://vyvi-some2.vy-verkko.fi/gtk/Minerals4EU/Deliverables

framework. There are a number of notable differences between the two routes, as discussed in the following sections.

## *CRIRSCO Template*

The Committee for Mineral Reserves International Reporting Standards (CRIRSCO) is an advisory body (without legal authority) set up to promote best practice in the international public reporting of Mineral Exploration Results, Mineral Resources and Mineral Reserves. An International reporting template (the CRIRSCO Template) was released in July 2006 and an update was published in 2013. This template is advisory and intended to be used as a model for development of new reporting codes, and alignment of existing ones, in for potential new members. CRIRSCO-aligned codes are organised according to the classification in Figure 3, which splits categories into mineral reserves, mineral resources and exploration results. The CRIRSCO family of codes has been designed specifically for the reporting of results to stock exchanges to ensure a consistent standard is applied to protect investors. As a result of this any 'reserves' or 'resources' stated are economic entities that have a realistic chance of being extracted in the future.

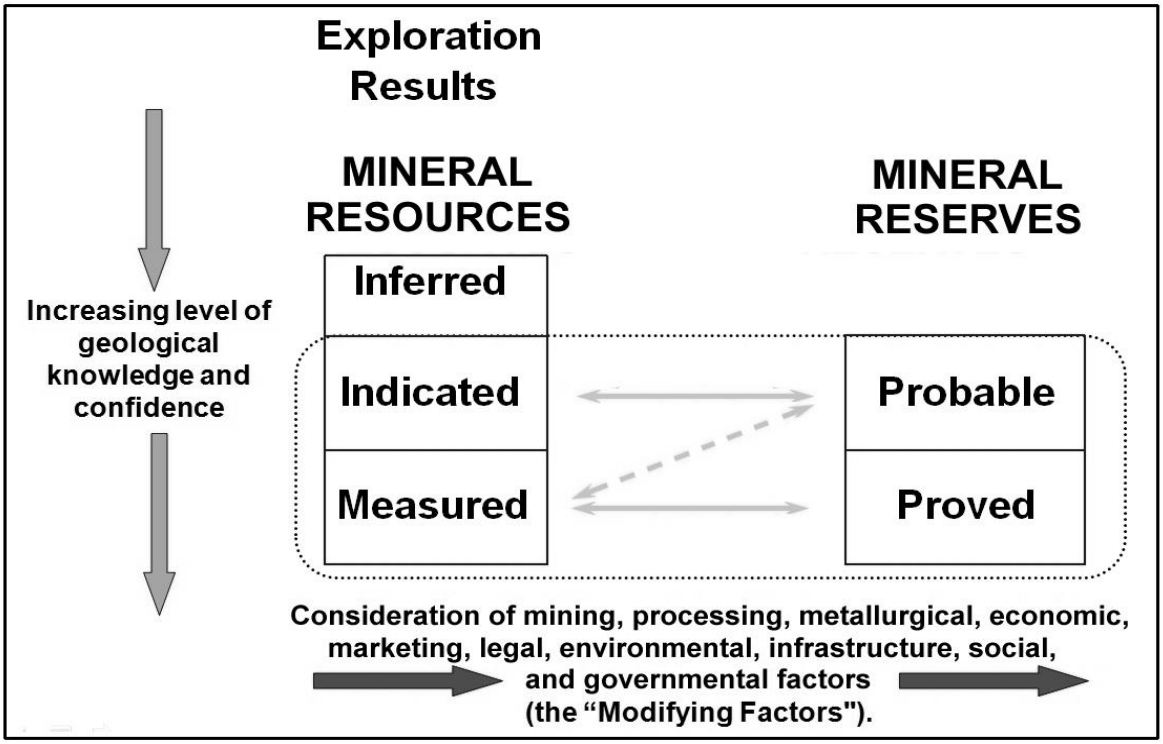


*Figure 3: The CRIRISCO classification scheme, source: CRIRISCO, modified from McKelvey, V.E., 1972. Mineral Resource Estimates and Public Policy. American Scientist, 60(1), pp.32-40.*

### *CRIRSCO summary:*

**Advantages (for regional/national/continental scale reporting)**

- Widely used by industry
- A lot of data are available that adheres to the CRIRSCO template (from industry)
- Individual codes (PERC, JORC etc...) are clearly defined standards and backed by professional bodies

- Confidence is given to any reported figures by the need for a 'competent person' whose qualifications are clearly defined in the standard.
- The modified McKelvey diagram is very clear way of conveying to non-experts the levels of confidence for different categories

**Disadvantages (for regional/national/continental scale reporting)**

- CRIRSCO is not designed for the purpose of national- or continent-scale strategic planning or policy making. It is designed for public reporting and to help protect investors. As such, it cannot take into account all that needs to be considered for national level reporting.
- There is no provision to record anything that is not currently economic. As a result, this is a 5–10 year snapshot of what is economic to extract or will be in the near future. It does not take into account known but poorly defined deposits or anything that is not currently worked due to environmental or economic constraints. This is not a true representation of the total mineral inventory.
- The requirements for a 'competent person' are quite onerous and discourage many organisations
- It is less frequently used for many construction or industrial minerals or by private companies
- Any work done by governments/geological surveys will most likely not adhere to the CRIRSCO template because it mostly relates to early-stage exploration and pre-competitive research.

### *UNFC*

The United Nations Framework Classification (UNFC) for Fossil Energy and Mineral Resources (UN, 2010) is a global classification system developed under a mandate from the UN Economic and Social Council and serviced by the Expert Group on Resource Classification (EGRC) of the United Nations Economic Commission for Europe (UNECE). The UNFC is a flexible classification system that is capable of meeting the requirements for application at national, industrial and institutional level, as well as to be successfully used for international communication and trans-national assessments. It should be emphasised that UNFC is a *classification* and not a full reporting standard. It provides no guidance on data quality or validation, or on methods or formats of reporting.

In the UNFC system quantities are classified using a numerical coding scheme for three fundamental criteria: economic and social viability (E); field project status and feasibility (F); and uncertainty, mostly related to geological knowledge (G). Combinations of these criteria can be displayed and visualized in three dimensions (Figure 4) or reduced to two dimensional presentations (Figure 5).

The UNFC system has been designed to create mineral inventories in harmonised ways that can be easily combined across regions and national borders for the purpose of developing mineral policies and planning. Unlike CRIRISCO, UNFC can accommodate resources that are not economic to extract under current market conditions. The UNFC system does not use the term 'reserves', rather all categories are considered 'resources.

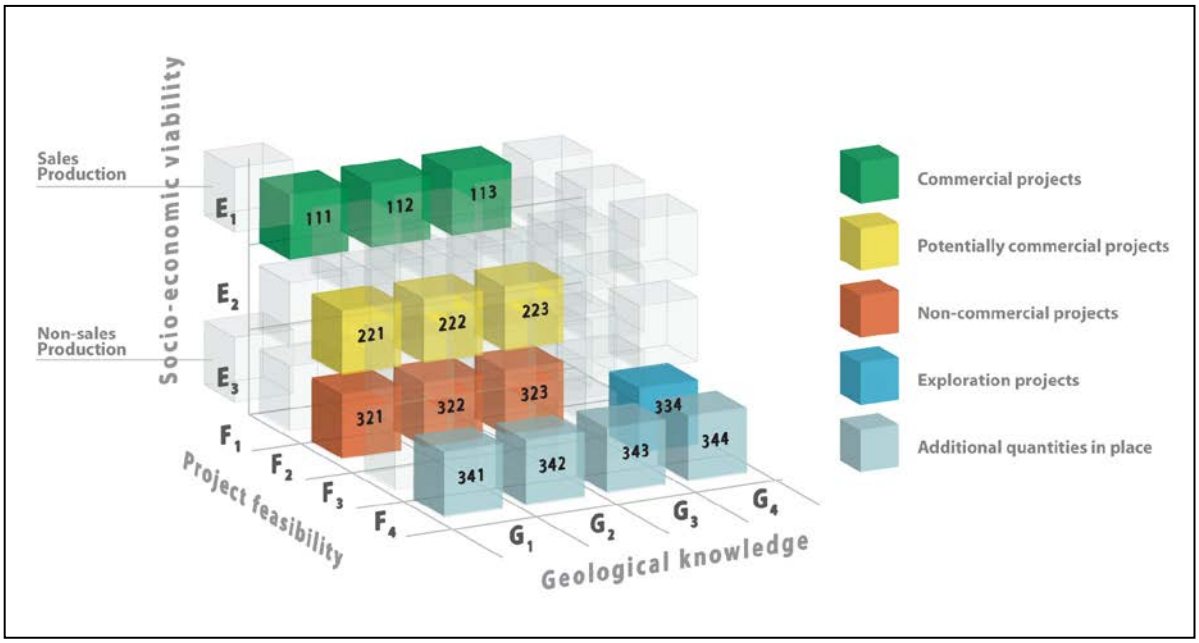


*Figure 4: The UNFC classification system, source: UNFC.*

### *UNFC summary*

**Advantages (for regional/national/continental scale reporting)**

- It is easy to compare a wide range of commodities using UNFC, including minerals, petroleum, renewable energy sources, water, etc.
- UNFC has been designed for national- or continent-scale reporting and has the flexibility to accommodate a wide range of different types of information.
- UNFC can accommodate 'uneconomic' and 'undiscovered' resources, including early stage exploration, giving a full picture of known mineral stocks.
- A bridging document has been prepared between CRIRSCO and UNFC.
- Work has already been completed that bridges some national codes to UNFC.
- It is already being used for mineral resource inventories in some countries – e.g. Hungary, Finland, Ukraine, Romania – and possible Norway in the future.
- Backed by the UN – internationally recognised.
- Although competency to report using the UNFC framework is required, this is not an essential requirement (i.e. the UNFC is not a certifying body). As a result it is more readily accessed by geological surveys

**Disadvantages (for regional/national/continental scale reporting)**

- UNFC is a classification that does not include any rules governing public reporting of estimates. It is not, therefore, accepted for reporting on any stock exchanges and consequently is unlikely to be taken up by large publically-listed companies.
- Many companies do not report data to UNFC and their data will need to be bridged across (but this is possible if they report in accordance with the CRIRSCO template as a bridging document already exists).

- The three axes approach makes it appear complicated – this can be an issue if trying to communicate with policy makers or encouraging others to adopt it. But 2D representations are also possible.
- Bridging from CRIRSCO to UNFC is not always a one-to-one association but a one-to-many association, i.e. a single category in CRIRSCO may bridge to two categories in UNFC. More information may, therefore, be required at the deposit level to be sure it is correctly classified.

# 5 Using UNFC

On account of its flexibility, together with the fact it has been designed to be used at a national level, and is already being used or considered for use in several European countries, UNFC appears to be the best tool for harmonisation. The three axes and block diagram representation (Figure 4) can appear to be complex and difficult to understand. It is, therefore, simpler to consider the classification system in two dimensions (Figure 5).

| Total Commodity Initially in Place | Extracted | Sales Production | | | |
|---|---|---|---|---|---|
| | | Non-Sales Production | | | |
| | | Class | Categories | | |
| | | | E | F | G |
| | Future recovery by commercial development projects or mining operations | Commercial Projects | 1 | 1 | 1, 2, 3 |
| | Potential future recovery by contingent development projects or mining operations | Potentially Commercial Projects | 2 | 2 | 1, 2, 3 |
| | | Non-Commercial Projects | 3 | 2 | 1, 2, 3 |
| | Additional quantities in place associated with known deposits | | 3 | 4 | 1, 2, 3 |
| | Potential future recovery by successful exploration activities | Exploration Projects | 3 | 3 | 4 |
| | Additional quantities in place associated with potential deposits | | 3 | 4 | 4 |

*Figure 5: Abbreviated version of UNFC-2009, showing the primary classes. Source: UNFC.*

This shows the range of codes that are possible for some typical stages of the lifecycle of a minerals project. However, the flexibility of the UNFC system means that other combinations of codes are possible to suit the individual circumstances. Each project, or data point for resources, needs to be considered in turn and its place on each axis considered separately, because many have individual properties, which may affect the UNFC classification.

## *The UNFC axes*

The simplest way to use the UNFC classification is to consider each of the three axes in turn. The E axis encompasses factors that influence economic and social viability. These can include the legal and fiscal framework in the jurisdiction where the resource is located, environmental factors, the social acceptability of mineral extraction and other factors of a non-technical nature (which would be covered by the F axis). An explanation of the different E axis categories is given in Figure 6. An example of E1 would be an operating mine, E2 may be a mine that is not yet operational but where a feasibility study has been completed, while E3 covers resources which may be too small to be economic, or deposits at an early stage of exploration with unproven economics or that may be unviable due to environmental constraints. The E axis may be the most difficult for geological surveys to assess. They may require additional help when considering economic and social aspects if the relevant expertise is not available in house.

| Category | Definition[b] | Supporting Explanation[c] |
|---|---|---|
| E1 | Extraction and sale has been confirmed to be economically viable.[d] | Extraction and sale is economic on the basis of current market conditions and realistic assumptions of future market conditions. All necessary approvals/contracts have been confirmed or there are reasonable expectations that all such approvals/contracts will be obtained within a reasonable timeframe. Economic viability is not affected by short-term adverse market conditions provided that longer-term forecasts remain positive. |
| E2 | Extraction and sale is expected to become economically viable in the foreseeable future.[d] | Extraction and sale has not yet been confirmed to be economic but, on the basis of realistic assumptions of future market conditions, there are reasonable prospects for economic extraction and sale in the foreseeable future. |
| E3 | Extraction and sale is not expected to become economically viable in the foreseeable future or evaluation is at too early a stage to determine economic viability.[d] | On the basis of realistic assumptions of future market conditions, it is currently considered that there are not reasonable prospects for economic extraction and sale in the foreseeable future; or, economic viability of extraction cannot yet be determined due to insufficient information (e.g. during the exploration phase).Also included are quantities that are forecast to be extracted, but which will not be available for sale. |

b the term "extraction" is equivalent to "production" when applied to petroleum.
c the term "deposit" is equivalent to "accumulation" or "pool" when applied to petroleum.
d the phrase "economically viable" encompasses economic (in the narrow sense) plus other relevant "market conditions", and includes consideration of prices, costs, legal/fiscal framework, environmental, social and all other non-technical factors that could directly impact the viability of a development project.

*Figure 6: Explanation for the UNFC E axis. Source: UNFC.*

The F axis considers the technical feasibility of a project. This differs from the E axis in that it assesses the confidence in technical aspects of project development, such as processing technology, the maturity of exploration and the commitments required, such as extra infrastructure necessary for development. The definitions and explanation for the F axis are given in Figure 7.

| Category | Definition | Supporting Explanation |
|---|---|---|
| F1 | Feasibility of extraction by a defined development project or mining operation has been confirmed. | Extraction is currently taking place; or, implementation of the development project or mining operation is underway; or, sufficiently detailed studies have been completed to demonstrate the feasibility of extraction by implementing a defined development project or mining operation. |
| F2 | Feasibility of extraction by a defined development project or mining operation is subject to further evaluation. | Preliminary studies demonstrate the existence of a deposit in such form, quality and quantity that the feasibility of extraction by a defined (at least in broad terms) development project or mining operation can be evaluated. Further data acquisition and/or studies may be required to confirm the feasibility of extraction. |
| F3 | Feasibility of extraction by a defined development project or mining operation cannot be evaluated due to limited technical data. | Very preliminary studies (e.g. during the exploration phase), which may be based on a defined (at least in conceptual terms) development project or mining operation, indicate the need for further data acquisition in order to confirm the existence of a deposit in such form, quality and quantity that the feasibility of extraction can be evaluated. |
| F4 | No development project or mining operation has been identified. | In situ (in-place) quantities that will not be extracted by any currently defined development project or mining operation. |

*Figure 7: Explanation for the UNFC F axis. Source: UNFC.*

The G axis considers confidence in geological knowledge. This will cover the stage of exploration, the quantities of samples taken, the amount of drilling carried out and/or the overall geological knowledge and complexity of the project or resource area. The definitions and explanations of the G axis are shown in Figure 8. G1 relates to deposits that have been extensively studied with detailed local scale investigations that allow detailed geological models to be built with a high degree of confidence. This includes, for example, projects that are in production, that have been in production or are at an advanced stage of development. As the G axis increases the level of confidence in the geological knowledge decreases. There is no precise definition of what is meant by high, medium and low levels of confidence in UNFC. Furthermore, the nature and amount of data required will be dependent on the deposit type and geological situation. This is discussed further in section 9. The G4 category is for resources where there is little actual geological knowledge of a deposit. This will include deposits inferred from regional geological mapping, geophysical or geochemical data, predictive modelling, poorly constrained historic estimates and early stage exploration.

| Category | Definition | Supporting Explanation |
|---|---|---|
| G1 | Quantities associated with a known deposit that can be estimated with a high level of confidence. | For in situ (in-place) quantities, and for recoverable estimates of fossil energy and mineral resources that are extracted as solids, quantities are typically categorised discretely, where each discrete estimate reflects the level of geological knowledge and confidence associated with a specific part of the deposit. The estimates are categorised as G1, G2 and/ or G3 as appropriate. |
| G2 | Quantities associated with a known deposit that can be estimated with a moderate level of confidence. | |
| G3 | Quantities associated with a known deposit that can be estimated with a low level of confidence. | |
| G4 | Estimated quantities associated with a potential deposit, based primarily on indirect evidence. | Quantities that are estimated during the exploration phase are subject to a substantial range of uncertainty as well as a major risk that no development project or mining operation may subsequently be implemented to extract the estimated quantities. Where a single estimate is provided, it should be the expected outcome but, where possible, a full range of uncertainty in the size of the potential deposit should be documented (e.g. in the form of a probability distribution). In addition, it is recommended that the chance (probability) that the potential deposit will become a deposit of any commercial significance is also documented. |

*Figure 8: Explanation for the UNFC G axis. Source: UNFC.*

The E and F axis can also be further divided into sub-codes, which differentiate between specific stages in the development of a project. For example, such sub-codes may be useful if government subsidies can make a deposit economic or if capital funding has been invested but production is not yet underway. It should be noted, however, that for use in a resource management system the use of sub-codes is essential to properly assess the status of a project.

# 6 Bridging, between different codes and classifications

Various documents, known as 'bridging documents,' exist to convert between different systems of defining resources, which have been developed by governments and the minerals industry to enable comparisons. However, not all commonly used definitions have bridging documents, as shown in Figure 9. This highlights that resource harmonisation can be a very challenging task.

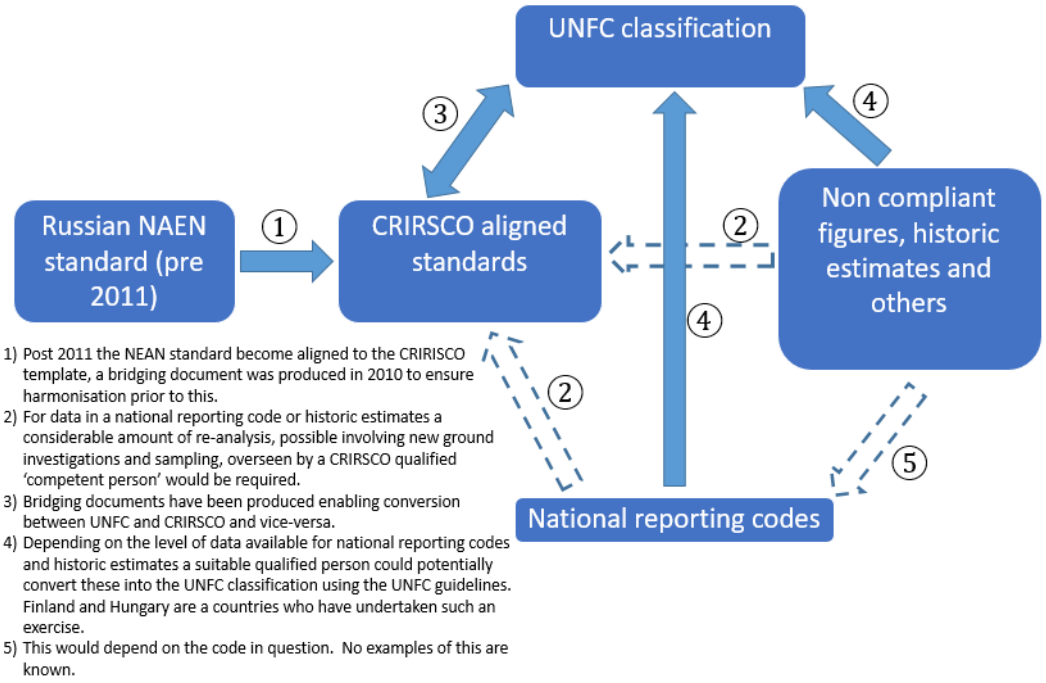


*Figure 9: Bridging documents between different reporting codes and classifications. Solid arrows indicate existing bridging documents, dotted arrows indicate where bridging may be possible but little or no official documents exist.*

## *Bridging between UNFC and CRIRSCO*

Both the UN and CRIRSCO have undertaken substantial work to develop a bridging document between the CRIRSCO template reporting standards and the classification systems employed by the UNFC. As a result there is a clear set of rules that can be followed to effectively bridge one to the other. Although it must be noted that the individual circumstances of specific deposits always need to be taken into account so a 'one size fits all' approach may not always work and each project needs to be considered on its own merits. The detailed bridging instructions can be found in the UNFC guidance document[9] and specific cases studies and examples can be found in associated case studies[10] which goes into great detail about the specific circumstances that users may encounter for different types of projects. Examples of how CRIRSCO template figures have been bridged to UNFC are provided in Annex 2, which is a case study that has compiled statistics for mineral resources in the UK using UNFC.

The simple bridging between CRIRSCO and UNFC is outlined in Figure 10, taken from the UNFC guidance document. This shows relatively simple one-to-one relationships between categories in either system. Although it should be noted that in many cases 'proved' and 'probable' reserves are combined, as are 'measured,' 'indicated' and 'inferred' resources, in these cases the specific location of the data point on the G axis is uncertain and a combination of G axis codes may be required, e.g. G1+G2.

[9]United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC-2009) https://www.unece.org/energy/se/unfc_2009.html
[10] S. Henley. CRIRSCO-UNFC 2009 mapping Solid Minerals Case Studies. https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc_egrc/egrc5_apr2014/30Apr/10_Henley_UNFC_Minerals_CS.pdf

| CRIRSCO Template | | UNFC-2009 "minimum" Categories | | | UNFC-2009 Class |
|---|---|---|---|---|---|
| Mineral Reserve | Proved | E1 | F1 | G1 | Commercial Projects |
| | Probable | | | G2 | |
| Mineral Resource | Measured | E2 | F2 | G1 | Potentially Commercial Projects |
| | Indicated | | | G2 | |
| | Inferred | | | G3 | |
| Exploration Results | | E3 | F3 | G4 | Exploration Projects |

*Figure 10: Bridging between UNFC and CRIRSCO. Source: UNFC.*

Another way of visualising the basic bridging of the two systems is shown in Figure 11.

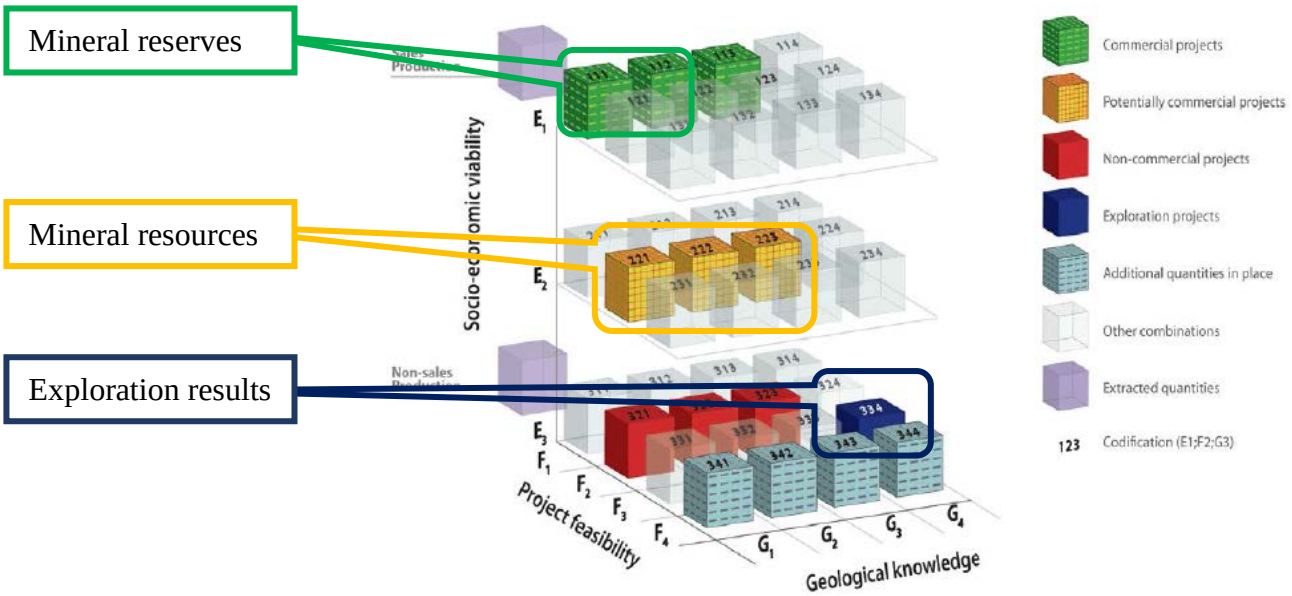


*Figure 11: Bridging between UNFC and CRIRSCO. Source UNFC.*

Figure 11 also shows the many possible resource types (especially non-commercial resources) that can be covered by UNFC but are not covered by CRIRSCO. This needs to be carefully considered as if only CRIRSCO figures are used a full dataset of resource stocks as defined by UNFC will not be possible.

It is also important to note when bringing between CRIRSCO and UNFC, if figures for reserves are included in those for resources (figures will often state weather resources are exclusive or

inclusive of material used to estimate reserves). These must always be separated to avoid double counting.

## *Bridging between UNFC and the Russian system*

The Russian code, or NAEN code, has, been aligned with the CRIRSCO template since 2011. As such the NAEN code incorporates the principles, terminology and definitions of the CRIRSCO template whilst retaining many of the principles behind the superseded Russian State System. Due to its alignment to CRIRSCO, the existing bridging document from CRIRSCO to UNFC can be used to bridge between NAEN to UNFC.

Within Europe many central and eastern European counties use a derivation of the older, non-CRIRSCO-aligned Russian State System. There is a bridging document that can be used to convert Russian State classification categories to CRIRSCO[11] and from there the CRIRSCO-UNFC bridging document discussed in section 0 can be used. The basic principles of bridging between some of the concepts in the Russian System and CRIRSCO are shown in Figure 12. This shows the concept of 'balance reserves' and 'off balance' material. These refer respectively to material that can be reported after approval by the relevant state body and is proven to be economically recoverable, and material that is uneconomic, for reasons such as they are below agreed cut-off grades, inaccessible by current mining methods or processing technologies.

Russian "Balance Reserves", with consideration of all MODIFYING FACTORS, **and after any adjustments for MINING LOSSES and DILUTION**

| Complexity Group | CRIRSCO category of Mineral Reserves | | | |
|---|---|---|---|---|
| | C2 | C1 | B | A |
| 1 | PROBABLE | PROVED | PROVED | PROVED |
| 2 | PROBABLE | PROVED | PROVED | no |
| 3 | PROBABLE | PROVED | no | no |
| 4 | PROBABLE | PROBABLE | no | no |

Based on level of geological knowledge. Includes Russian "off-balance" material provided there are reasonable prospects for eventual economic extraction

| Complexity Group | CRIRSCO category of Mineral Resources | | | |
|---|---|---|---|---|
| | C2 | C1 | B | A |
| 1 | INDICATED | MEASURED | MEASURED | MEASURED |
| 2 | INDICATED | MEASURED | MEASURED | no |
| 3 | INDICATED | MEASURED | no | no |
| 4 | INDICATED | INDICATED | no | no |

*Figure 12: Conversion of the Russian State Committee on Reserves (GKZ) system to CRIRSCO mineral resources and reserves system (Source: S. Henley, 2010[12]). Note that the CRIRSCO categories refer to the coloured boxes not the A, B, C1 and C2 categories.*

Another term used by the Russian State system which is not simply transferable to the CRIRSCO template are 'Prognostic resources': these are estimates based on inferred geological data. The category of P3 in particular does not translate to the CRIRSCO template as these represent the potential possibility of discovery of a mineral deposit based on regional survey work. P3 would, however, bridge to the UNFC category of 334 there is currently however no official guidance of bridging between the old (GKZ) Russian system and UNFC.

Further details of how individual countries use a system based on the Russian State system can be found in section 0. This includes several case studies of how individual countries bridged their existing data to UNFC.

[11] GKZ and CRIRSCO. Guidelines on Alignment of Russian minerals reporting standards and the CRIRSCO Template. 2010. https://docplayer.ru/26006551-Table-of-contents-1-introduction-2-scope.html
[12] S. Henley. 2010. Reporting Russian reserves and resources for international markets. Presentation for CRIRSCO and ICMM. https://www.slideshare.net/silicondale/russiacrirsco-june-2010

# 7 UNFC as a tool for harmonisation

As discussed above UNFC is the only commonly used, internationally recognised system that can incorporate something close to the concept of 'all there is' in terms of mineral resources and can, therefore, provide a relatively complete picture of mineral stocks. The majority of other internationally recognised systems cannot accommodate uneconomic and undiscovered resources, including early stage exploration and historical estimates. For commercial development the concept of 'all there is', sometimes referred to as the ultimate recoverable resource, is unnecessary, and perhaps even unhelpful, because it is not required for stock markets or investors. However, it is important to know more broadly what the ultimate recoverable resources are likely to be when considering longer-term minerals planning and industrial strategy on a national or continental scale. However, it should be recognised that, even though UNFC may be able to accommodate this kind of data, for many countries such data has not previously been collected and may not currently exist in any format. An absence of data does not necessarily mean an absence of resources. These issues are further explained in section 8.

As discussed in section 6, UNFC is also a useful system to use because several bridging documents already exist between UNFC and other codes and standards, including many examples of national resource codes (see section 8). In addition, although competency to report using the UNFC framework is required, this is not an essential requirement (UNFC is not a certifying body, unlike CRIRSCO family codes) and as a result it is potentially more easily assessed by geological surveys.

The following hypothetical example (Figure 13 and following text) is provided to summarise the challenges of harmonising resource data in Europe discussed above and to highlight how UNFC can help with harmonisation. This uses a theoretically identical deposit located in three different countries that utilise three different systems of reporting.

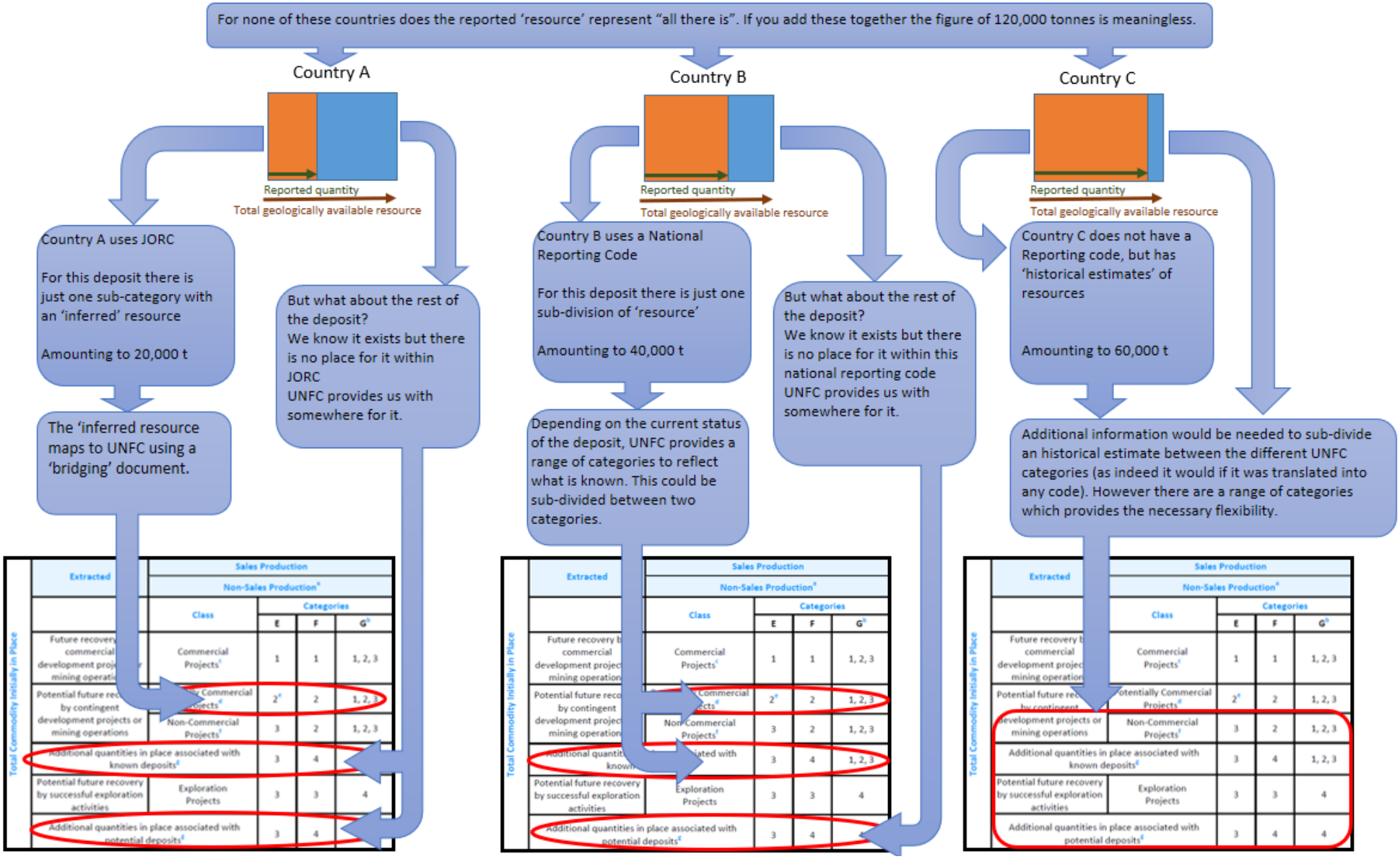


*Figure 13: How UNFC can help in harmonisation*

By using UNFC the three resource figures in the example, which were previously incompatible, can be compared in a consistent manner. This allows aggregated totals for separate categories under UNFC to be produced (Figure 14).

| UNFC category | Description | Country A | Country B | Country C |
|---|---|---|---|---|
| 222 | Potentially commercial project | 20,000 | 20,000 | 20,000 |
| 343 | Additional quantities in place associated with known deposits | 20,000 | 20,000 | 20,000 |
| 344 | Additional quantities in place associated with potential deposits | 20,000 + 10,000 | 20,000 + 10,000 | 20,000 + 10,000 |

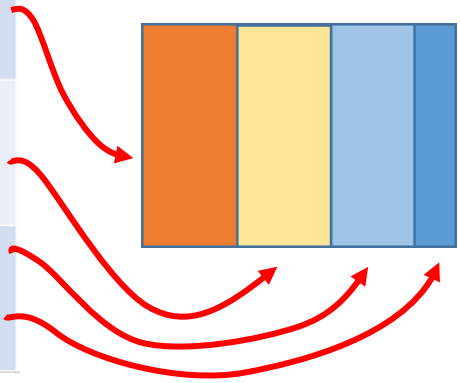

*Figure 14: International comparison using UNFC*

## *Data gaps in European reserve and resource data*

An important point to consider when using UNFC as a tool for harmonisation are gaps in the data. The UNFC provides a flexible and adaptable tool for defining resources, by including categories for everything from well-constrained stocks of material currently being extracted, to deposits that have low confidence in their location, properties or technical and economic feasibility to be extracted. Although for an accurate full inventory of resources, and for use in a resource management system, it is important to include the lower confidence, sub-economic resources, it should be noted that these data are not commonly available. Such data may include resource figures derived from probabilistic modelling on a regional level[13] or by using historic estimates that do not conform to any modern standards or by extrapolating from regional mapping, geochemical or geophysical spatial data.

If the data source is from a CRIRSCO-compliant system of reporting it cannot take into account non-economic resources, although there is a category for 'exploration results'. However, this category is intended for use with data such as grades and drill core intercepts rather than tonnages. If using the Russian system, or a national code derived from the Russian system, the 'Prognostic resource' categories 2 and 3 cover these low confidence resource categories but this data may not always be calculated by national geological surveys or other organisations condign resource assessments.

The vast majority of available resource data will relate to working or closed mineral operations. These will be provided by the minerals industry through financial or regulatory reporting, but as a result there may be very little data for resources that are currently uneconomic, or for which the extractive industry is not actively exploring. However, an absence of data does not mean resources are absent and these data gaps must be clearly identified. National geological surveys

[13] USGS. 2018. Probabilistic mineral assessment research & development, project summary. https://minerals.usgs.gov/west/projects/probminassmnt.htm

may be able to fill some of these gaps using their expert knowledge and wealth of historical data.

# 8 National resource and reserve reporting in Europe

Detailed descriptions of the reserve and resource reporting procedures in different European countries can be found in Annex 1. This gives details of the codes, standards and classification schemes used, the legal and regulatory framework, the level of data availability, existing harmonisation work and any recommendations for further harmonisation.

By understanding existing practices in individual European countries it is hoped that current approaches to harmonisation can be shared and gaps in bridging documents from national schemes to internationally recognised schemes can be identified.

Generally there are two broad positions regarding national collection of resources and reserve data: (a) a country may have some form of resource management system, or legislation that specifies a specific code or standard to be used when reporting on resources and reserves; or (b) a country will have no specific systems (and often no resource management system). In the latter example public companies that operate in that county will use whatever code they are required to by the stock exchange where they are registered (e.g. the CRIRSCO-compliant JORC or NI 43-101). However, if they are privately owned then no data may be publically available and any data that are collected may not conform to any recognised code or standard. Examples of such countries include the UK, France and Italy. In these cases the data may not exist unless obtained from publically owned companies or unless the national geological survey takes an active role in mineral exploration. This absence of data needs to be appreciated before issues over harmonisation can be addressed.

Amongst the countries that have a national resource code within Europe, there is an even split between: (a) some derived from the Russian code, for example Hungary, Slovenia and Croatia; (b) a unique national code, such as Austria or Lithuania; and (c) a code compliant with the CRIRSCO template, such as Norway, Finland and Sweden (Table 1; Figure 15). In these countries, some form of resource management system is in place and the minerals industry will often have a legal obligation to report figures to a national body. As a result, if some form of bridging document is developed for figures from these national codes, the data can be translated into internationally recognised systems, such as CRIRSCO and UNFC (however it must be noted that in many cases the non-commercial projects, exploration projects and undiscovered resources, as defined by UNFC are not routinely collected as discussed in section 0).

There are also examples of national schemes that are not directly related to internationally recognised ones, for example Slovakia. Elsewhere responsibility to collect these data does not lie at a national level but a state level, for example in Germany. In these examples there are major barriers to the creation of national datasets, before harmonisation across national borders can be considered.

| Country | Reporting code | Comments |
|---|---|---|
| Austria | National (Other) | ÖNORM G 1050 |
| Belgium | None | |
| Bulgaria | National (Russian, or based on Russian) | |
| Croatia | National (Russian, or based on Russian) | |
| Cyprus | National (Other) | |
| Czech Republic | National (Russian, or based on Russian) | |
| Denmark | None | In Greenland data are reported in accordance with CRIRSCO codes such as JORC and NI 43-101 |
| Estonia | National (CRIRSCO) | *Estonia Mineral Resource Classification System* (aligned to PERC) |
| Finland | National (CRIRSCO) | *Fennoscandia Review Board Standard* (aligned to PERC, JORC, etc.) |
| Germany | National (Other) | Each federal state has its own regional code |
| Greece | National (Other) | |
| Hungary | National (Russian, or based on Russian) | Most commonly used system of reporting |
| Ireland | None | Companies must report data in line with a CRIRSCO code such as PERC or JORC |
| Italy | None | |
| Latvia | National (Russian, or based on Russian) | |
| Lithuania | National (Other) | Aligned to UNFC |
| Luxembourg | None | |
| Malta | National (Other) | |
| Netherlands | None | |
| Norway | National (CRIRSCO) | *Fennoscandia Review Board Standard* (aligned to PERC, JORC, etc.) |
| Poland | National (CRIRSCO) | *Polish National Reporting Code* (aligned to UNFC) |
| Portugal | None | |
| Romania | National (Russian)/CRIRSCO | Since 1998 resource and reserve data in Romania have been reported in line with UNFC |
| Slovakia | National (Other) | |
| Slovenia | National (Russian, or based on Russian) | |
| Spain | None | |
| Sweden | National (CRIRSCO) | *Fennoscandia Review Board Standard* (aligned to PERC, JORC, etc.) |
| United Kingdom | None | |

*Table 1: National resource reporting codes in countries covered by the ORAMA project.*

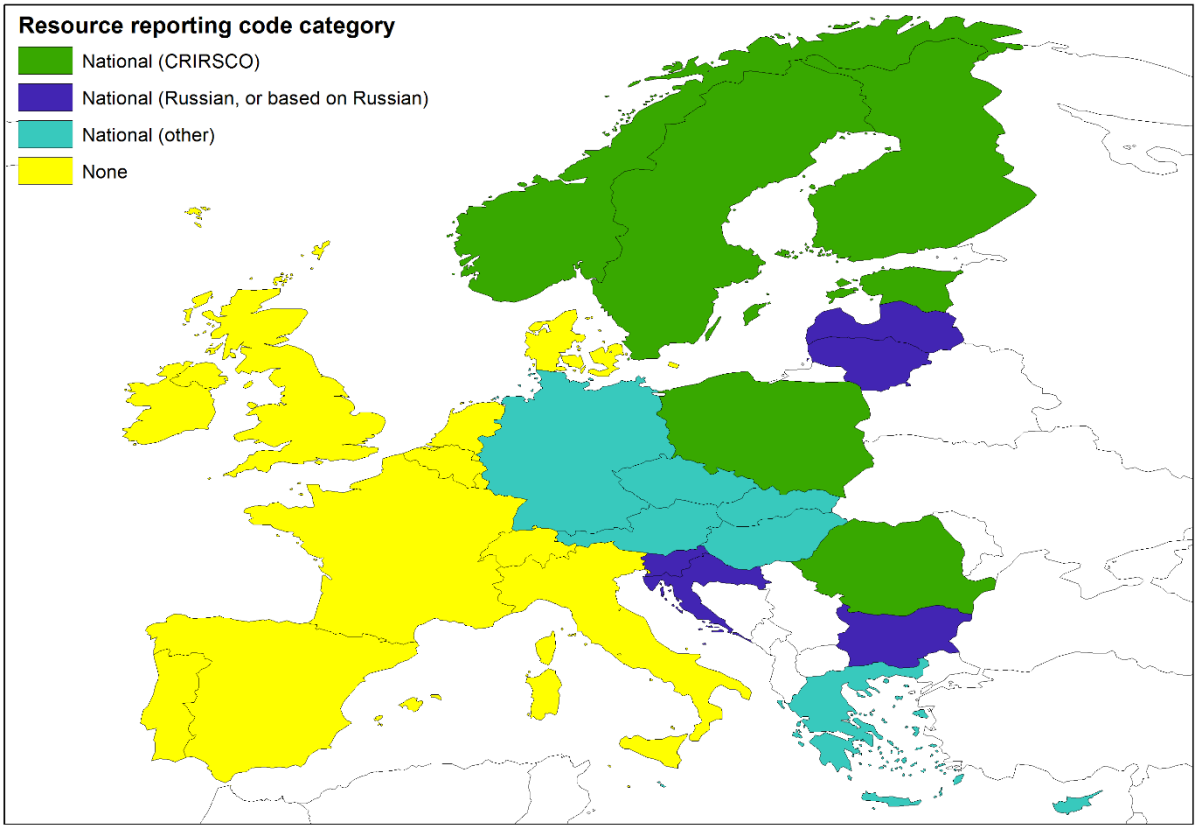


*Figure 15: National resource reporting codes in countries covered by the ORAMA project.*

## *National case studies*

As outlined in the previous section it can be very helpful to consider the framework in which a specific country sits before attempting to bridge across to UNFC for harmonisation purposes. A well-structured dataset with clear definitions will be comparatively straightforward to harmonise with UNFC and other classification schemes. In contrast datasets that are fragmented and have loose definitions, such as in the UK, and commonly rely on historical data, can be very challenging. This section contains a number of case studies of national projects to bridge country- or region-specific data to UNFC. These cover the wide range of examples discussed above and can be used as good practice examples and learning experiences for bridging between new datasets.

### Case studies from countries with a national reporting code

#### *Hungary*

In order to achieve the modernisation of the national mineral resources inventory, the predecessors of the Mining and Geological Survey of Hungary (MBFSZ) started a research project in 2013. During the last 5 years, the project members have analysed the mineral resources classification systems applied in practice and the reporting standards and codes based on these classifications (UNFC-2009, CRIRSCO-aligned standards, SPE-PRMS (Society of Petroleum Engineers Petroleum Resource Management System) and Australian Geothermal Reporting Code). The Survey has organised several consultations with professional organisations and companies to discuss the recently used Hungarian and internationally applied

definitions and methods in order to make an agreement about the common ground and application. A set of case studies covering all mineral deposit types (metallic ores, coal, non-metallic minerals, hydrocarbon, geothermal energy, carbon capture and storage) has been carried out to test the conversion algorithms.

The principles and elements of the SPE-PRMS that are aligned with the UNFC were integrated into the Hungarian Mining Law in 2017. This was based on stakeholder consultation between the representatives of oil and gas companies and the MBSZ (Mining and Geological Survey of Hungary) and the experts of the Hungarian Geological Society (MBSZ was integrated into MBFSZ in 2017.)

Several case studies were been carried out in the project mentioned above. Here the classification of non-metallic resources in Zala County is presented. In Zala County there are approximately 600 million $m^3$ of non-metallic mineral resources according to the national inventory of 1 January 2015; mainly building stones and organic sediments (Figure 16).

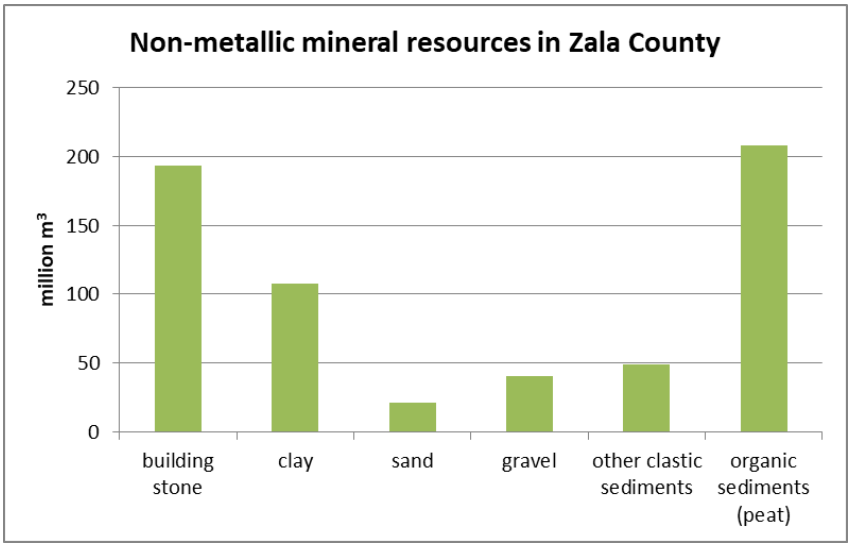


*Figure 16: Non-metallic mineral resources in Zala County, Hungary*

Mineral resources are registered in the Hungarian national mineral resource inventory based on the reports of mining operators according to the “Russian” classification system. For resource conversion the following information has been used:

- The status of the mine or quarry (active, pending, abandoned, unoccupied explored area);
- Resource category (A, B, C1 or C2; in case of non-metallic resources categories A and B are merged into A+B);
- In situ mineral resource quantity;
- A 'complexity group' is also necessary to be defined, as is explained below. However, it is not registered in Hungarian non-metallic mineral resources inventory so it has been estimated.

Complexity is one of the most important differences between the Russian-type national system and international systems. Complexity is designed to support the mineral resource management blocks that make up the productive part of the deposit and considers the homogeneity of the deposit that needs to be taken into consideration for a specific volume. These blocks may be separated tectonically or may differ by quality. Resources can be calculated for these blocks

and separation may also be interpreted by the need for different mining operations. Deposits may be classified into 3, 4 or 5 classes depending on national/regional practices. Generally below 50 blocks/km$^2$ can be considered as a deposit of low complexity (relatively homogeneous), whereas over 100 blocks/km$^2$ a deposit can be considered as a complex one (heterogeneous).

The conversion algorithm used in this case study (Figure 17) is based on the GKZ to CRIRSCO bridging document and consists of 3 steps:

1. Category C1 is divided into two parts based on complexity group.
2. Categories A+B and less complex C1 are converted into Measured Resources whereas the more complex C1 and C2 go into Indicated Resources.
3. The status of the mine is examined: in case of an active mine or quarry, all modifying factors had been considered so the resources can be converted into reserves.

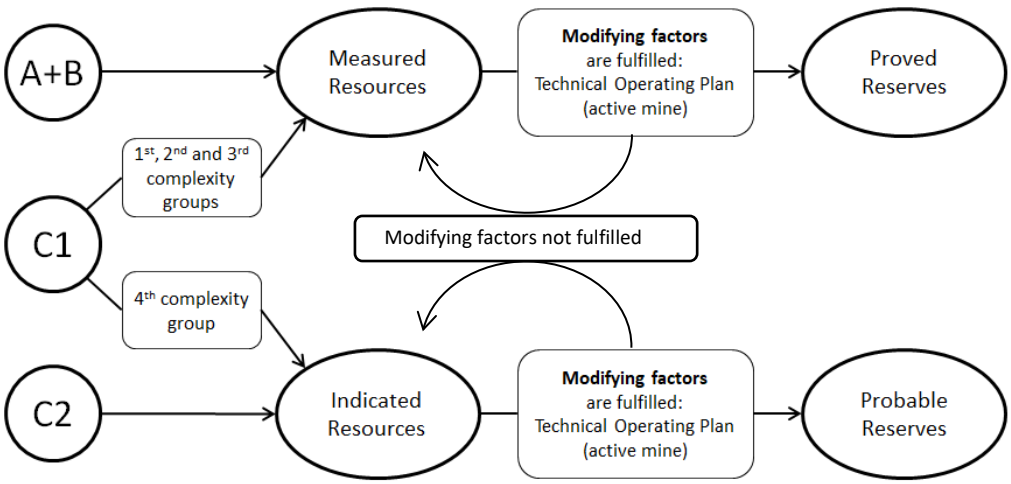


*Figure 17. Conversion algorithm between the national (Russian type) and international systems including the CRIRSCO type reporting codes and the UN classification framework.*

UNFC classes can be determined based on UNFC–CRIRSCO bridging document (UNECE 2013). Figure 18 compares the mineral resources according to the original, CRIRSCO and UNFC classification systems. Classes A+B represent a high level of geological knowledge (maximum 20% uncertainty). C1 has 35% uncertainty and C2 has 60% uncertainty in the calculation of the volume of the resource. The D categories (D1, D2 and D3) are not indicated in Figure 18 because these poorly known resources are the topics of potential assessments. However, lesser known resources can also be interpreted as Inferred Resources or Exploration Results that may be harmonised with the UNFC classes 223 and 334, respectively.

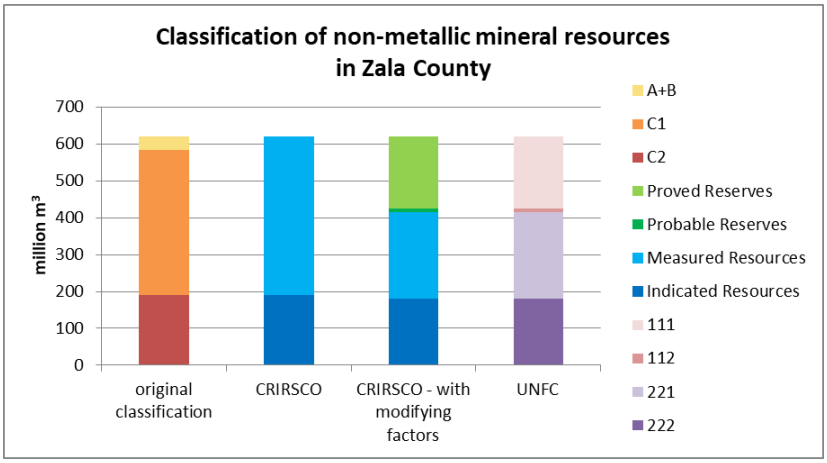


*Figure 18: Original, CRIRSCO and UNFC classification of non-metallic mineral resources in Zala County*

### *Slovenia*

In Slovenia, there is a national "Commission for determining mineral reserves and resources". All minerals are in state ownership. Concessioners are obligated to report annually to the ministry responsible for mining (at present, Ministry for Infrastructure). Annual reporting forms include the following data:

- Volume of extracted mineral commodities (tonnes or $m^3$)
- Degraded area (ha)
- Reserves/resources in situ ($m^3$).

Mineral commodity data are collected by:

- "Public Mining Service" organised within the Geological Survey, on behalf of the ministry responsible for mining, (National MR Database and Mining Registry Book) and
- "Commission for determining mineral reserves and resources" on a national level.

The Slovenian national classification is derived from the Russian mineral classification. Resources and reserves are divided into 3 classes: 1- economic, 2-potentially economic and 3-non-economic. Each of these classes is further sub-divided into the following categories: A, B, C1 (which are classes as "reserves") and C2 (classed as "resources"). The same reporting system is used for all types of mineral commodities including aggregates, because all types of minerals are in state ownership and managed by the state.

Only mineral Resources and reserves inside 'mining areas' and 'exploration areas' with granted mining rights and/or exploration permits are classified (as stated in the Report on classification on reserves and resources) and defined by the national Commission for determining mineral reserves.

The Geological Survey of Slovenia (GeoZS) was involved in the Minerals4EU project. In order to incorporate the data into the Minerals yearbook created by Minerasl4EU Slovenian mineral data were transformed from the national classification into the UNECE- 2009 classification (Figure 19). Because the resource/reserve data for single deposits are not public, the data reported to Minerals4EU were summarised for each type of mineral resource/ reserves (e.g. crushed stone - limestone) at a national level.

| fundamental characterization | economic efficiency | categories (national classification) | UNFC $E_{axis}$ | UNFC $F_{axis}$ | UNFC $G_{axis}$ |
|---|---|---|---|---|---|
| economic | proved reserves | A, B, $C_1$, $C_2$ | 1 | 1 | 1, 2, 3 |
| potentially economic | | A, B, $C_1$, $C_2$ | 2 | 2 | 1, 2 , 3 |
| non-economic | measured resources | A, B, $C_1$, $C_2$ | 3 | 2 | 1, 2, 3 |

*Figure 19: Overview of simplified transformation of the Slovenian national classification into UNFC*

However, only those UNFC-2009 categories (marked yellow in Figure 20) have been adopted for reporting, as these can be transformed from the existing national mineral classification. For the rest of the categories, the balancing of mineral data will have to be generated separately.

| Total Commodity Initially in Place | Extracted | Sales Production | | | |
|---|---|---|---|---|---|
| | | Non-Sales Production[a] | | | |
| | | Class | Categories | | |
| | | | E | F | G[b] |
| | Future recovery by commercial development projects or mining operations | Commercial Projects[c] | 1 | 1 | 1, 2, 3 |
| | Potential future recovery by contingent development projects or mining operations | Potentially Commercial Projects[d] | 2[e] | 2 | 1, 2, 3 |
| | | Non-Commercial Projects[f] | 3 | 2 | 1, 2, 3 |
| | Additional quantities in place associated with known deposits[g] | | 3 | 4 | 1, 2, 3 |
| | Potential future recovery by successful exploration activities | Exploration Projects | 3 | 3 | 4 |
| | Additional quantities in place associated with potential deposits[g] | | 3 | 4 | 4 |

*Figure 20: Categories from UNFC used for transformation*

Therefore the model for the transformation of statistical data from the national mineral classification to UNFC in Slovenia was developed. As such it is suitable for annual reporting of mineral statistics into EU data platforms.

It should be noted that the Slovenian transformation model cannot be used for other ESEE (East and South East Europe) countries (using national classifications based on Russian system) because each country has its own version of the classification system.

### *Poland*

The Polish Geological Institute has compiled a detailed case study converting the Polish classification system to UNFC in their publication 'The Mineral Resources of Poland'[14]. This

[14] POLISH GEOLOGICAL INSTITUTE. 2017. Mineral Resources of Poland. (Warsaw). http://geoportal.pgi.gov.pl/css/surowce/images/2017/pdf/mineral_resources_of_poland_2017.pdf

outlines in detail how the Polish classification system can be bridged across to UNFC and explores some of the issues such as the lack of a definition for 'reserves' in the Polish system. This case study shows the difficulties in converting data between two systems that, although they share many basic principles, have many substantial differences. For example, the Polish system is hierarchical and higher levels categories will include figures from lower level ones, as opposed to UNFC in which no one category is included within another. Despite such barriers a robust system for bridging between the two classifications systems has been developed and the Geological Institute was able to publish an inventory of their national mineral resources using UNFC. The Polish classification system splits resources into D (inferred resources, with a possible error greater than 40%), C2 (inferred resources, with a possible error less than 40%) C1 (indicated resources), B (measured resources, with a possible error less than 20%) and A (measured resources, with a possible error less than 10%). Detail of how these categories bridge across to UNFC are shown in Table 2 and Figure 21.

| Polish classification | UNFC-2009 | | |
|---|---|---|---|
| | Geological documentation | | Mineral deposit development plan |
| | Deposits licensed for mining | Deposits not licensed for mining (beyond concession areas) | |
| Resources<br>perspective $D_2$<br>prognostic $D_1$ | Resources<br>344<br>334 | | |
| Anticipated economic resources<br>D, $C_2$<br>$C_1$<br>A+B | Resources<br>223, 233<br>222, 232<br>221, 231 | | |
| Anticipated sub-economic resources<br>D, $C_2$<br>$C_1$<br>A+B | Resources<br>323, 333<br>322, 332<br>321, 331 | | |
| Sub-economic resources<br>D, $C_2$<br>$C_1$<br>A+B | | | Resources<br>313, 323<br>312, 322<br>311, 321 |
| Economic resources<br>D, $C_2$<br>$C_1$<br>A+B | | | Resources<br>213<br>212<br>211 |
| Extractable resources<br>D, $C_2$<br>$C_1$<br>A+B | | | Resources ("economic")<br>113, 123<br>112, 122<br>111, 121 |
| Reserves<br>$C_2$<br>$C_1$<br>A+B | | | |

*Table 2: A comparison of the Polish classification system and UNFC-2009. Source: NIEĆ M. 2010. International classifications of mineral resources [in Polish]. Mining and Geoengineering (Górn. Geoinż.), 34, 3: 33–49.*

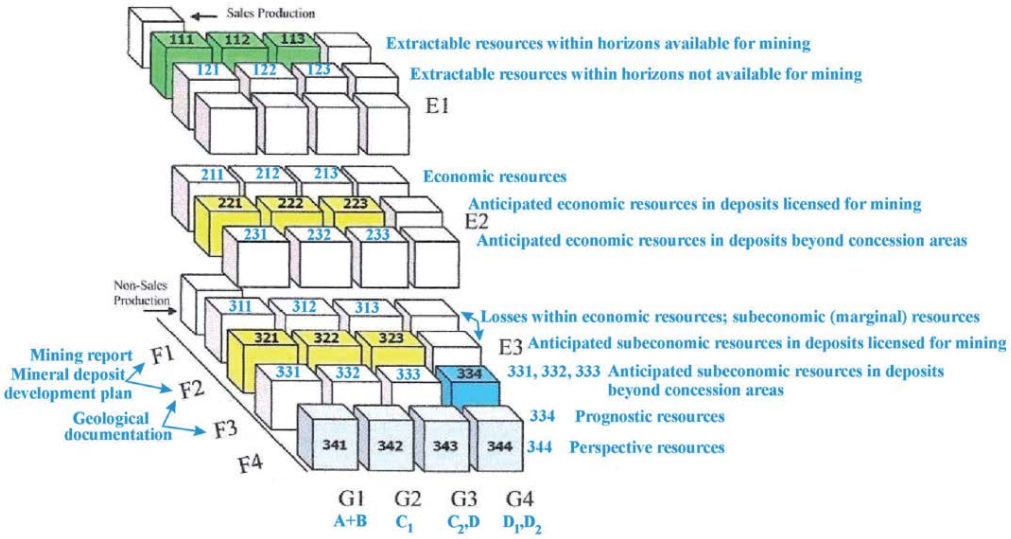


*Figure 21: Ties between the Polish and international (UNFC-2009) classification systems. Source: NIEĆ M. 2009. Polish and United Nations Framework Classification of resources (UNFC) – similarities and differences [in Polish]. Open Cast Mining (Górn. Odkryw.) 50, 2/3: 50–57.*

### *The Nordic countries UNFC work*

A team from the Geological Surveys of Finland (GTK), Norway (NGU) and Sweden (SGU), the Swedish Association of Mines, Minerals and Metal Producers (SveMin) and Petronavit a.s., have worked on the application of the UNFC for mineral resources in Finland, Norway and Sweden. The group have presented the "Draft guidance for the application of the UNFC for mineral resources in Finland, Norway and Sweden"[15] . The purpose of the document is to provide guidance on the application of UNFC incorporating Specifications for its Application (as set out in ECE Energy Series No. 42), to mineral resources in Finland, Norway and Sweden.

The draft document is intended to assist in producing UNFC inventories and support the users by clarifying how UNFC can be used to facilitate policy and strategy formulation, Government resource management, industry business processes and capital allocation, the four principal areas of application of the UNFC. By using the full UNFC inventory in conjunction with the underlying project information, the classification provides a system that can be used for data collection, standardisation, aggregation and cross-comparison, thus facilitating the management of extractive activities across multiple temporal and spatial scales.

Part of the motivation has been to explore how the application of UNFC will provide better harmonisation of mineral resource data across projects from uncertain, reconnaissance stage, and under-explored prospects to well characterized and well assessed resources and reserves.

Conventional reporting standards are mostly employed in developing or on-going mining projects and are required only for listed companies. These standards are not used, nor intended to be used, comprehensively, and are therefore not suitable tools for comparing and aggregating resource, and potential resource, inventories.

[15] Draft guidance for the application of the UNFC for mineral resources in Finland, Norway and Sweden. 2017. https://www.unece.org/index.php?id=45992

### *Norway*

In Norway, the Geological Survey of Norway (NGU) has modernised and reclassified the national mineral deposits databases according to INSPIRE. In this work NGU has introduced an INSPIRE compliant nomenclature for mineral occurrence types using the terms: occurrence, prospect, deposit. Mineral deposits have been reassessed and reclassified from a qualitative scale of significance to a more quantitative economic value/public importance assessment scale based on criteria, such as in situ value, volume, location, quality, national supply etc. As a result the deposits are now classified according to public significance and are classified as; international, national, regional, local importance, not important or not assessed. The Norwegian Directorate of Mining can then react if deposits of international, national or regional importance are affected by competing land use, such as infrastructure, nature conservation or other types of land use.

NGU delivers much of this data as a map service. This is continually being updated and new maps of mineral resources created. These maps will include both deposits previously registered in the database as points, as well as newly defined areas for prospects, deposits and provinces. Although this reclassification does not adhere to UNFC, the use of INSPIRE standards will greatly aid in data harmonisation and data collected as part of this database can be used for further classification.

A separate study has taken information from the mineral deposit database for sand and gravel deposits and attempted to classify deposits according to UNFC. This study looks specifically at Forsand municipality, in Rogaland County in Norway where NGU have registered several large and minor gravel deposits. NGU have assessed the significance of the resources based on geology, quality, location, estimates of volume etc. In addition, Rogaland County have made a resource management plan for the region. In this plan the region has made a prioritization of the areas in the region. In this prioritization different issues are considered, such as areas protected by natural diversity or cultural heritage, areas for agriculture and protection of important resources. Based on the regional plan, the local municipality in Forsand have made local area plans of the deposits. The largest deposit, named Forsand, is regulated in to smaller areas where some are protected due to natural diversity, some are extraction areas, other are possible extraction areas for the future and some of the areas will be used for agriculture. In Norway the Directorate for Mining (DMF) is the authority for giving concession for extraction. DMF have given concession for extraction to two producers and two more have applied for concession in the Forsand gravel resource.

NGU has used all information from these various sources (Data from NGU's resource database, applications to DMF for mining concession, Local municipality area plans, Local municipality area plans and the regional plan for resource management) to execute UNFC classification to for sand and gravel resource in Forsand municipality (including spatial information and metadata).

Figure 22 shows the study area with the various different resource zones, labelled A-K and Table 3 shows the detail of the UNFC classification.

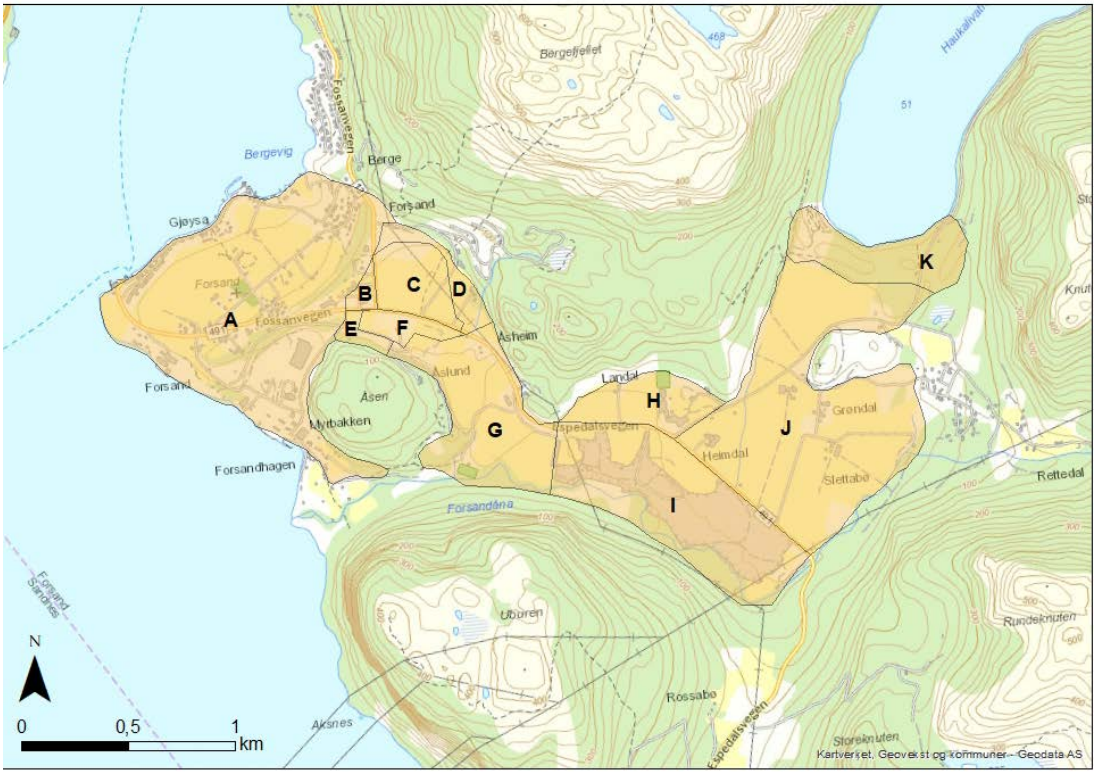


*Figure 22: Area of the UNFC classified resource. The different areas are classified separately*

| AREA | Mosaikk | Comments | Area m2 | G-axis G1 (m3)* 8 m | G2 (m3)* 10 m | G3 (m3)* 25 m | F-axis | E-axis |
|---|---|---|---|---|---|---|---|---|
| A | Forsand - built-up area | Built-up area, area for extraction not included in regional plan | 992 000 | 7 936 000 | 9 920 000 | 248 000 000 | F4 | E3.2 |
| B | Vest A – Ryggjen / Langheim | Built-up area, area for extraction not included in regional plan | 20 600 | 164 800 | 206 000 | 5 150 000 | F4 | E3.2 |
| C | Vest B – Hestamoen | Future extraction area in regional plan, local area plan for extraction, application for mining consession sent | 117 000 | 936 000 | 1 170 000 | 29 250 000 | F1.2 | E1.1 |
| D | | Future extraction area in regional plan, local area plan for extraction | 60 000 | 480 000 | 600 000 | 15 000 000 | F2.3 | E2 |
| E | Del av Vest C – Gøysamyra | Future extraction area in regional plan, local area plan for extraction, application for mining consession sent | 24 000 | 192 000 | 240 000 | 6 000 000 | F1.2 | E1.1 |
| F | Vest D + del av Vest C – Bergekrossen | Resouce in production | 47 000 | 376 000 | 470 000 | 11 750 000 | F1.1 | E1.1 |
| G | LNF landsbruk | Local plan for agriculture, nature and outdoor recreation | 339 000 | 2 712 000 | 3 390 000 | 84 750 000 | F4 | E3.2 |
| H | Mindtre A - Landal forhistorisk landsby | Area with protection of historical cultural monuments | 136 000 | 1 088 000 | 1 360 000 | 34 000 000 | F4 | E3.2 |
| I | Mindtre B og Øst B – Forandmoen / Gnr 41, Bnr 3 & 26 | Resource in production | 505 000 | 4 040 000 | 5 050 000 | 126 250 000 | F1.1 | E1.1 |
| J | Øst A – LNF landsbruk | Local plan for agriculture, nature and outdoor recreation | 850 000 | 6 800 000 | 8 500 000 | 212 500 000 | F3 | E2 |
| K | Vassryggen - LNF naturvern | Area with protection according to the nature diversity act,nature conservation | 190 000 | 1 520 000 | 1 900 000 | 47 500 000 | F4 | E3.2 |
| | * based on volume estimates and probability | | | | | | | |

*Table 3: UNFC classification for Forsand Municipality, Norway.*

## *Finland*

GTK has conducted persistent mineral exploration and bedrock mapping in Finland leading to an excellent understanding of the location and size of many of the country's mineral deposits. GTK's current mineral potential mapping approach is more reconnaissance to prospecting stage exploration to attract further investments in ore potential areas. In this context UNFC provides a neutral framework for reporting governmental resources and a mechanism for reporting early stage exploration results to disseminate geological information for industry and society.

Mining Decree (28.6.2012/391) states that when reporting exploration results under an Exploration permit in a study area, an internationally recognized standard has to be followed. However, the mining law does not specify which code to use. International exploration and mining companies operating in Finland follow the CRIRSCO Template and prepare the Public Reports under the company specific reporting codes. The most common reporting standards

being used in Finland are the Australasian Code (JORC Code) and Canadian National Instrument 43-101 (see Figure 18). There is no national standard reporting code for Finland.

GTK decided in 2014 that UNFC will be implemented and a few case studies have been undertaken (e.g. Kiviniemi Sc, Mäkärä Au, Virtasalmi Cu). In these case studies deposits have been classified according to UNFC for demonstration purposes but formal reports have not yet been made. GTK is currently participating in the Mintell4EU project in which one objective is to make a UNFC report for one of these case studies.

Before the UNFC classification of all mineral resources and reserves of Finland can be made, there needs to be a common understanding of the criteria of classification. Criteria cannot change by deposit, commodity or time and they have to be comparable with other countries. Work on the criteria of classification is ongoing, draft guidance has been prepared by the Nordic Project (see section 0) and work continues in GeoERA-funded Mintel4EU project. Based on the criteria, GTK needs to create consistent practice with regards to how to classify new and historical mineral resources. The CRIRSCO template could provide basic information for this work but the final classification will be UNFC.

Due to a large amount of non-compliant resource estimates (Figure 18) the harmonisation of the whole dataset to UNFC will be challenging. These non-compliant resource estimates can be based on sparse geological data with a low level of confidence or systematically explored targets with high data density. Non-compliant resource estimates cannot be bridged to UNFC before a deposits' data is inspected and classified by persons with expertise. Currently non-compliant resource estimates will be problematic in terms of providing data. A temporary solution could be that all of these deposits will be classified as "Additional quantities in place" (344) until further knowledge has been obtained.

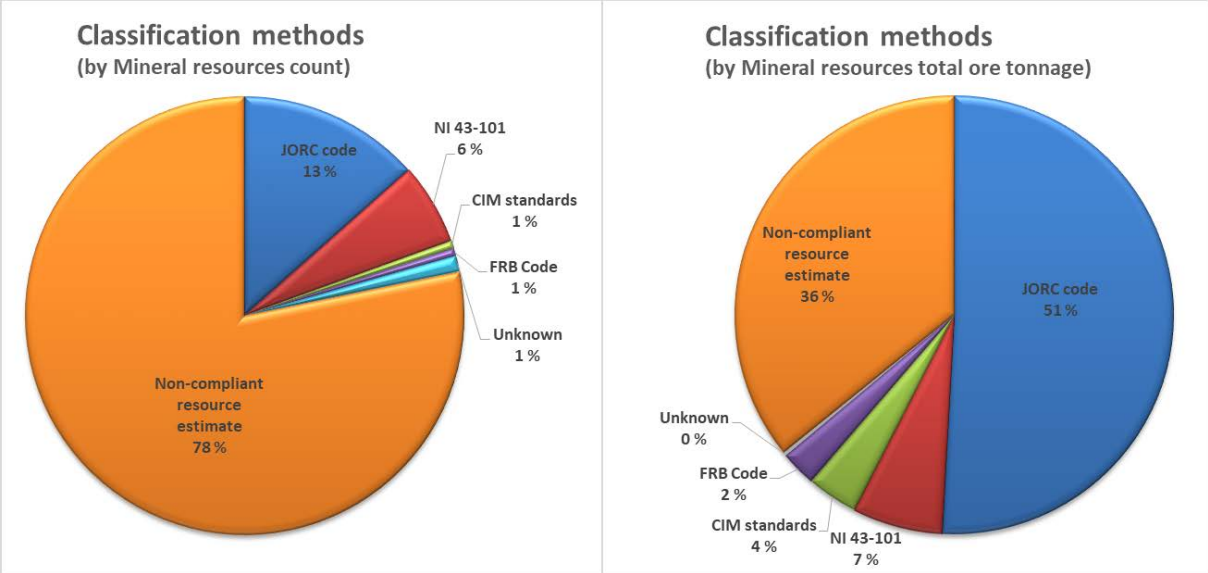


*Figure 23: Mineral resources of Finland classified by the number of the resource estimates (349) and by the total ore tonnage (7009 Mt). Exploration and mining companies use mainly JORC and NI43-101 codes, but since there is no national code, all GTK's and old Outokumpu's resource estimates are non-compliant.*

## Case studies from countries without a national reporting code

### *UK*

As part of the ORAMA project the British Geological Survey (BGS) has attempted to create an inventory of national resources for the UK using UNFC. The UK has no centralised system of data collection for mineral resources, although data are collected for some aggregate minerals (see Annex 1 for further details of resource data collection and reporting in the UK). As a result BGS was required for many commodities to compile resource figures from a range of disparate sources such as company reports, historical estimates, regional assessments and data inferred from geological mapping. The initial work was undertaken in the Minerals4EU project and produced a resource inventory displaying data to whatever code, standard or confidence level the data was originally reported in or calculated to. This inventory was the first to have been developed for the UK but as data were presented in a wide variety of different formats it was difficult to compare with other national inventories, across commodities. The ORAMA project has provided an opportunity to convert the Minerals4EU compiled data into UNFC. This was a complex process due to the wide variety of data sources and commodities considered. .

This work attempted to create a resource inventory that is as complete as possible using the full range of categories available in UNFC. Consequently, efforts were made to collect data for the uneconomic proportion where geological and economic confidence was low as well as published industry and data published by national Government data. In some cases figures were calculated via spatial analysis using GIS software to estimate the quantities of resources for certain minerals. This was done by applying assumptions, such as thickness of deposit, mineral to waste ratios and mineral quality, to surface mapping of mineral resources, which had been conducted previously by BGS. This method of spatial analysis using geological information is the only way to estimate inferred resource quantities for many minerals in the UK due to a lack of any other data.

However, this spatial analysis approach estimates resource quantities on a regional or national level, and it was, therefore, difficult to integrate into the UNFC system, which is designed to examine resource quantities at a project level. There are some instances where existing projects have been incorporated into larger regional and national figures, calculated using GIS techniques or regional estimates that include resources over the entire geological outcrop/subcrop, because data may not be available on a project by project basis. In these cases it is possible that a range of categories along the E and F axes of the UNFC system are included within a single number, which is never the case if resources are taken on a project by project basis. In these instances footnotes have been applied. Similar issues would also arise if using probabilistic mapping or any kind of geostatistical analysis techniques.

Others issues arose with the use of historical estimates. For a country, like the UK, with a rich history of mineral exploration but no centralised system of reporting, information from past academic and industry studies formed the basis of many resource figures used in the inventory. However these historic studies were rarely reported according to any standards, codes or current definitions, although many undertook significant field campaigns involving drilling, laboratory analysis, detailed mapping, etc. As a result a high degree of geological expertise was required in order to allocate some of these historical estimates to UNFC categories. Knowledge of the deposit or deposit type was also required to assess how much geological information may be necessary for an accurate assessment of ‘confidence’, as well as knowledge of the economic situation for that particular commodity. This again highlights the importance of persons with appropriate levels of competence for compilation of this kind of resource inventory.

Fluorspar provides an example of the use of such historical estimates. Fluorspar has been historically worked in the UK since Roman times and is still worked by one company. A previous study (2010) from when several sites were still operating estimated remaining resources as 25 million tonnes. Unfortunately no methodology was recorded for how this estimate was calculated, although it is assumed to be robust due to a stringent quality assurance procedure on all published documents by the BGS. Ideally this would be considered on a project by project basis, but no data are now available for many of the historic fluorspar deposits and past workings. If such data were available it would be extremely time consuming to collect and analyse and a regional approach using the available published data is, therefore, preferred in the absence of the significant resources required to undertake such study. . Due to the lack of metadata, regarding the levels of confidence associated with it, this estimate for fluorspar could go into UNFC category 334 (exploration results). However, it is known that fluorspar is likely to be present in certain locations due to the presence of past workings, and consequently it has been classified as G3 rather than G4 as a result of the large amount of geological information available.

Similar examples can be seen for metallic mineral deposits. For example, a nickel-copper deposit at Arthrath in north-east Scotland, was extensively explored in the 1970s with 6850 metres of core drilled and a considerable amount of chemical analysis and geophysical surveys also undertaken. The study resulted in a resource estimate but this was not in accordance with any reporting code and was not compliant with modern practices. After consideration, BGS classed the deposit as 333 in the UNFC system. G3 was given due to the amount of drilling and analysis undertaken, because the estimate was not based primarily on indirect evidence as for G4, which is normally used for exploration results. However, this might also be classified as G2 because the reported quantities could be estimated with a moderate level of confidence. However, without detailed knowledge of the work actually undertaken and a reasonable understanding of the deposit geology, it would be difficult to confirm this. Similarly, nickel sulphide deposits of this type are reasonably well understood and, given the quantity of data available for this deposit, it could potentially be classed as F2. However, without the extra detail from the exploration campaign this cannot be verified.

### *Spain*

IGME have conducted a study to illustrate mapping of national minerals data to UNFC. Spain has a national dataset, the Spanish "National Inventories of Resources", a series of monographic studies conducted from 1978 to 2002 aimed at defining the resources and reserves of the main mineral substances and their distribution within the country. The National Inventories of Resources have been compiled using the standards set out in USGS Circular 831 (1980)[16] Principles of a Resource/Reserve Classification for Minerals.

This USGS classification is based on the system established by McKelvey in 1972[17], which allows extrapolation of the mineral resources to country level, as an alternative to resource definition from an operator perspective which can be focused on discovering sufficient ore as the exploitation progresses to guarantee the continuity of the mine for a certain number of years.

[16] US Bureau of Mines and US Geological Survey, 1980. Principles of a resource/reserve classification for minerals. *US Geological Survey Circular 831*, p.5.
[17] McKelvey, V.E., 1972. Mineral Resource Estimates and Public Policy: Better methods for estimating the magnitude of potential mineral resources are needed to provide the knowledge that should guide the design of many key public policies. *American Scientist*, *60*(1), pp.32-40.

The system established by McKelvey in 1972 with the modifications made in 1980 by the USGS and that gave rise to the Circular 831, was considered the most suitable for the Spanish National Inventories of Resources based on two fundamental considerations:

1. Its ability to provide information on the most recommendable measures to be taken in the field of exploration of mineral resources.

2. Its flexibility to place the national resources and reserves into a potentially changeable economic environment in relation to geological and mining parameters.

The national inventories cover 21 metallic, non-metallic and industrial minerals as show in Table 3.

| **Date** | **Mineral** |
|---|---|
| 1979 | Tin |
| 1980 | Iron |
| 1980 | Lead, zinc, silver |
| 1981 | Copper |
| 1982 | Fluorspar |
| 1982 | Manganese |
| 1982 | Titanium |
| 1983 | Barite |
| 1983 | Feldspar |
| 1983 | Pyrite |
| 1984 | Talc |
| 1984 | Kaolin |
| 1985 | Tungsten |
| 1988 | Titanium update |
| 1989 | Strontium |
| 1991 | *Sodium sulphate |
| 1997 | Sodium chloride & potash salts |
| 2000 | *Special clays |
| 2000 | Wollastonite |
| 2002 | *Special clays update |

*glauberite, thenardite
**palygorskite-attapulgite, sepiolite,

*Table 4: Date and mineral studied in each inventory*

### Methodology

In the USGS Circular 831 (1980) known resources should be classified from two standpoints: (1) purely geologic or physical/chemical characteristics, such as grade, quality, tonnage, thickness, and depth of the material in place; and (2) profitability analysis based on costs of extracting and marketing the material in a given economy at a given time (Figure 23 and Figure 24).

RESOURCES OF (commodity name)

[A part of reserves or any resource category may be restricted from extraction by laws or regulations (see text)]

AREA: (mine, district, field, State, etc.) UNITS: (tons, barrels, ounces, etc.)

| Cumulative Production | IDENTIFIED RESOURCES | | | UNDISCOVERED RESOURCES | |
|---|---|---|---|---|---|
| | Demonstrated | | Inferred | Probability Range (or) | |
| | Measured | Indicated | | Hypothetical | Speculative |
| ECONOMIC | Reserves | | Inferred Reserves | | |
| MARGINALLY ECONOMIC | Marginal Reserves | | Inferred Marginal Reserves | | |
| SUB-ECONOMIC | Demonstrated Subeconomic Resources | | Inferred Subeconomic Resources | | |
| Other Occurrences | Includes nonconventional and low-grade materials | | | | |

*Figure 24: Major elements of mineral resource classification, excluding reserve base and inferred reserve base.*

RESOURCES OF (commodity name)

[A part of reserves or any resource category may be restricted from extraction by laws or regulations (see text)]

AREA: (mine, district, field, State, etc.) UNITS: (tons, barrels, ounces, etc.)

| Cumulative Production | IDENTIFIED RESOURCES | | | UNDISCOVERED RESOURCES | |
|---|---|---|---|---|---|
| | Demonstrated | | Inferred | Probability Range (or) | |
| | Measured | Indicated | | Hypothetical | Speculative |
| ECONOMIC | Reserve | | Inferred | | |
| MARGINALLY ECONOMIC | Base | | Reserve Base | | |
| SUB-ECONOMIC | | | | | |
| Other Occurrences | Includes nonconventional and low-grade materials | | | | |

*Figure 25: Establishment of the categories of reserve base and inferred reserve base, taking into account that the reserve base is a global resource category delineated by physical and chemical criteria and when those criteria are determined, the initial reserve-base estimate will be divided into three component parts: reserves, marginal reserves, and a remnant of subeconomic resources.*

To determine those criteria of "geology and profitability" the information used at a national level is as follows:

- Types of deposits and methods of exploitation.
- Mineral and metallurgical processes.
- Volumes, specifications and market prices.

- Situation of the mining sector.
- Known resources of such mineral in the country (where the data came from: operating mining companies, operating mines, research projects, occurrences, provincial mining authority and the annual mining work plan of the mines).

These criteria results in a template where UNFC categories can be placed (Figure 25)

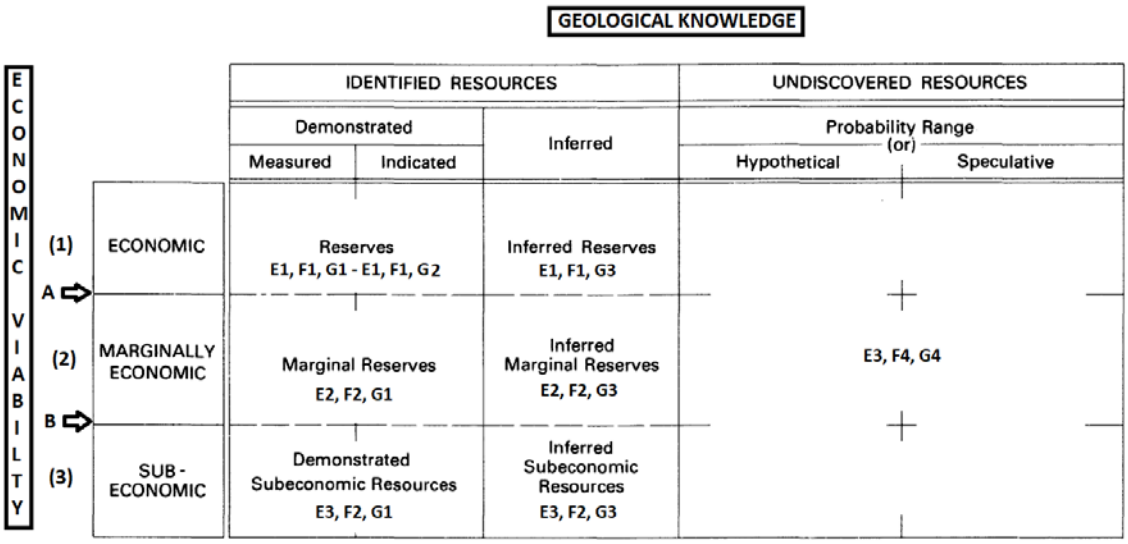


*Figure 26: USGS categories with UNFC categories mapped on to them.*

In the template there are established two lines that inbound three economic zones.

- Line A: Establishment of the boundary between the part of the resources that it is possible to exploit profitably, and those for which it could become if there were changes in the current economic and technological factors.
- Line B: Indicates the minimum level, below which, a mining resource is not exploitable, in profitable terms, in the current situation of market and technology.

These delineate three economic zones:

(1) Economic: where the ore grade > cut-off grade resulting in reserves and inferred reserves.

(2) Marginally economic: where the ore grade +/- cut-off grade resulting in marginal reserves and inferred marginal reserves.

(3) Sub-economic: where the ore grade < cut-off grade resulting in demonstrated subeconomic resources and inferred subeconomic resources.

This is based on the UNFC definitions as detailed in section 5 of this report and the following definitions from the USGS classification scheme:

**Reserves:** 'That part of the reserve base which could be economically extracted or produced at the time of determination'.

**Inferred Reserves:** 'Inferred reserves are postulated extensions of reserves. They are identified resources quantified with a relatively low degree of certainty'.

**Marginal Reserves:** 'That part of the reserve base which, at the time of determination, borders on being economically producible. Its essential characteristic is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technologic factors'.

**Inferred Marginal Reserves:** 'Inferred marginal reserves are postulated extensions of marginal reserves. They are identified resources quantified with a relatively low degree of certainty'.

**Demonstrated Subeconomic Resources:** 'The part of identified resources that does not meet the economic criteria of reserves and marginal reserves'.

**Inferred Subeconomic Resources:** 'Inferred subeconomic resources are postulated extensions of subeconomic resources. They are identified resources quantified with a relatively low degree of certainty'.

**Hypothetical Resources:** 'Undiscovered resources that are similar to known mineral bodies and that may be reasonably expected to exist in the same producing district or region under analogous geologic conditions. If exploration confirms their existence and reveals enough information about their quality, grade, and quantity, they will be reclassified as identified resources'.

**Speculative Resources:** 'Undiscovered resources that may occur either in known types of deposits in favourable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential. If exploration confirms their existence and reveals enough information about their quantity, grade, and quality, they will be reclassified as identified resources'.

This bridging exercise between the USGS Circular 831 and UNFC revealed the following issues:

- Cumulative production: there is no distinction between "Sales Production" and "Non-sales Production". Whilst not an issue for resource and reserve data this may have an impact on wider reporting of statistical minerals data.
- There is no place for "Exploration Projects (3, 3, 4)" neither for "Additional quantities in place associated with known deposits (3, 4, 1-2-3)".
- "Additional quantities in place associated with potential deposits (3, 4, 4)" are divided into "Hypothetical and Speculative Undiscovered resources".
- There is no mention of the need to have a competent or qualified person performing resource estimation and/or classification.

# 9 Commodity specific issues

As well as considerations due to different national approaches when attempting to harmonise resource data, differences in commodities must also be considered. Different types of commodities will require different amounts of data to gain suitable levels of geological and economic confidence in a deposit. The UNFC recognises this and defers to the more detailed commodity-specific specifications that are contained within other internationally recognised standards and codes that have been aligned with UNFC-2009. For example, the PERC code

has separate guidelines for the reporting of data on construction, industrial and metallic minerals. Clearly, for example, a gold deposit will generally be more geologically complex and will require more capital investment than a sand and gravel quarry. Consequently the latter may require less geological investigation and fewer economic studies before a project can begin production.

Another commodity-specific issue that may need to be considered is that different levels of information may be available for different commodities, which can become a challenge when building a comprehensive inventory of resources. When minerals data are collected on a national level there is normally a practical reason for doing so, for example data are often collected for minerals that the state owns or receives royalties for. However, in many cases this does not include all minerals, e.g. aggregates, industrial minerals or minerals currently uneconomic to extract may be excluded, and as such data gaps often exist. Data are also not collected in some national systems for smaller operations, e.g. those employing less than a certain number of people. These types of operations are more likely to be working construction and industrial minerals due to the lower amounts of infrastructure required for extraction. In countries where there no centralised data collection, data for metals are often much more readily available as companies involved in metallic mineral extraction and development are likely to be publically listed and, therefore, required to publish results for investors. In contrast, construction and industrial mineral operations are more likely to be operated by private operations with no obligations for public reporting. This again can lead to data gaps for construction and industrial minerals.

# 10 Conclusions

In order to move forward with harmonisation of reserve and resource data for primary raw materials, to facilitate the creation of an adequate knowledge base for the formulation of policy decisions relating to raw materials, relevant EU public authorities need to come to an agreement about using a single system of reporting at European level.

Although there are several options for different systems of reporting, all with advantages and disadvantages regarding compilation of statistics at a European level, the ORAMA project recommends the use of UNFC. This classification system seems best suited for the task as it is designed for national scale resource management, has several guidance documents and case studies linked to it bridging other systems of reporting to UNFC and has the flexibility to include a variety of different resource types.

It is not being suggested that countries abandon their already well established systems of reporting, which serve national needs and may have requirements in national law, only that the use of UNFC, or conversion to UNFC be considered for reporting at a European level to allow comparison and aggregation with other European data. Similarly it is not suggested that UNFC can, or should, replace CRIRSCO compliant systems of reporting which serve a different purpose, principally aimed for protection of investors and the specific needs to the minerals industry.

# 11 Useful sources for further information

Table 2 outlines some of the main sources regarding harmonisation of mineral resource and reserve data from previous work that has been undertaken in this area, links to codes and classifications discussed in this document, links to the bridging documents discussed and some prominent national case studies attempting harmonisation of resource and reserve data.

| Source | Description |
|---|---|
| **Previous work** | |
| https://ec.europa.eu/growth/content/final-report-minventory-eu-raw-materials-statistics-resources-and-reserves-0_en | Minventory final report. This report contains a great deal of background information on different resource definitions, codes, standards and classifications as well as a proposed roadmap for resource data harmonisation. |
| http://www.minerals4eu.eu/images/images/minerals4eu_wp4_del4.3_20150730_bgs_v1.0.pdf | Minerals4EU report on minerals data. This report contains a discussion over some of the issues of resource data harmonisation and some recommendations for future harmonisation. |
| https://minatura2020.eu/wp-content/uploads/2018/01/MINATURA2020-D2.3_FINAL.pdf | Minatura Deliverable 1.2, a harmonised mapping framework. This contains a review of resource definitions, codes, standards and classifications and a brief discussion over some of the harmonisation issues. |
| https://minfuture.eu/sites/default/files/D5.3_Roadmap.pdf | MinFuture Roadmap - A roadmap towards monitoring the physical economy. This report outlines many of the problems in defining accurate representations of mineral resource stocks. |
| http://www.vmine.net/perc/documents/EGM-PAPER-PERC2013.pdf | An article explaining the differences, uses and purpose of both UNFC and CRIRISCO |
| **Resource codes a classifications** | |
| https://www.unece.org/energy/se/unfc_2009.html | UNFC 2009. |
| http://www.crirsco.com/template.asp | CRIRSCO template. |
| **Bridging documents** | |
| https://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/UNFC_specs/Revised_CRIRSCO_Template_UNFC_Bridging_Document.pdf | Revised annex iii bridging document between the CRIRSCO template and UNFC-2009. |
| https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc_egrc/egrc5_apr2014/30Apr/10_Henley_UNFC_Minerals_CS.pdf | CRIRSCO-UNFC 2009 mapping Solid Minerals Case Studies. A presentation outlining detailed case studies converting figures from CRIRSCO compliant data to UNFC. |
| http://igi.ie/assets/files/courses/NRReporting%20Workshop/Alignment%20of%20CRIRSCO%20and%20RF%20systems-NYoung%20et%20al.pdf | Alignment of Resource and Reserve Classification Systems Russian Federation and CRIRSCO |
| https://docplayer.ru/26006551-Table-of-contents-1-introduction-2-scope.html | Guidelines on Alignment of Russian minerals reporting standards and the CRIRSCO Template. |

| National case studies | |
|---|---|
| https://static1.squarespace.com/static/592636dad482e9754a483451/t/5aefd42d88251b4d160dd0c2/1525666885536/Mineral_Resource_Estimate_Final_Ebeleben_Signed.pdf | This outlines a case study converting from Germany converting historic figures that have used the GKZ (Russian State System) of reporting to JORC. |
| http://geoportal.pgi.gov.pl/css/surowce/images/2017/pdf/mineral_resources_of_poland_2017.pdf | A case study from Poland converting from the Polish national system to UNFC. |
| https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc_egrc/egrc8_apr_2017/EGRC.8.2017.INF.8e.pdf | A guidance for the application of the unfc-2009 for mineral resources in Finland, Norway and Sweden. |
| https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc_egrc/egrc9_apr2018/26.04/p.10_Horovath_Cases_HZ.pdf | Experience with mineral data harmonization and UNFC application – case studies (Hungary / Central Europe). |
| https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc/IntWs_UNFC_Ankara_Sept2011/14_Rokavec.pdf | A case study on converting data from the Slovenian national system to UNFC. |

*Table 5: useful sources for mineral resource and reserve data harmonisation.*

# Annex 1: Country summaries for national legal and regulatory frameworks for resource and reserve data

## *Introduction*

Several H2020 projects, such as Minventory, Minatura, Minguide, Minerals4EU and Minlex, have complied data on the regulatory and legislative structures that relate to minerals in European countries. The Minventory report especially compiled a great deal of information specifically on resources and reserves and how these figures are handled on a national basis. The following country summaries draws from these previous reports brings together the relevant information regarding resources and reserves data and adds extra detail as to the precise situation regarding how and if figures for resources and reserves are reported on a national basis and if any attempts have been made to harmonise with other classification systems.

The relevant information from previous projects that have been used by this study can be found at:

**Minventory**:

A summary of national minerals reporting by country can be found at: https://ec.europa.eu/assets/jrc/minventory/national-reportingf546.html?field_cs_country_lexique_tid=&page=1

The final report for the Minventory project: https://ec.europa.eu/growth/content/final-report-minventory-eu-raw-materials-statistics-resources-and-reserves-0_en

**Minatura**

Deliverable 1.2, a harmonised mapping framework: https://minatura2020.eu/wp-content/uploads/2018/01/MINATURA2020-D2.3_FINAL.pdf

Deliverable D2.3, Harmonised Mapping Framework, Version 1.0: http://minatura2020.eu/wp-content/uploads/2018/01/MINATURA2020-D2.3_FINAL.pdf

Deliverable 3.1 Multi-sectorial analysis of mineral policies and land use polices in EU countries: https://minatura2020.eu/wp-content/uploads/2018/01/MINATURA2020_D3.1.pdf

**Minguide**

Deliverable 2.1: Taking stock of EU and Member States Mineral Policy and Legislation: https://www.min-guide.eu/sites/default/files/project_result/D2%201%20Taking%20stock%20on%20EU%20and%20EU%20MS%20mineral%20policy%20and%20legislation_final_v02.pdf

D2.3 EU and EU MS Minerals Policy Report: https://www.min-guide.eu/sites/default/files/project_result/min-guide_d2_3_eu_and_eu_ms_minerals_policy_report.pdf

Country profiles: https://www.min-guide.eu/project-results

**Minerals4EU**

Deliverable 4.3 Report on availability of mineral statistics: http://www.minerals4eu.eu/images/images/minerals4eu_wp4_del4.3_20150730_bgs_v1.0.pdf

**Minlex**

Minlex final report: https://publications.europa.eu/en/publication-detail/-/publication/18c19395-6dbf-11e7-b2f2-01aa75ed71a1/language-en

## *Austria*

### Codes/standards/classifications used

In Austria, there is a national code (ÖNORM G 1050) for the classification of mineral deposits. In ÖNORM G 1050 mineral deposits are classified based on increasing geological certainty and increasing degree of economic viability. Information on geological certainty is provided via a numeric code which ranges from category 3 (tentative estimates) through 2 (preliminary estimates) to category 1 (reliable estimates) (Figure 26). Category 1 deposits are subdivided into classes A, B and C representing the increasing geological certainty (A±20%, B±30%, C±50%). Economic viability in ÖNORM G 1050 is indicated via a letter with mineral occurrences being indicated with O as a prefix and mineral deposits which are economic to extract now or in the foreseeable future being indicated with R as a prefix. Both economic categories (R and O) can be subdivided based on the level of economic knowledge as obtained via details on the geological nature of the deposit such as metal content or depth and thickness.

For example, R-1A-E is the highest class and represents a deposit which has been fully evaluated both geologically and economically. A mineral deposit that has undergone very limited geological and economic investigation would be classified as O-3-Z. The ÖNORM G 1050 also has a category that allows for the classification of mineral deposits which are only of scientific interest.

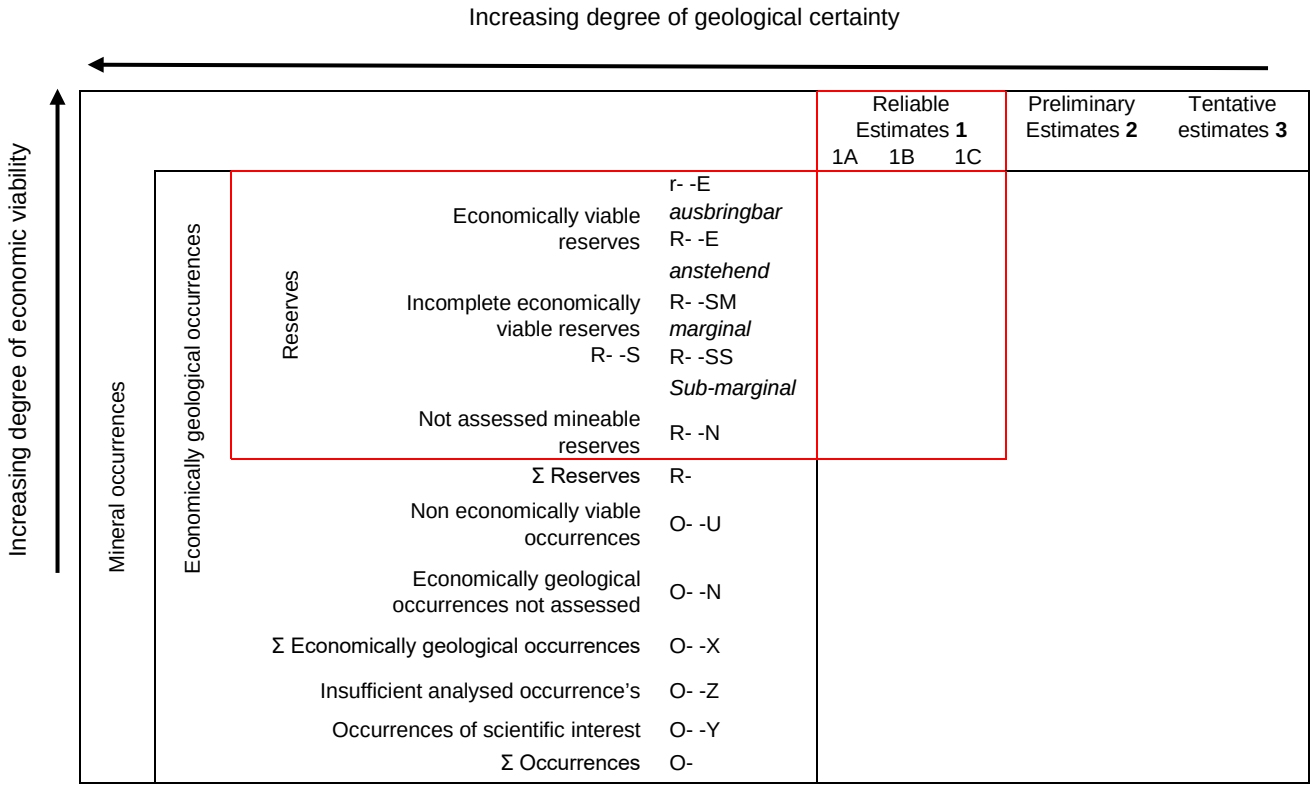


*Figure 27: Classification of mineral occurrences and reserves of solid mineral raw materials after ÖNORM G 1050 (1989).*

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

Legal regulations comprise the implementation of the federal law on mineral "Mining Law no. 38 1999, nr. 115, 2009" and a law on mineral exploration 'Vollzug des Lagerstättengesetzes', no. 246/1947. The federal law on mineral deposits requires national surveying of mineral resources, but not quantification of resources and reserves (Tiess et al., 2016). Data collection is made by the geological survey through mapping and monitoring. Exploration companies have an obligation to use the ÖNORM G 1050.

### Level of data available

Datasets relevant to primary raw material resource evaluation (e.g. mineral resource maps, mineral occurrences databases, mine and quarry information) do exist and are owned by the Geological Survey (Geologische Bundesanstalt) and the Federal Ministry of Science, Research and Economy (BMWFW).

There is no obligation by the Mining Law to collect resources and reserves data. Data are collected at national and regional level for construction, industrial and metallic minerals that are actively exploited. Mineral operators provide data once through initial permitting procedure. Although Mining Authorities monitor exploration activity, they are not under a statutory obligation to report resource and reserve data. Metallic and industrial mineral data are partially available to the public through free web-based systems IRIS (Interactive Resource Information System https://www.geologie.ac.at/services/webapplikationen/iris-interaktives-rohstoffinformationssystem/) and BERGIS (Mining Information System,

http://www.bergis.at/). Both information systems are in German language. The IRIS systems provides only geological data rather than detailed quantitative resources or reserves data for Austrian provinces.

### Existing harmonisation

The ÖNORM G 1050 was originally UNFC-based and can be considered as an advancement of the USGS classification scheme from 1976. The Austrian national reporting system is no longer aligned with international classification codes.

In the ÖNORM G 1050 estimates (1A, 1B and 1C) are corresponding to the "identified resources" of the USGS system. The subclass „feasible reserves" corresponds to the subclass „economic", „incomplete feasible reserves" to the subclass „marginally economic". Terms like „not assessed reserves" and „subeconomic" („the part of identified resources that does not meet the economic criteria of reserves and marginal reserves") are different. There are no information relevant for valuation for this subclass after ÖNORM G 1050. The "Reserve Base" USGS class correspond to the total sum of classes 1A and 1B. Further, ÖNORM G 1050 system gives information about the reliability of each individual class: 1A: 90 % ± 20 %; 1B: 90 % ± 30 %; 1C: 90 % ± 50 %.

Using ÖNORM G 1050 the combination of geological certainty codes with the economic viability codes provides a clear indication of the class of deposit (and as such is analogous to UNFC). However, the Austrian classification is no longer aligned with internationally used standard codes. Additionally, the ÖNORM G 1050 systems only provides results for deposits with known quantities.

The category "Indicated Mineral Resources" corresponds analogously to the class 1B in the ÖNORM G 1050. "Measured Mineral Resources" or 222 in UNFC, or 221 according to UNFC definition, are designated as 1A in the ÖNORM G 1050 system. The certainty of this category is about 90 % ± 20 %. "Probable Ore Reserves" after CRIRSCO are defined as "the economically mineable part of an Indicated, and in some circumstances, a Measured Mineral Resource". The UNFC describes a "Probable Mineral Reserve" as the following: "Measured or Indicated Resource on which sufficient technical and economic studies have been carried out to demonstrate, at the time of reporting, that it can justify exploitation under appropriate technical and economic conditions" classified as 112.

"Probable Ore Reserves" in the ÖNORM G 1050 are titled as R-SM (marginal) bzw. R-SS (submarginal). A "Proved Ore Reserve" in the CRIRSCO system is the economically mineable part of a Measured Mineral Resource. The UNFC system stated "Proved Ore Reserves" as Measured Mineral Resource on which detailed technical and economic studies have been carried out to demonstrate, at the time of reporting, that it can justify exploitation under specific technical and economic conditions" (code 111). The ÖNORM G 1050 system categorise "Proved Ore Reserves" as subclasses r-E (economically viable reserves-"ausbringbar") and R-E (economically viable reserves-"anstehend").

### Recommendations for harmonisation

The similarities of ÖNORM G 1050 comparable to USGS classification, CRIRSCO and UNFC system are described by the Technical Norm Committee of Mining 1989 ("Fachnormenausschuss 097 Bergbau"). Other attempts to harmonise data received from different sources are not made.

### Useful links and references

Classification of resources and occurrences for solid mineral raw materials, ÖNORM G 1050: Klassifikation von Vorkommen fester mineralischer Rohstoffe.- Österreich Normungsinstitut; FNA 097 Bergbau, 1. April 1989:

https://shop.austrian-standards.at/Preview.action?preview=&dokkey=10443&selectedLocale=de

IRIS on-interactive minerals system: http://geolba.maps.arcgis.com/apps/webappviewer/index.html?id=ef8095943a714d7893d41f02ec9c156d

Country profile for minerals policy: https://www.eea.europa.eu/publications/more-from-less/austria-material-resource-efficiency/view

Economic geological assessment for reserves of solid mineral resources: https://opac.geologie.ac.at/wwwopacx/wwwopac.ashx?command=getcontent&server=images&value=JB1481_099_A.pdf

Tiess, G., Murguia, D., Hamadová, B., 2016, MINATURA Deliverable D2.3, Harmonised Mapping Framework, Version 1.0

## *Belgium*

### Codes/standards/classifications used

For sand and gravel, clay, limestone/dolomite, sandstone and aggregates, data and reporting on primary raw material resources and reserves do not correspond to an international standard code.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

Primary raw materials are managed at regional level (Flemish and Walloon governments), as no national mining law exists. Each region has its own legislation and regulation framework. For the Flemish region, the Flemish Parliament Act on Surface Mineral Resources forms the legislative framework of the Flemish Minerals Policy and defines the making of a general surface mineral resources plan and specific Surface Mineral Resource Summaries, applying to sand and clay in practice. The Flemish Environmental Licensing Degree, or VLAREM, is responsible for the environmental regulatory process, for any activities and/or projects that have an impact on the environment, which applies to sand, gravel and brick clay.

In the Walloon region the decree “Carrières du 04 juillet 2002, par le décret du 11 mars 1999 relatif au permis d’environnement (et permis unique lorsque l’urbanisme est concerné), et par le Code wallon de l’aménagement du territoire, de l’urbanisme et du patrimoine (CWATUPE)” applies, which is related to quarry products.

For the Belgian offshore areas, special concessions, royalties and supervision for sand and gravel are agreed: “Wet van 13 juni 1969 inzake de exploratie en de exploitatie van niet -

levende rijkdommen van de territoriale zee en het continentaal plat, gewijzigd door de wetten van 20 januari 1999 en van 22 april 1999".

### Level of data available

Data are currently collected on primary construction raw material resources. Data is not continuously collected on construction mineral reserves and industrial or metallic mineral resources as well reserves. Data collection is the responsibility of surveys and a number of government departments for the following regions:

*Flemish region*: The Natural Resources Service of the Flemish government (Department LNE – Environment, Nature and Energy department, direction ALBON).

*Walloon region*: The natural resources service of the Walloon government (Direction Générale Agriculture, Ressources Naturelles et Environnement - DGO3/SPW:

Département des Permis et des Autorisations (DPA),

Département de la Police et des Contrôles (DPC)

*Belgian offshore*: FOD Economie, K.M.O., Middenstand en Energie, Algemene Directie Kwaliteit en Veiligheid, FOD Economie, K.M.O., Middenstand en Energie, Algemene Directie Kwaliteit en Veiligheid, Dienst Continentaal Plat.

Exploration and mining companies are under a statutory obligation to report data on annual mined quantities to the departments responsible (listed above). Construction mineral operators have a statutory obligation to report the data in annual reports "voortgangsrapport". Resources and reserves data are not directly reported to the authorities but can be deduced from these reports.

The General Surface Mineral Resources Plans (abbreviated in Dutch as AOD) are elaborated (Tiess & Murguía, 2016) and estimations of resources are available. These Plans are obligatory and made every 5 years. However, data collection does not contain reserves estimates in a structured way, but it should be possible to calculate reserves based on available data.

In future, thematic focus of international interest will be made available in English, as currently all data and information is in French. The Geological Survey of Belgium also holds mineral resource and reserve data for Belgium.

### Existing harmonisation

For sand and gravel, clay, limestone/dolomite, sandstone and aggregates, data and reporting on primary raw material resources and reserves do not comply with an internationally recognised standard code. Attempts are made to harmonise data received from different sources but not through a specific regional code. A reporting agreement does exist between the monitoring department and industry. A code is not used for reporting marine or industrial/metallic minerals. Codes and classifications used for Wallonia and Flanders regions are unknown.

### Recommendations for harmonisation

As in Belgium mineral resources are managed on a regional level, and each region has its own legislation and regulation framework, even a consistent data collection and reporting seems to

be difficult. Therefore, data harmonisation of mineral resource and reserve data would be the second stage.

### Useful links and references

Country profile for minerals policy: https://www.eea.europa.eu/publications/more-from-less/belgium-material-resource-efficiency

Tiess, G., Murguía, D., 2016. Exploring options for a harmonised mapping framework (MINATURA2020 Deliverable No. 2.1. Version 1.1). MinPol, Dreistetten, Austria.

## *Bulgaria*

### Codes/standards/classifications used

Bulgaria uses a national modified Soviet code, so could possibly be bridged to other codes and standards via this but no further details are known.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

National legislation requires the collection of mineral resource and reserve data. The relevant legislations are: 1) The "Law on Underground Natural Resources (Prom. SG. 23/12 Mar 1999, amend. SG. 28/4 Apr 2000, amend. SG.108/14 Dec 2001, amend. SG. 47/10 May 2002, amend. SG. 86/30 Sep 2003, amend. SG. 28/1 Apr 2005", 2) "Regulation for the Compilation and Keeping of the National Balance and the Reserves and Resources, Register of the Discoveries and Specialised Cadastre and Register of the Deposits of the Underground Resources", 3) "Regulation for the register and cadastre of permits for prospecting and/or exploration", 4) "Regulation for the National Geological fund", 5) "Regulation for the geological and technical documentation of exploration and mining and extraction sites", and 6) "Tariff for the charges that are collected in the system of the Ministry of Economy, Energy and Tourism". The "Law on Underground Natural Resources" states the conditions for prospecting, exploration and extraction of underground resources in Bulgaria, including the continental shelf and exclusive economic zone and applies to all non-energy minerals (metallic, industrial, construction), energy minerals and to secondary raw materials (mining waste). Furthermore, the law means that exploration and mining companies have a statutory obligation to report resource and reserve data.

### Level of data available

Data collection on primary raw material resources and reserves and monitoring of exploration activity is the responsibility of the National Geological Survey (Natural Resources and Concessions Directorate, Ministry of Economy, Energy and Tourism). Resource and reserves data are available for construction minerals and selected industrial minerals. Resource and/or reserve data are also available for some metals, e.g., bauxite, chromium, copper, gold, tungsten etc. The "National Geological Fund" contains thousands of geological reports covering all geological activities in the country for the last 50 years, including exploration for mineral

deposits and geochemical data. Bulgaria's Geofund collect, process, store and provide for use against payment geological information from surveys and other activities relating to the prospecting, exploration and extraction of subsurface resources.

The national balance of subsurface resources, called the "National Balance", is prepared annually based on status updates and changes of reserves and resources. Data status and changes may be provided by contractors of public procurement orders for geological surveys, holders of licences for prospecting and exploration, and concessionaires and sole proprietorships with the state as sole owner of capital, that carry out extraction of subsurface resources. Reserves of subsurface resources included in the National Balance are accounted for in compliance with endorsed by the Council of Ministers "Classification of reserves and resources of the deposits of ores and minerals". Reserves and resources in the Balance are grouped by economic effectiveness and readiness of deposits for industrial use, and degree of exploration and authenticity.

#### Existing harmonisation

Bulgaria has a centralized data collation and harmonisation procedures on a national level for mineral inventory analysis required by law. It is unknown if ay efforts have been made to harmonise with any internationally recognised codes or classifications.

#### Recommendations for harmonisation

As the national reporting code is not known, data harmonisation cannot be supported.

#### Useful links and references

Minlex country report:

http://rmis.jrc.ec.europa.eu/uploads/cprofiles/MINLEX_CountryReport_BG.pdf

Law for the underground natural resources: http://www.geology.bas.bg/admin/LUNR_en.pdf

Report on the Status of the Environment – 2000:
http://eea.government.bg/eea/en/publicat/2000/zned/zned.htm

Country profile for minerals policy: https://ec.europa.eu/assets/jrc/minventory/country-summaries8e19.html?country=Bulgaria

Tiess, G., Murguia, D., Hamadová, B., 2016, MINATURA Deliverable D2.3, Harmonised Mapping Framework, Version 1.0

### *Croatia*

#### Codes/standards/classifications used

Details about the national reporting code in Croatia are not known. According to their own statements, the national code is modified after the Soviet code but not aligned with international standards.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

Under "mineral raw material reserves" the Mining Law from 2009 specifies that raw material reserves are classified in classes and categories "pursuant to the regulations on the unified method of establishing, recording and collecting data on mineral raw material reserves and a balance of these reserves". Companies must report their data using the national code.

### Level of data available

The Mining Directorate of the Ministry of Economy, Labour and Entrepreneurship is responsible for data collection on primary raw material resources and reserves. Maintenance of data base of all active and abandoned mines and quarries is devolved to the Croatian Geological Survey.

The Mining Law from 2009 and the Mineral Resource Management Strategy of Croatia cover provision of data on primary raw materials resources and reserves. According to the Mining Law from 2009, as overseen by the Department of the Mining Inspectorate, owners of mineral concessions are obliged to submit data and documents on mineral primary raw materials reserves (e.g. quality, production data and volumes sold, amount in stockpiles) to the commission for determination of mineral raw material reserves. Data on minerals can be obtained both on the internet and through direct requests to the responsible bodies.

The Ministry of Economy holds all reports, geographical and geological data for all areas of exploitation, including statistical data related to both production and reserves on an annual basis for all counties, as well as for aggregates. A centralised database and GIS with commodities locations and types, but without reserves information is maintained by the Ministry of Economy (Directorate for Mining). This data is not generally available to the public or accessible through the internet, but is available free of charge for groups of commodities on request. The Ministry of Economy produces an annual balance sheet (1997-2016) of mineral resources and reserves in Croatian language based on their uniform information system of mineral raw materials (www.mingo.hr). In general, reserves data for Croatia are confidential for a period of five years.

Resources and reserves data for sand, gravel and salt from the marine environment are available from the Croatian register of mining exploration fields verified by the Mining Directorate of the Ministry of Economics.

The Croatian Geological Survey maintains a geological database and a GIS (ArcMap) of all existing and past mining activities in Croatia (~4000 mining sites), which is continuously updated by the Ministry of Economy, Labour and Entrepreneurship, and the Mining Directorate. The GIS comprises a mineral resource database, containing all available data on the mining sites and their history and mineral potential resource maps at a scale of 1:100000. The data from the Croatian Geological Survey is not available on the internet, and the GIS is not INSPIRE compliant.

### Existing harmonisation

There is no data harmonisation available in accordance to internationally reporting classification codes. The strategy "Potential and management of mineral resources in the counties" comprise basic information for the direction and harmonisation of various measures, and the implementation of international obligations for the management of mineral resources

(http://www.hgi-cgs.hr/). The Ministry of Economy, Labour and Entrepreneurship establishes a data management of mineral resources, which basically aims to record mineral raw materials reserves and annual balances of mineral resource reserves (Slobodan et al., 2007).

### Recommendations for harmonisation

The Croatian Geological Survey is working towards developing a unified mineral GIS and INSPIRE compliant database that provides publically available mineral resource and reserve data.

### Useful links and references

Slobodan, M., Vidić, D., Kruk, B., Krasić, D., 2007. Mineral resources management in Croatia. https://bib.irb.hr/datoteka/315782.26_Slobodan_Miko.pdf http://www.hgi-cgs.hr/Potencijal-gospodaranje-mineralnim-sirovinama-na-podrucju-zupanija-Rudarsko-geoloske-studije.htm

Webpage for the ministry of mining: https://www.mingo.hr/page/kategorija/rudarstvo

Minguide country profile: https://www.min-guide.eu/sites/default/files/project_result/Minerals_Policy_Country_Profile_HR.pdf

## *Cyprus*

### Codes/standards/classifications used

Reporting mineral resource and reserve data have to comply with a system of codes defined by the Cyprus “Mines and Quarries Regulation Law”, which do not meet the terms of any internationally recognised reporting codes.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

The Mines and Quarries Regulation Law Cap. 270 of 1965 regulates the operation of mines and quarries in the Republic of Cyprus.

### Level of data available

Data for primary minerals are collected by the Geological Survey Department and Mines Service of the Ministry of Agriculture, Natural Resources and Environment. Data are collected, processed and held at local scale, but are only available on a regional or national scale. Operating companies are under a statutory obligation to report annually to the Mines Service, including tables and maps. Reported statistics on construction and industrial mineral resource and reserves are either in cubic metres and/or tonnes; metallic minerals data are reported in tonnes. Holder of prospect and exploration areas are obliged to keep correct plans of prospecting, mining and quarrying done, records of all minerals values found and ore reserves calculated. On request, they have to supply these records to the Inspector of Mines.

In general data are held by the Geological Survey Department and Mines Service, stored in a national geodatabase within a GIS and are spatially referenced. This is quoted as being INSPIRE compliant. The Geological Survey Department also holds a Mineral Resource Map of Cyprus at 1:250,000 scale, published in 2007. Data are not publicly available, and not in multilingual formats. They can be accessed by specific data requests and are chargeable. Especially metallic minerals data are confidential on a deposit level.

#### Existing harmonisation

Data are not aligned with any internationally recognised reporting codes.

#### Recommendations for harmonisation

Data availability to the public and the usage of an international standard reporting system are key requirement for data harmonisation.

#### Useful links and references

Geological survey of Cyprus:
http://www.moa.gov.cy/moa/gsd/gsd.nsf/dmlIndex_en/dmlIndex_en?OpenDocument

Mining and quarrying legalisation:
http://www.moa.gov.cy/moa/mines/minesSrv.nsf/dmllegmining_en/dmllegmining_en?OpenDocument

Mines and quarries (regulation) law:
http://www.moa.gov.cy/moa/mines/minesSrv.nsf/All/CF7BCA66EE5FDBCDC22574B90035C157/$file/Mines%20and%20Quarries%20(Regulation)%20Law.pdf

### *Czech Republic*

#### Codes/standards/classifications used

In the Czech Republic, a modified Soviet code is used for reporting mineral resources and reserves. The national code is aligned to the UNFC classification.

After 1948 the reserves classification of the USSR was progressively adopted in Czechoslovakia, of which the Czech Republic formed part. Primarily geological reserves (defined as all reserves in their original state in the deposit without subtracting losses from mining, beneficiation and processing) were classified into subdivisions of groups and categories (A, B, C etc.).

In 1989 the Czech Geological Office issued Decree No. 121/1989 Coll., which redefines the prognostic reserve categories and changes their designation to resources. The reserve categories $P_1$, $P_2$, $P_3$ are defined as follows:

$P_1$: Assumed due to the continuation of an already investigated deposit or due to the discovery of new deposit parts or bodies. The basis for this category are the results of geological mapping, geophysical, geochemical and other work in the area of possibly occurring prognostic

resources: geological extrapolation of data results from the investigation, or the verification of part of the deposit.

$P_2$: Assumed in basin districts and geological regions, where deposits of the same formation and generation type were detected. This category is based on a positive evaluation of deposit indications and anomalies observed during geological mapping and geophysical, geochemical and other work, whose prospect is.

$P_3$: Assumed on the basis of conclusions concerning the formation possibilities of the deposit types with regard to favourable stratigraphic, lithological, tectonic and paleogeographic conditions. Detection and evaluation is based on geological mapping, and during analysis of geophysical and geochemical data.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

A number of legal regulations (Acts) are relevant to provide data on primary raw material resources and reserves, covering collection, storage, processing, assessment and provision of geological documentation and results of geological surveys; management of an inventory of reserves and 'prognostic mineral resources', for all minerals. In accordance with an Act "on the protection and use of mineral resources (Mining Act nr. 44 1988)", the Ministry of the Environment maintains an "Inventory of Reserves of Non-Reserved Mineral Deposits of the Czech Republic" and the 'Register of Mineral Deposit Reserves' of the Czech Republic.

### Level of data available

The Czech Geological Survey (CGS) owns and holds data on national mineral resources and reserves on behalf of the Ministry of the Environment. They are authorised to collect data annually via a questionnaire survey, which mineral operators, exploration companies and holder/owner of mineral rights have a statutory obligation to fulfil. Data is stored in a national centralised database and GIS system, therefore data is spatially referenced but is not INSPIRE compliant. Selected data is available to the public and this can be accessed as printed documents "Mineral Commodity Summaries of the Czech Republic" produced by the CGS. Since 1993 data are online and free for download in English and Czech versions. Since 2009 the 'Mineral Commodity Summaries of the Czech Republic' has included resource and reserve data for minerals which do not have a production history in the Czech Republic, including critical raw materials such as REE, selenium, tellurium, tantalum and niobium.

### Existing harmonisation

The Czech classification system is well aligned with internationally recognised standard codes, as all categories in the Czech system, with the exception of 'prognostic resources' can be mapped to a CRIRSCO category and 'prognostic resources' are comparable to the 'Reconnaissance Mineral Resource' category of the UNFC system. The term reserves as used, by contrast, in standard international classifications represents only the parts of explored resources which are available for immediate or developed extraction. All other registered parts are resources, not reserves, of a given mineral. All mineral resource and reserve data are harmonised at its source level, which means when data is reported to CGS it should meet the terms of the Czech national code. Company reports are checked by the Ministry of the

Environment and the Czech Mining Authority and the Ministry of Industry and Trade for completeness, reliability and relevance to previous reports.

*Table 6: Comparison of UNFC category code with the reserve and resource classifications of the CRIRSCO and of the Czech Republic (after 1991). (Source: Czech Geological Survey, 2018 Yearbook)*

| Code of UNFC category | Proposed designation of the UNFC category | CRIRSCO category | Czech categories after 1991 |
|---|---|---|---|
| 111 | Proved Mineral Reserve | Proved Mineral Reserve | part of exploitable part of explored economic reserves |
| 121 + 122 | Probable Mineral Reserve | Probable Mineral Reserve | part of exploitable part of explored economic reserves |
| 123 | - | Inferred Mineral Resource | prospected potentially economic reserves |
| 211 | Feasibilty Mineral Resource | Measured Mineral Resource | part of explored potentially economic reserves |
| 221 + 222 | Prefeasibility Mineral Resource | Indicated Mineral Resource | part of explored potentially economic reserves |
| 223 | - | Inferred Mineral Resource | prospected potentially economic reserves |
| 331 | Measured Mineral Resource | Measured Mineral Resource | part of explored potentially economic reserves |
| 332 | Indicated Mineral Resource | Indicated Mineral Resource | part of explored potentially economic reserves |
| 333 | Inferred Mineral Resource | Inferred Mineral Resource | prospected potentially economic reserves + part of $P_1$ |
| 334 | Reconnaissance Mineral Resource | not available | $P_2$ + $P_3$ part of $P_1$ |

### Recommendations for harmonisation

A significant difference in terminology is that “reserves” in the Czech classification system include “potentially economic reserves”, which mean “currently unexploitable due to limited existing technical and economic conditions of exploitation, yet assumed to be exploitable in the future”. Therefore, these reserves are potentially economic resources. This difference in terminology needs to be respected in any attempts to harmonise with other classification schemes and codes.

### Useful links and references

Czech Geological Survey, 2018. Mineral Commodity Summaries of the Czech Republic 2018, Statistical data to 2017, http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries/mineral%20-commodity-summaries-2018.pdf

## *Denmark*

### Codes/standards/classifications used

In Denmark a national reporting code for mineral and non-energy mineral resource and reserve data is not known. In Greenland reporting codes for collected data are in accordance with internationally recognised standard codes that companies will use depending on their nationality, such as JORC and NI 43-101.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

Data collection by the Geological Survey of Denmark and Greenland (GEUS) take place according to the Geological Survey of Denmark and Greenland Act (no. 536 of 6 June 2007), the Act on Raw Materials, the Act on Danish subsoil (No. 889 of 200), and others. On Greenland, the requirement for data collection on primary raw material resources and reserves and other information is defined by Greenland Parliament Act no. 7 of December 7, 2009, on mineral resources and mineral resource activities (The Mineral Resources Act), with amendments from Greenland Parliament Act No. 26 of December 18, 2012.

### Level of data available

GEUS owns and holds numerous archives and datasets. The Knowledge Center for Mineral Raw Materials and Materials (MiMa) was established in 2013 under GEUS. On their website they are providing several reports and publications in Danish (http://mima.geus.dk/). The Danish Nature Agency and the Danish Coastal Authority are responsible for monitoring exploration and extraction activities for marine minerals (sand and gravel). Companies that hold dredging licences are obliged to map and quantify the marine mineral resources and reserves in the licensed area. Non-energy mineral resources are composed mainly of industrial and construction minerals. In Denmark are no known economically exploitable reserves of metallic ores.

The majority of the work undertaken by GEUS on mineral resource assessment is focused on Greenland (Parker et al., 2015). The Online Greenland Portal provides reports on several commodity occurrences. The Ministry of Industry and Mineral Resources are responsible for data collection on primary raw material resources and reserves. Other types of data relevant to primary raw material resource evaluation exist (see www.greenmin.gl). Data storage is managed through a centralised database, containing data on deposit level scale but without spatially referenced and multilingual formats. Data are available to the public and free of charge (www.govmin.gl) and www.greenmin.gl) except for confidential material, which usually remains confidential for 5 years. Exploration and Mining companies are under a statutory obligation to report resource and reserve data according to the exploitation licence and approvals under this licence, based on the Mineral Act. These reports must include data in form of tables of all available data regarding geological mapping, drill hole logs, drill cores etc. The code for reporting data is normally outlined in the company's licence.

Responsible for the collection of statistical data on marine sand and gravel, and rubble production is the Danish Nature Agency. They are yearly producing reports available from the Statistics Office in Denmark (Parker et al., 2015).

### Existing harmonisation

Information about data harmonisation in Denmark are not available. On Greenland, data collected comply internationally recognised standard such as JORC and NI 43-101. There do not exist attempts for data harmonisation from different data sources.

### Recommendations for harmonisation

Due to the lack of information available on standardisation, classification and usage of the national reporting code especially in Denmark, comments for recommendations cannot be issued.

### Useful links and references

Interactive map for the mineral resources of Greenland:
http://data.geus.dk/geusmap/?mapname=greenland_portal#baslay=baseMapGl&optlay=&extent=-2696488.827160494,5853989.540895062,3524498.827160494,10194100.459104938&layers=northpole_graticule,dodex_reports_visible

Parker, D., Petavratzi, E., Mankelow, J., Waugh, R., Bertrand, G., 2015, Minventory: EU raw materials statistics on resources and reserves.

## *Estonia*

### Codes/standards/classifications used

There is a national code, the Estonia's Mineral Resource Classification System, which is PERC aligned.

The system distinguishes three categories: T, R and P.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

The Estonian Commission on Mineral Resources developed for Estonia the Mineral Resource Classification System, which is based on internationally accepted principles.

### Level of data available

Data collection is the responsibility of the Ministry of the Environment - Geological Survey of Estonia preserved in the Estonian Land Board. Data is collected quarterly by the Ministry of the Environment. Data collection is based on the list of mineral deposits in the Environmental Register.

According to the Estonian Earth`s Crust Act, which entered into force on April 1, 2005, mineral resources are clay, crystalline building stone, dolostone, gravel, lacustrine lime, lake and sea muds, limestone, oil shale, peat, phosphate rock (phosphorite), and sand.

In the Estonian National Geoportal, spatial data that are owned by the Estonian state, local governments and other legal persons governed by public law are published and made available. The Estonian geoportal is a part of the Estonian Spatial Data Infrastructure aiming to ensure that different spatial data meet certain requirements and are available via harmonised services. The INSPIRE compiled data map also provides mineral resource data, including mineral occurrences and mines, but without any detailed information.

The inventory of the Environmental Register is a database of mineral resources that are located on mainland, transboundary waters, territorial and inland waters of Estonia as well as economic zones. The responsible sector for registration is the Ministry of the Environment and the Land Board is the authorised competent for the inventory of mines. According to the Environmental Register Act 2002, everyone has the right to access public data and extract them. The data on the inventory of the environmental register is disclosed through the map application of "Maardlate". Also on their website available are so-called "Consolidated Balance Sheets for Mineral Resources". These lists refer to the aggregated balance sheet of mineral resources, which contains data on mineral resources, extracted quantities and stock changes. However, the map application and balance sheets for mineral resources are only available in Estonian language.

### Existing harmonisation

Data harmonisation on mineral resources and reserves is carried out on a national level. Estonia's Mineral Resource Classification System is based on internationally accepted standards, whereby three categories (T, R and P) are separated, according to the classification of the UN Committee on Natural Resources from 1979. There, category T corresponds to category R1 (reliable estimates of tonnages and grades of known deposits), category R to R2 (extensions of known deposits and newly discovered deposits with preliminary estimates), category P to R3 (undiscovered deposits with tentative estimates) in the UN classification. The term "active" expresses the economic (E) status of resources, while the term "passive" marks their subeconomic (S) status. Proved Mineral Reserves are corresponding to the Estonian category $T_a$, Inferred Mineral Resources to the Estonian category $R_a$, and Submarginal Mineral resources to the Estonian categories $T_p$ and $R_p$ (as constituted on 1st January 2007, Raudsep, 2008).

### Recommendations for harmonisation

Availability of data in other languages, apart from Estonian, would facilitate a data harmonisation.

### Useful links and references

Geology and Mineral Resource of Estonia: http://geoloogia.info/

Interactive map for the mineral resources of Estonia: http://inspire.maaamet.ee/map

Estonian Geodata portal: https://geoportaal.maaamet.ee/

Consolidated Balances of Mineral Resources: https://geoportaal.maaamet.ee/est/Andmed-ja-kaardid/Geoloogilised-andmed/Maardlad/Maavaravarude-koondbilansid-p193.html

## *Finland*

### Codes/standards/classifications used

There is not a national reporting code for Finland. According to Holopainen and Skogström (2017), the Canadian CIM and the Australian JORC system are used by the mining industry to report mineral resources and reserves.

The Fennoscandia Review Board Standard (FRB Standard) is an independent set of rules that has been adopted by SveMin (Swedish Association of Mines, Mineral and Metal Producers), FinnMin (Finnish Mining Association) and Norsk Bergindustri (Norwegian Mineral Industry) to be applied in Sweden, Finland and Norway, respectively. It is roughly based on the first version of the CRIRSCO Template from 2006 for the commercial reporting of exploration results, mineral resources and mineral reserves. Therefore, it is similar to the PERC and JORC Code since both are also based on the CRIRSCO Template. The Fennoscandia Review Board (FRB) designates Qualified Persons (QP) to operate in accordance with specified rules, which apply to companies that present commercial reports of exploration and survey results as well as feasibility studies and project assessments. A Qualified Person is a member approved and registered by SveMin or FinnMin or Norsk Bergindustri, the requirements of approval and the registration being determined by each body respectively.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

The Ministry of Employment and the Economy (MEE) in collaboration with the Finnish Safety and Chemicals Agency (TUKES) are responsible for collecting data on primary raw material resources and reserves. The relevant legislation is the Mining Act nr. 621, 2011, which relates to metal ores and industrial minerals and the Land Extraction Act nr. 555, 1981, which relates to rock, gravel, sand, clay and soil complemented by the Mining Decree nr. 391, 2012. Therefore, exploration and mining companies are required to report resource and reserve data. Reports must include an estimate of the mineral resources in the area, based on a widely used standard, and an estimate of the ore potential (reserves) of the area, as well as geological, geophysical and geochemical data. Reports and related information must be delivered as electronic files. In 2019, TUKES in collaboration with the Geological Survey of Finland (GTK) aim introduce a new web-based data transfer system (TUKES-GTK Geodata flow) where all mining and exploration companies are obligated to provide annual reports stating mine production data, exploration costs and exploration data (Bide et al., 2018).

### Level of data available

Data collection on primary raw material resources and reserves is accomplished by the MEE and TUKES. However, the GTK is responsible for all primary raw materials (Construction, Industrial and Metallic minerals). The data collection period is variable, but exploration and mining companies under the mining law are required to report data annually. Data are reported at a national level for metallic and industrial minerals, and at a regional level for construction minerals. Data on marine minerals are not collected in Finland.

Data on mineral resources and reserves and, where relevant, production for primary raw materials can be freely accessed from the GTK. Further information on mineral investigation in Finland can be obtained via http://en.gtk.fi/mineral_resources/exploration.html#. Where otherwise available, data are reported at a national and regional scale. The main users of the data are exploration and mining companies. In addition public media, land use planners and non-professional users are increasingly using the data because of the rapidly growing mining

sector in Finland. However, data are mainly reported in Finnish with certain information being provided in English.

### Existing harmonisation

Exploration and mining companies are required to provide data to an international standard code, which is not specified by the mining law (only "the widely used standard"). In 2014, the GTK has decided to use the UNFC classification for reporting of resources and reserves figures. Case study deposits such as Kiviniemi Sc, Mäkärä Au, Virtasalmi Cu have been classified according to UNFC, but formal reports are not available yet (Bide et al., 2018).

There exists a draft of a guidance for the application of the UNFC-2009 classification for mineral resources in Finland, Norway and Sweden published in August 2017 available on the UNECE website. This guidance has been drafted by the GTK, Norway (NGU) and Sweden (SGU), SveMin and Norsk Bergindustri. The guidance do not change the various regulatory requirements set by Governments or accounting standard setters for reporting on extractive activities. Guidance is provided on how to construct a UNFC inventory, so that an inventory that satisfies the regulated reporting requirements most commonly used in the Finland, Norway and Sweden can be generated based on it.

### Recommendations for harmonisation

Digital available data are mainly INSPIRE compliant and GTK are participating in the IUGS/CGI EarthResourceML interoperability working group in order to further progress data harmonisation. Key challenges to availability and harmonisation of mineral resource and reserve data are the reporting of secondary raw materials, reports on mineral statistics and material flow analyses, as the mining sector in Finland is growing fast.

### Useful links and references

Interactive map of mineral resources: http://geomaps2.gtk.fi/activemap/.

Boliden mineral resources and reserves report:
https://www.boliden.com/operations/exploration/mineral-reserves-and-mineral-resources

Guidance for the application of the unfc-2009 for mineral resources in Finland, Norway and Sweden:
https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc_egrc/egrc8_apr_2017/EGRC.8.2017.INF.8e.pdf

Finland's Minerals strategy:
http://projects.gtk.fi/export/sites/projects/minerals_strategy/documents/FinlandsMineralsStrategy_2.pdf

Holopainen, P. and Skogström, P., 2017, Getting The Deal Through, Mining 2017, Chapter Finland

Bide, T., Horváth, Z., Brown, T., Idoine, N., Laukó, Á., Sári, K., Sőrés, L., Petavratzi, E., McGrath, E., Bavec, Š., Rokavec, D., Eloranta, T., Aasly, K., 2018, Deliverable 1.2: Final analysis and recommendations for the improvement of statistical data collection methods in

Europe for primary raw materials, Optimising quality of information in RAw MAterial data collection across Europe – ORAMA.

## *France*

### Codes/standards/classifications used

National systems of reporting exist in France (for legacy metallic ores and coal only). DREAL (Directions Régionales de l'Environnement, de l'Aménagement et du Logement – Regional direction of environment, land use planning and housing), the French Ministry of Ecology, Sustainable Development and Energy and the French Ministry of Industry monitor mineral exploration activity. There is no obligation for exploration and mining companies to report resource and reserve data.

Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

It is not a legal requirement to collect data on mineral resources in France. Thus, there is no centralized data collation on mineral resources and reserves nor harmonization of reporting codes is done (Horváth et al., 2016). For onshore minerals, the main authority responsible for issuing mining permits (ministerial authorisation) for non-energy minerals is the Ministry of Economy and Finance. The reporting authority is the Agency for Environment and Energy Management

### Level of data available

Data are not currently collected on primary raw materials resources and reserves in France.

### Existing harmonisation

Secondary data collected on legacy metallic commodities and coal do not comply with an internationally recognised code, although a national code is used for reporting (which covers metallic ores and coal).

### Recommendations for harmonisation

BRGM consider the obligation to produce resource / reserve data according to a standard code as a key challenge to availability and harmonisation of mineral resource and reserve information for France.

GEODERIS, the institution dealing with post mining assistance and expertise, consider that good opportunities are the key challenge to availability and harmonisation of mineral resource and reserve information for France.

### Useful links and references

Minventory country summary: https://ec.europa.eu/assets/jrc/minventory/country-summariesdaea.html?country=France

Mineral resources portal: http://www.mineralinfo.fr/

## *Germany*

### Codes/standards/classifications used

Individual regional codes are related to single Federal States like Baden-Württemberg or Saxony-Anhalt. These codes do not correlate with any international resource classification system of CRIRSCO and UNFC. International codes are not being used in any case.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

Overall mineral resources and reserves are classified according to the Federal Mining Law, the Law to prospect and protect natural resources (Lagerstättengesetz). Legislation is regulated in Federal Mining Act of 13 August 1980 (Federal Law Gazette I p 1310), last amended by Article 4, paragraph 71 of the Law of 7 August 2013 (Federal Law Gazette I p 3154).

### Level of data available

Information on resources and reserves of primary raw materials is available on a regional level for the different Federal States of Germany. The rights of the data are held by the data owners like private enterprises, the SGD (Staatliche Geologische Dienste), the planning authorities and the mining authorities. There is restricted access to the data and data of active licensed areas are confidential. The confidentiality either ends with the cessation of the mining control or is not terminated at all. Data are stored in numerous databases and/or GIS. Geospatial data will be INSPIRE compliant. Data are organised at regional, local or deposit level using own regional terminology and methods. Most of the data is available in a limited or aggregated form, and in German language only except for a limited number of data that are also available in Russian. Data are accessible through reports, online or via specific data requests, which are commonly made by land use authorities, regional councils, municipalities, the public, as well as from enterprises and consultants. Certain States might charge for a specific data request.

Responsibility upon data collation is characterised by significant heterogeneity mainly due to its federal structure. The ministries, the SGD, the mining authorities, or the state administrations can be responsible. For example in Saxony-Anhalt and Thuringia data are collected annually, while in most other states data are collected occasionally or intermittently.

Primary raw materials covered by the mining law are subject to registration by the individual mining authority. Resource information such as location, boring data and estimated ore grades are collected. There is no estimation on mineral reserves, and exploration and mining companies are not statutorily obliged to report mineral resource and reserve data.

Some states have specific raw materials projects, for example in the so-called ROHSA project (Raw Materials Data in Saxony), relevant geological data on raw materials such as spars and ores in the Free State of Saxony have been systematically collected, stored, the content mined and made available for third parties. For Saxony-Anhalt, raw materials reports from 1998 to 2012 in German language are available on the website of the “Landesamt für Geologie und Bergwesen Saxony-Anhalt” (State Office for Geology and Mining). Furthermore, there is a raw materials report for the years 2010/2011 in German language published by the “Thüringer Landesanstalt für Umwelt und Geologie” (State Office for Environemnt and Geology).

## Existing harmonisation

In Germany, no centralized data collection and harmonisation is used in inventory analysis at federal level. There are no initiatives for data harmonisation of the individual regional codes or for the use of international resource classification systems. At least, there exists a classification system of mineral oil and natural gas after the UNFC classification 2003.

*Table 7: Classification of mineral oil and natural gas reserves after the UNFC classification system (UN, 2003).*

| Code | E<br>Economic importance | F<br>Feasibility (Project status) | G<br>Geological Exploration degree |
|---|---|---|---|
| **10** | Commercial | Committed | Proved |
| **20** | Contingent commercial | Contingent feasible | Explored and delineated |
| **30** | Not commercial | Exploration | Discovered |
| **40** | - | - | Prospective |

For example, Davenport Resources Ltd is the holder of the Ebeleben mining licence in Thuringia State. Micon International Co Limited reported ore resources and reserves of the Ebeleben deposit, which are according to the internationally recognised standard classification of the JORC Code 2012. All historical estimates refer to the "Kali-Instruktion" classification based on the established system developed and administered by the Russian State Commission for Mineral Resources (GKZ). Their technical report illustrates the possible correlation between the JORC code and GKZ system in Figure 27.

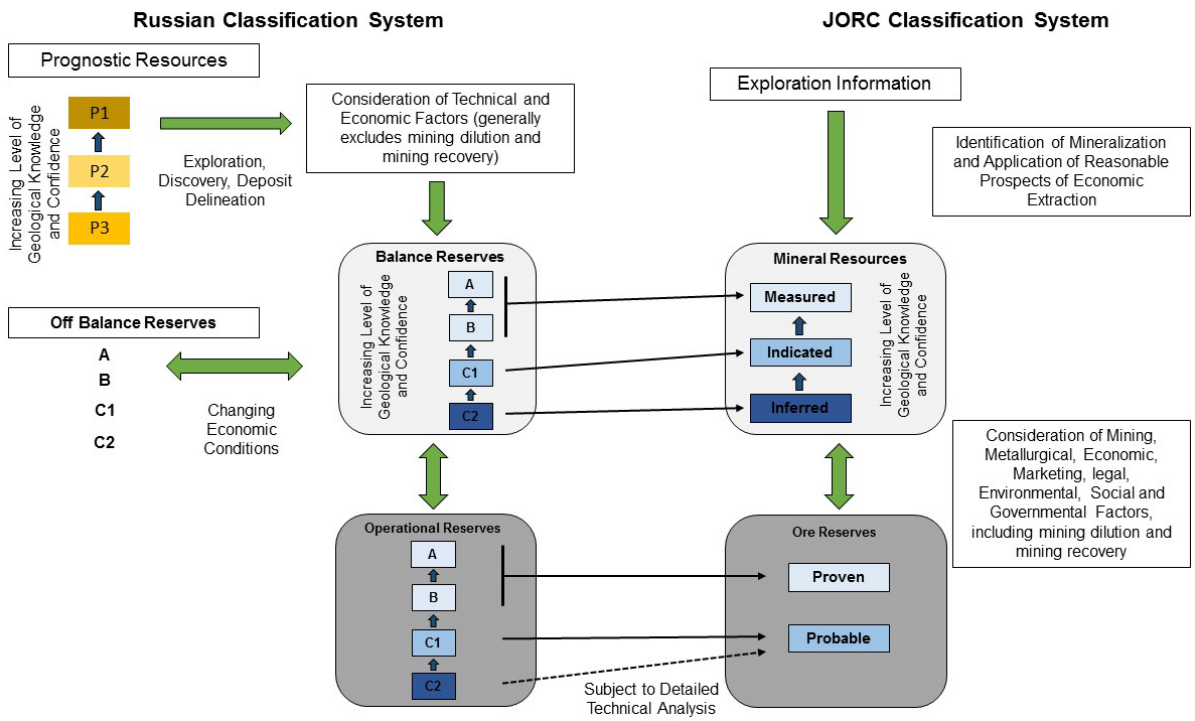


*Figure 28: Correlation of the Russian (GKZ) and JORC Classification System of Mineral Resources and Reserves. (Davenport Resources Limited and Micon International Co Ltd, Technical Report, Ebeleben deposit, Thuringia, Germany)*

### Recommendations for harmonisation

A national classification system instead of state-based classification codes would be required before any attempt at any level of national or European level harmonisation is made.

### Useful links and references

Raw material report for Baden-Württemberg: http://lgrb-bw.de/produkte_lgrb/informationen/informationen_27

Commodity Security Report 2018 for Hannover: http://www.lbeg.niedersachsen.de/portal/live.php?navigation_id=667&article_id=570&_psmand=4

Spatial minerals data for Baden-Württemberg: http://maps.lgrb-bw.de/

Geological data for Saxony: http://www.at-minerals.com/en/artikel/at_The_ROHSA_3_project_3126854.html

Spatial minerals data for Saxony: https://www.rohstoffdaten.sachsen.de/ (German language only)

## *Greece*

### Codes/standards/classifications used

The Greek Mining code (legislative degree 210/1973, amended by Law 274/1976) is the main piece of law on mining activity in Greece. This classifies commodities in two general categories (metalliferous ores and quarry products) mainly with respect to their importance for national economy. The National Policy for the Strategic Planning and Exploitation of Mineral Resources was adopted in February 2012 to ensure the supply of minerals to society in a sustainable way and in compliance with national development policies for 2030 (Ministry of Environment, Energy and Climate Change, 2015). However, this does not include any framework to utilise a CRIRSCO-type code to report Greek mineral resources and reserves.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

Data collection on mineral resources is legally not required in Greece. Standard reporting codes are not required for mineral resources and reserves. No centralized data collation and harmonization processes are applied.

### Level of data available

The National Policy states that it must be ‘based on knowledge of the country’s mineral reserves. This knowledge presuppose that all deposits…are registered in a documented way’ (Ministry of environment, Energy and Climate Change, 2016). It has the overall strategic goal to ensure the supply of MRM to the society in a sustainable way and in compliance with other national sectoral development policies by:

1. promoting and revealing mineral resources and assign their exploitation through international tenders in order to maximize the benefits for the national economy.

2. valorising the mineral resources through rational exploitation processes and apply the principles of sustainable development.

3. ensuring significant offsets for the local society and socially fair allocation in conformity with the relevant national revenue.

The Mineral Deposits' database stores all the information related to mineral deposits of the country. Each deposit is described through 40 fields, distributed in 8 folders: (1) General Information, (2) Deposit Information, (3) Information on Mineralization and Host Rocks, (4) Economic Information, (5) High-tech Metals, (6) Comments, (7) Iconography and (8) Bibliography. Reserves are reported in the database in a form supplied by the industry. For many industrial mineral deposits entries in the database there are no supportive drill-holes data and so reserves are characterized as inferred reserves. No further information is available on how this characterisation is carried out.

The resource and reserve figures do not include information on marine or offshore deposits, or deposits in overseas territories.

The probable and proven reserves of most of the mineral resources of Greece are unknown, as detailed investigations (e.g. drillings, mineralogical and chemical analyses, etc.) are lacking. In addition, recent feasibility studies for most of the Greek resources are inexistent (Tsirambides and Filippidis, 2012).

### Existing harmonisation

No efforts to harmonise ore reserves estimation for all the deposits of the country have been undertaken nationally.

Tsirambides and Filippidis (2012) have recalculated the indicated reserves of the mineral resources of Greece, using data from the PERC Code, annual public reports posted on the web sites of the companies involved in Greece, press releases and specific scientific reports.

### Recommendations for harmonisation

In the first instance, access to the information on deposits in Greece, the database mentioned above, not just those addressed by Tsirambides and Filippidis (2012), would allow for initial understanding of the resources present.

### Useful links and references

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/StaticPage1.aspx?pagenb=14493

http://www.latomet.gr/ypan/Hypertrak/BinaryContent.aspx?pagenb=4031
https://ec.europa.eu/docsroom/documents/10003/attachments/1/translations/en/renditions/pdf+&cd=3&hl=en&ct=clnk&gl=uk

https://eclass.uoa.gr/modules/document/file.php/GEOL290/Chalkidiki_fieldtrip/Metallic%20Mineral%20Res%20Greece%20CEJG%20641-650.pdf
Mineral Policy Country guide: https://www.min-guide.eu/sites/default/files/project_result/Minerals_Policy_Country_Profile_GR.pdf

Greece: National policy for the Exploitation of Mineral Resources: https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/community/document/greece-national-policy-exploitation-mineral-resources for the Exploitation of Mineral resources

https://ec.europa.eu/docsroom/documents/10002/attachments/1/translations/en/renditions/pdf
Tsirambides, A. & Filippidis. 2012. Central European Journal of Geosciences,4: 641. https://doi.org/10.2478/s13533-012-0110-2

## *Hungary*

### Codes/standards/classifications used

The Mining Law of Hungary, Act No XLVIII of 1993 (as amended by Law No. CXXXIII of 2007) provides for the prospecting of mineral raw materials, and for the exploration and exploitation of mineral resources. The National Mineral and Geothermal Energy Resource Inventory (and Balance) of Hungary is managed by the Hungarian Office for Mining and Geology (HOMG) and its predecessors since the 1950's. It is updated each year. The inventory includes more than 2700 deposits and mines. The inventory contains quantitative data (resource, reserve, production, status of mine, etc.) and some qualitative data (type of mineral, main constituents, etc.). HOMG operates the National Archive for all geological data. Data are to be submitted on a yearly basis, including primary (field) data, and processed and interpreted data as well as reports, maps etc. The inventory of national mineral raw materials is based on obligatory data delivery from mining companies as well as the resolutions issued by the concerned County Government Offices. The data collected on primary raw materials corresponds to 'UNFC and USGS systems', but the use of 'standards is not obligatory: legal documents do not prescribe the use of international standards'. Traditionally the Russian system of mineral resource estimation is used in Hungary.

The system used in Hungary can be converted to CRIRSCO systems using the following logic: "A+B correspond to the Measured Mineral Resources, C1 ~ Indicated Mineral Resources, C2 ~ Inferred Mineral Resources, D1+D2 ~ hypothetical resources, D3 ~ speculative resources (**¡Error! No se encuentra el origen de la referencia.**).

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

The Hungarian Office for Mining and Geology keeps the records of mineral resources and reserves of Hungary pursuant to provisions of the multiple amended Section 25. of Act No. XLVIII. of 1993 on mining as well as Government decree No. 203/1998 for its implementation.

### Level of data available

Mineral resource and reserve data is collated in Budapest by the Hungarian Office of Mining and Geology, Division for Geology and Data Management. Provision of the data to the government is a statutory requirement. The National Registry on Mineral Raw Materials and Geothermal Resources consists of more than 4,000 registered mining areas.

Raw data of the registry are the following:

- Quality and quantity of mineral resources and reserves;
- Annual change in mineral resources, reserves (production, exploration, reclassification, etc.) according to annual delivery;
- Mineral resource, reserve left behind subsequent to mine closure, field abandonment.

### Existing harmonisation

Work is currently underway to harmonise resources and reserves data according to international standards. A detailed case study has been made of the Hungarian project using UNFC to harmonise their resource data, this can be found in Horvath et al, 2014.

### Recommendations for harmonisation

The detailed collation of data in a national inventory of mineral resources aids harmonisation in Hungary as is evidenced by the countries ongoing project to convert national figures to UNFC.

### Useful links and references

Mining and Geological Survey of Hungary; Inventory of mineral resources: https://mbfsz.gov.hu/index.php/en/asvanyvagyon_nyilvantartas

Hungarian Mining Law http://faolex.fao.org/docs/pdf/hun74236.pdf

Minerals Policy country guide

https://www.min-guide.eu/sites/default/files/project_result/Minerals_Policy_Country_Profile_HU.pdf

HORVÁTH, Z, SÁRI, K, AND KOVÁCS, Z. 2014b. Classification of selected Hungarian mineral resources according to UNFC-2009, CRIRSCO Template, PRMS and the Importance of a common language for mineral resources in SEE countries. Presentation to UNECE EGRC. Geneva. . https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc_egrc/egrc5_apr2014/2May/23_Horvath_HZ.pdf

## *Ireland*

### Codes/standards/classifications used

The Minerals Development Bill was published in July 2015. The Bill consolidates and modernises legislation on exploration and extraction of minerals, and seeks to replace a number of pieces of legislation from 1940 to 1999. The Bill provides a modern regulatory regime for exploration and mining (min-guide.eu). Companies reporting resource and reserve data to the Department of Communications, Climate Action and Environment have to use a CRIRSCO aligned code such as PERC, or JORC. No independent national code exists. Ireland has a significant mining and ore processing activity, but there is no direct minerals policy established. The Irish Department of the Environment, Community and Local Government Issued a sustainability strategy under the name of "Our Sustainable Future: A Framework for Sustainable Development in Ireland" in 2012 (Department of the Environment, Community and Local Government, 2012).

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

There is a legal requirement to provide resources and reserves data for 'scheduled minerals' (most metallic and industrial minerals) on the basis of specific requests submitted by persons or organisations.

### Level of data available

Data for metals and industrial minerals are reported on an ad hoc basis to meet the requirements of stock exchanges/investors. The Exploration and Mining Division of the Irish Government collects information from all exploration and producing mineral companies, with information released into the public domain at staged intervals according to several criteria. Data for aggregates and construction materials are not collected/collated.

### Existing harmonisation

No national code exists, therefore harmonisation has not been necessary.

### Recommendations for harmonisation

As CRIRSCO compliant data is collated in country, it would be a relatively simple process to harmonise data to UNFC.

### Useful links and references

Department of Communications, Climate Action and Environment: https://www.dccae.gov.ie/en-ie/natural-resources/topics/Minerals-Exploration-Mining/Pages/home.aspx

http://www.dcenr.gov.ie/naturalresources/Lists/Legislations%20Documents/Exploration%20and%20Mining/Minera ls%20Development%20Bill%20as%20published.pdf

http://www.irishstatutebook.ie/eli/1931/act/54/enacted/en/html?q=mines+and+minerals+act
Geological Survey of Ireland: https://www.gsi.ie/en-ie/Pages/default.aspx

Min-guide.eu Mineral Policy Country Profile: https://www.min-guide.eu/sites/default/files/project_result/Minerals_Policy_Country_Profile_IE.pdf

## *Italy*

### Codes/standards/classifications used

There is no mineral act on a national level in Italy, but mineral legislation exists on lower levels. The Geological Survey of Italy does not use an internationally recognised standard code for data collection, and a national code is not used for reporting.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications

Legal competences dealing with solid minerals extraction and mining activities, both for mines and quarries, were assigned to regions and local authorities by Articles 33, 34 and 35 of Legislative Decree March 31, 1998 n.112. The Raw Materials Laboratory of the Ministry of Economic Development gives support to regional policies for raw materials exploitation and supplies collaboration for the definition of strategic minerals on a national scale in compliance with European mining policy.

### Level of data available

In Italy, the centralized data collation and harmonization procedures are used for mineral inventory analysis. At a national level, some statistical data on quarrying activities are collected by the Geological Survey of Italy (Department of ISPRA) in the Environmental Data Yearbook. ISPRA holds a database collecting data about industrial and metallic mineral extraction activities in the period 1860-2007 over the entire Italian territory. ISTAT (Italian National Institute of Statistics) collects data about economic /financial/statistical data of mining activities.

Data is, therefore, available for all primary raw materials in Italy, sourced from regional mining databases, at a regional scale. Data is collected annually, but does not include raw materials from the offshore / marine environment.

### Existing harmonisation

Currently ISPRA, in collaboration with ISTAT (Italian National Institute of Statistics), are arranging a national harmonized census of mining activities (quarries and mines) based on international standard codes. The census must be agreed with the Ministry of Economic Development (Directorate-General for mineral and energy resources).

### Recommendations for harmonisation

A priority for Italy is the harmonisation of the great number of available data, based on an exchange format that is INSPIRE compliant and elaborated by all subjects who have interests in extractive activities (Regions, Ministers, Environmental and Statistic Institutes). The collection of data at national level (industrial and metallic minerals) is hampered by the heterogeneity of regional databases.

#### Useful links and references

Higher Institute for the Protection and Environmental Research: http://www.isprambiente.gov.it/en

Italian Petroleum and Mining Industry Association: https://www.assomineraria.org

Min-guide Minerals Policy Country Profile:

https://www.min-guide.eu/sites/default/files/project_result/Minerals_Policy_Country_Profile_IT.pdf

### *Latvia*

#### Codes/standards/classifications used

A national (modified Soviet) code is used in Latvia for the identification of mineral resources (Minventory final report/Parker et al., 2015).

#### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

A national (modified Soviet) code is used in Latvia for the identification of mineral resources (Parker et al., 2015; Hamadová et al., 2018).

#### Level of data available

In previous EU projects, Latvia has not provided any information on their primary raw materials (Parker et al., 2015).

#### Existing harmonisation

There is a legal requirement to provide resources and reserve data nationally and these must be reported to a standard reporting code. In this case there is a modified version of the Soviet code used, this is not aligned with CRIRSCO compliant codes. These data are compiled centrally by the Latvian Environment, Geology and Meteorology Center (LEGMC).

#### Recommendations for harmonisation

Latvia has little mineral production other than aggregates (sand and gravel) and gypsum. Production data for these commodities is provided by the statistics office however, data regarding resources and reserves are compiled centrally by the Latvian Environment, Geology and Meteorology Centre (LEGMC).

### Useful links and references

Parker, D., Petavratzi, E., Mankelow, J., Waugh, R., Bertrand, G., 2015, Minventory: EU raw materials statistics on resources and reserves.
Latvian Environment, Geology and Meteorology Centre (LEGMC): https://www.meteo.lv/en/lapas/geology/geology?id=1522&nid=417

Hamadova. B, 2018. Deliverable D5.6 Report on RMI implementation status quo and needs in EU-28: http://www.mica-project.eu/wp-content/uploads/2016/03/D5.6_RMI-implementation-status-quo-and-needs-in-EU-28.pdf

## *Lithuania*

### Codes/standards/classifications used

The Ministry of the Environment is responsible for collection of data on primary raw material resources and reserves, but this activity is devolved to the Lithuanian Geological Survey. All data on the subsurface and the minerals covered by the project must be reported using the national code, therefore there is no requirement to harmonise data from different sources. It does not comply with an internationally recognised standard code, but is comparable to the UNFC. In the Classification of Solid Mineral Resources of the Republic of Lithuania all the reserves of mineral resources are classified by three criteria: geological exploration, investigation of utilisation potential and economic value. Data is received in a range of formats including reports, tables and maps. Boreholes (presumably the core) drilled in the course of subsurface investigations must be provided to the Geological Survey upon request.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

Collection of data on primary raw material resources and reserves is covered by national legislation, the Underground Law VIII-573, 1995. This states that individuals and organisations (e.g. ministries, departments, other state institutions, municipalities, scientific and educational institutions) must provide the Lithuanian Geological Survey with data on the subsurface acquired in the course of direct and remote investigations or during utilisation of the underground resources, irrespective of who financed the work. It indicates that the data must be provided free of charge by these sources. This legislation applies to all raw materials covered by this study. Reports on the results of prospecting, exploration and development have to be provided by the licence owners. Mineral exploration activity in Lithuania is monitored by the Geological Survey, with companies under a statutory obligation to report associated resource/reserve data.

### Level of data available

Resource and reserve data is collected for selected construction minerals (Lithuanian mineral production is dominated by these), industrial minerals and iron ore by purity. The data is derived from a combination of geological prospecting (by the Survey) and mineral operators. Data is collected on a variety of unspecified scales. Data from mineral operators is collected quarterly, whilst the frequency of data collection from other sources (primarily geological prospecting and exploration) is variable depending on when licences are issued and new data becomes available. Collection of data can be via specific requests to the licence owner or specified in the licence terms. The Geological Survey may instruct the license owner to conduct additional investigations relevant to their work. No data is collected on marine/offshore minerals. Data resulting from geological prospecting and 'reserve development' by the Geological Survey is owned by the State Treasury. Data acquired by private operators is owned by them, but must be provided to the Survey. State-owned data is stored in a GIS, which is created and managed by the Geological Survey. Deposits, prospective areas and associated resources are registered in the 'State Cadastre of Underground Resources', which is managed by the Geological Survey. Data is organised at a national level and spatially referenced. Data acquired by licence holders can be accessed and used by the Geological Survey, without the permission of the licence/data provider for official purposes, but cannot be published or transferred to third parties, with the exception of requests from state institutions. These restrictions on data availability are valid for five years from the time of the data acquisition, or for two years following expiry of a licence to conduct exploratory work. Publically available data can be used free of charge, but charges apply for administering access to the data (e.g. printing, scanning etc.). Data is requested by mineral prospectors, mineral operators and landowners. Most information is only available in Lithuanian, with selected introductory information on the Lithuanian Geological Survey website (www.lgt.lt) available in English. Some reports held by the Geological Survey are in Russian. No data are accessible from the website.

### Existing harmonisation

All data on the subsurface and the minerals covered by the project must be reported using the national code, therefore there is no requirement to harmonise data from different sources. It does not comply with an internationally recognised standard code, but is comparable to the UNFC. In the Classification of Solid Mineral Resources of the Republic of Lithuania all the reserves of mineral resources are classified by three criteria: geological exploration, investigation of utilisation potential and economic value. Data is received in a range of formats including reports, tables and maps. Material from boreholes drilled in the course of subsurface investigations must be provided to the Geological Survey upon request.

### Recommendations for harmonisation

Although a national database of data exists for Lithuanian resources and reserves, it is in Lithuanian and uses the Lithuanian national code. This code is similar to UNFC so converting to UNFC should be possible by speakers of the national language.

### Useful links and references

The following online report in English contains limited information on the quantities of 'explored' resources in Lithuania:

https://www.thefreelibrary.com/Lithuanian+mineral+resources,+their+reserves+and+possibilities+for...-a0250135106
Lithuanian Geological Survey website: www.lgt.lt

## *Luxemburg*

### Codes/standards/classifications used

No data is publically available on the codes used for mineral resources in Luxembourg.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

No specific legislation has been written for the use of standardisation of mineral resource codes.

### Level of data available

There is a lack of information about mineral inventory of Luxembourg, this is due to the lack on domestic resources of metals. Information on the industrial resources of Luxembourg are limited. Production in country is for domestic supply only.

### Existing harmonisation

No information on data harmonisation or standardisation is publically available.

### Recommendations for harmonisation

Mineral production in Luxembourg comprises extraction of a limited number of industrial minerals for domestic consumption. If information on these resources is publically available it is possible that harmonisation of these resources to UNFC may be possible.

### Useful links and references

Minguide country profile:

https://www.min-guide.eu/sites/default/files/project_result/Minerals_Policy_Country_Profile_LU.pdf

## *Malta*

### Codes/standards/classifications used

In 1996, the Malta Environment and Planning Authority (MEPA) as it was then known, published a Minerals Resource Assessment outlining potential future resources of ‘hardstone’ (Corraline Limestone) and ‘softstone’ (Lower Globigerina Limestone) (Cassar et al. 2017). The assessment identified 26 areas of interest. The resource classification used was based on two degrees of confidence in terms of the areas’ geology: inferred or indicated. Indicated resources were further classified to determine constraints in development in Level 1 (good degree of

geological confidence and apparent lack of conflict with other land uses), and Level 2 (a lesser degree of confidence and further investigations are required).

There is no harmonised data and no requirement to report to a single international reporting code.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

The minerals industry in the Maltese islands is dominated by the extraction of limestone for use in construction. The Malta Resources Authority (MRA) is the responsible authority for regulating mineral resources and for issuing exploration licenses in the mineral resources sector. Further details on legislation from the MRA are only available in Maltese.

### Level of data available

Historically, there were no statistical data on resources and reserves and even figures on mineral production have not been comprehensive. The Environment and Resources Authority (ERA), previously as the MEPA, has undertaken research and produced a Draft Minerals Subject Plan, which puts in place a comprehensive framework to provide for the future supply of minerals and to control the impact of extraction. Through this research, figures of permitted reserves have been estimated and used to produce a database on production and permitted reserves data. The Minerals Subject Plan for the Maltese Islands was approved by MEPA Board in May 2003. According to the draft Minerals Subject Plan, MEPA had been in the process of developing a database on production and permitted reserves data. Current literature and online resources do not specify whether this database currently exists. Data for ‘softstone’ and ‘hardstone’ indicate that the permitted reserves in existing local quarries are estimated to last about 40 years (Cassar et al. 2017).

### Existing harmonisation

No existing harmonisation of limestone resources exists.

### Recommendations for harmonisation

The provision of public data would allow for harmonisation of data for dimension stone from Malta with the rest of the EU.

### Useful links and references

Malta Resource Authority: http://mra.org.mt/

Environment and Resources Authority: https://era.org.mt/en/Themes/Pages/Welcome.aspx

Cassar J, Torpiano A, Zammit T, Micallef A. 2017. Proposal for the nomination of Lower Globigerina Limestone of the Maltese Islands as a" Global Heritage Stone Resource" EPISODES 40:221-231

## *Netherlands*

### Codes/standards/classifications used

There is no harmonised data and no requirement to report to a single international reporting code.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

National legislation, the Mining Act 2003 (as amended 2006, 2008, 2009 and 2010), requires the collection of data due to the requirement to produce environmental impact assessments for extraction sites and the need for national spatial planning which includes the assessment of reserves on a local scale.

### Level of data available

In the Netherlands, the State Supervision of Mines is the agency within the Ministry of Economic Affairs that oversees the production of minerals and the Netherlands' continental shelf. The Ministry of Economic Affairs and the Ministry of Infrastructure and the Environment are responsible for collecting information about mineral resources and reserves. Statistical data on offshore minerals, such as gravel, sand, clays, shells, and salt are collected in the Netherlands. Data are collected on variable time intervals. Additional information, such as mineral resource maps for sand and gravel have been produced by the Geological Survey of the Netherlands. Available data are stored in a centralised database (DINO), which comprises a digital archive of subsurface data developed by the Geological Survey of the Netherlands. This database mainly holds borehole data. Data are publicly available.

### Existing harmonisation

No data exists regarding existing harmonisation.

### Recommendations for harmonisation

As there appears to be a centralised collation of resource and reserve data for minerals in the Netherlands and no use of a national code, harmonisation of the data to UNFC should be possible.

### Useful links and references

Data and Information from the Dutch Subsurface: www.dinoloket.nl

## *Norway*

### Codes/standards/classifications used

Data on primary resources and reserves are currently collected by the Geological Survey of Norway and the Norwegian Directorate of Mining, both of which are administered by the

Ministry of Trade, Industry and Fisheries. Whether resource or reserve data are compliant with internationally recognised codes depends entirely on the companies who report. The Geological Survey do not practice the function of a "qualified person". There is no requirement for a specific code to be used.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

Norway has a "National Minerals Strategy" which requires that deposits are classified into "nationally, regionally or locally important". The requirement for operators to report annually is a statutory one under the Norwegian Mining Act nr 101 2009. Collection of resource and reserve data is not comprehensive, but all producing companies are asked yearly about remaining resources, (no distinction between reserves and resources are made), and non-producing developers and exploration companies are not subjected to the same enquiry.

Data relating to all known deposits are kept in databases, many available mining reports are publically accessible. These are owned by either the Geological Survey or the Directorate of Mining. The Directorate of Mining owns all data related to mineral exploration activity but data collection is carried out jointly with the Geological Survey.

### Level of data available

Resource data are collected by the Geological Survey, but these are not updated at fixed intervals and the dataset is not comprehensive. The Geological Survey of Norway maintains the national databases on all deposit types and possesses estimated figures of variable quality and history. Data are owned/held by the Geological Survey of Norway and the Directorate of Mining.
Data are stored in national databases at the deposit level, and are spatially referenced. Data at the deposit level reported by producers are confidential. Database is not INSPIRE compliant. Data are available to the public, free and can be accessed via two websites www.prospecting.no and www.ngu.no. The former is primarily maps. Data are available in Norwegian and some in English.

### Existing harmonisation

The Geological Survey of Norway is participating in the EU-project Minerals4EU and other EU-projects requiring harmonization of databases. The Geological Survey is also a partner in the Fennoscandian Ore Deposit Database and through this delivers data to Promine. There are also other co-operative projects.

### Recommendations for harmonisation

As no one specific code is used to characterise the resource and reserve data, and some of these data are confidential, it may be challenging to harmonise Norwegian data.

### Useful links and references

Minventory country summary:

https://ec.europa.eu/assets/jrc/minventory/country-summariesdaea.html?country=Norway

## *POLAND*

### Codes/standards/classifications used

In Poland mineral resource and reserve figures are reported in accordance with the Polish national reporting code, which is largely based on a similar set of rules and assumptions to those underpinning the UNFC classification system. The Polish national reporting system recognises five categories of mineral resource:

Category **D** – **Inferred Mineral Resources**;

Category **C2** – **Inferred Mineral Resources**;

Category **C1** – **Indicated Minerals Resources**;

Category **B** – **Measured Minerals Resources**;

Category **A** – **Measured Minerals Resources**.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

In Poland there is a legal requirement for mineral exploration and mining companies to report mineral resource and reserve data on an annual basis to the Polish Geological Institute-National Research Institute (PGI-NRI). Companies are also obliged to report the data in line with the requirements of the Polish national reporting code, which is based on Polish law (Act Dz. U. No. 291, Poz. 1712 – *Regulation of the Minister of the Environment*).

### Level of data available

In Poland national-level mineral resource and reserve data for metallic minerals, industrial minerals and construction materials, are collected by the PGI-NRI, primarily from two sources: (1) geological documentation, which is contained in the 'National Geological Archive' and (2) statistical forms, which are filled out by concession holders and submitted annually to the PGI-NRI. The data are hosted on one of two PGI-NRI-hosted websites: (1) the MIDAS database platform, which includes detailed information on all raw material deposits in Poland (e.g. location, concession holder, deposit depth, deposit shape and thickness, and resources); or (2) the '*Mineral Resources of Poland*' website, which contains spatially referenced data (maps) for almost 13,000 individual mineral deposits. The former is only available in Polish, whereas the latter is available in both Polish and English.

### Existing harmonisation

Exploration and mining companies in Poland are obliged to report mineral resource and reserve data in line with the national reporting code. This requirement ensures that all data are reported in the same format/style, meaning the data are at least internally (within Poland) 'harmonised.

Work by Szamale et al. (2017) provides details of how mineral resources reported in accordance with the Polish national reporting code can be compared and/or converted to fit the UNFC classification scheme.

### Recommendations for harmonisation

Harmonisation of Polish mineral resource and reserve data to the UNFC system should, in theory, be straight forward because these data are all reported in line with the requirements of the Polish national system, which is very well aligned with the UNFC system of reporting. Work by Szamale et al. (2017) provides details of how mineral resources reported in accordance with the Polish national reporting code can be compared and/or converted to fit the UNFC classification scheme.

### Useful links and references

Mineral resource and reserve data can be accessed, or requested from the Polish Geological Institute-National Research Institute (PGI-NRI) website (English and Polish): http://geoportal.pgi.gov.pl/surowce

Szamałe, K., Szuflicki, M., Malon, A. and Tymiński, M. 2017. Mineral Resources of Poland. *Polish Geological Institute, National Research Institute* (Warsaw). http://geoportal.pgi.gov.pl/css/surowce/images/2017/pdf/mineral_resources_of_poland_2017.pdf

Spatially referenced mineral resource and reserve data can be accessed, via the Polish Geological Institute-National Research Institute (PGI-NRI) MIDAS website (Polish only):

http://geoportal.pgi.gov.pl/midas-web

## *PORTUGAL*

### Codes/standards/classifications used

Portugal does not have a national reporting code for mineral resources and reserves, nor is there any requirement for companies to report mineral resources and reserves to a single international code (e.g. JORC).

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

In Portugal mining and exploration companies are under a statutory obligation to report mineral resource and reserve data, as specified in the following legal regulations: Decree-Law No. 90 (1990); Decree-Law No. 88 (1990) Mineral Deposits Regulation; and Decree-Law No. 89 (1990) Quarry Regulation. However, there isn't a requirement to report this information to a single national, or international reporting code.

### Level of data available

Mineral resource and reserve data are collected annually by the Ministério da Economia e do Emprego (Ministry of Economy and Employment) for all types of primary raw materials; however, the regularity of data collection can be variable. These data are typically drawn from exploration and mining company reports, press releases and company websites. These national-level data are held by the Geological Survey (Laboratório Nacional de Energia e Geologia) in digital archives and databases. It should be noted that most of the mineral resource and reserve data held by the Geological Survey is confidential.

### Existing harmonisation

In Portugal there is no harmonised national-level inventory of mineral resources nor reserves, and there has been no attempt made to convert existing mineral resource and reserve data to UNFC.

### Recommendations for harmonisation

National-level mineral resource and reserve data are available for Portugal; however, the lack of a national reporting code, and lack of any requirement to report mineral resource data to a single international code may make harmonisation to UNFC challenging.

### Useful links and references

Mineral resource and reserve data are either available to download, or can be requested, from the Geological Survey Portugal (LNEG) website: http://www.lneg.pt/

## *ROMANIA*

### Codes/standards/classifications used

Before 1998 Romania reported mineral reserves using a national reporting code that was very similar to codes used in other Eastern and Central European countries based on the Russian code. However, from 1998 onwards all mineral resource/reserve data in Romania have been reported in line with the UNFC classification system.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

The mining law (No. 85/2003) of Romania requires the collection of mineral resource and reserve data for all mineable mineral commodities on an annual basis. According to the mining law mineral licence holders have a statutory obligation to report their production, exploration results, as well as any changes in resources and reserves (using the UNFC classification system), and the quality characteristics of the explored/mined resources, to the National Agency of Mineral Resources (NAMR). The NAMR is responsible for surveying and registering Romanian mineral resources, but also for establishing national databases (e.g. the national resource/reserve database), and for preparing the *mining book*, which is based on registered resources and reserves determined from information submitted by mineral licence holders. The NAMR is also responsible for issuing compulsory regulations and instructions for the minerals

sector that cover the organisation and monitoring of the national resources and reserves database, and the method of reporting all data associated with it.

### Level of data available

The NAMR is responsible for collecting and managing mineral resource and reserve data for all mineral commodities in Romania. The NAMR holds centralised archives of mineral resource and reserve data; however, the majority of this information is confidential and is covered by special regulations on data, which only permit use by authorised persons. National-level resource estimation figures for specific commodities can be accessed for a charge, although the data are currently only available in Romanian language format.

### Existing harmonisation

Since 1998 all mineral resource/reserve figures in Romania have been reported in line with the UNFC classification system; however, it is unclear if any attempt has been made to convert any of the pre-1998 mineral resource/reserve figures to UNFC.

### Recommendations for harmonisation

Little harmonisation is required as UNFC is already used, however, if not already attempted it would be useful for all pre-1998 mineral resource/reserve figures to be converted from the national reporting code to UNFC.

### Useful links and references

Mineral resource and reserve data can be accessed, or requested from the Romanian National Agency of Mineral Resources website: http://www.namr.ro/home/

## *SLOVAKIA*

### Codes/standards/classifications used

Slovakia has its own national reporting code; however, it is not aligned to any of the international CRISCO reporting codes. It also differs significantly from the national reporting codes used in neighbouring countries, such as the Czech Republic. Oddly the Slovakian reporting code does not use the term mineral resource, but instead has three broad categories of mineral reserve: Z-1 proved mineral reserves; Z-2 probable mineral reserves; and Z-3 supposed mineral reserves. The designation of a mineral reserve to one of these three categories is based on exploration results, quality and technological characteristics, and mining conditions. In Slovakia reserves may also be classified according to their economic viability into: (1) economic reserves, which are viable based on existing technical and economic conditions; or (2) potential economic reserves, which may be economically exploitable in the future. In addition, the Slovakian system also includes the category *prognostic resources*; these are unverified resources based geological assumptions, and are thus comparable to the *reconnaissance mineral resource* category of the UNFC system.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

There is a statutory obligation in Slovakia for exploration and mining companies to report data relating to reserved (exclusive) mineral deposits and deposits of non-reserved minerals (e.g. clays, building stones, and sand and gravel). This is in accordance with the Mining Law (SNR Act No. 44/1988 Coll.), which covers mineral protection and use, and the Geological Law (SNR Act No. 569/2007 Coll.), which relates to all geological works. These laws outline the process for collecting, storing, processing and assessing geological documentation and the results of geological surveys. They also provide guidance on the management of mineral reserves inventories.

### Level of data available

The State Geological Survey of Slovakia (SGUDS) collects national-level mineral reserve data, for all mineral commodities, on behalf of the Ministry of the Environment. Data are collected via questionnaires, which are sent directly to mineral operators, exploration companies and mineral rights owners on an annual basis. The SGUDS is also responsible for storing and maintaining centralised, national-inventories of mineral reserves, in the form of databases and GIS systems. These data are made freely available, via the SGUDS website in the form of a minerals yearbook; however, data pertaining to specific deposits can remain confidential for up to ten years at the request of the reporting company.

### Existing harmonisation

All mineral reserve data held by the SGUDS are harmonised to the Slovakian national reporting code, but not any of the international CRISCO codes. However, *prognostic resources*, where reported, are comparable to the *reconnaissance mineral resource* category of the UNFC system.

### Recommendations for harmonisation

In Slovakia national-level mineral reserve data, harmonised to the Slovakian national reporting code, are readily available, which should make harmonisation to the UNFC system possible. However, the Slovakian national reporting code bears little resemblance to any of the CRISCO reporting codes and no bridging document between this code and any others exists, which may make harmonisation challenging.

### Useful links and references

Mineral resource and reserve data can be accessed, or requested from the Geological Survey of Slovakia website: https://www.geology.sk/

The Slovakia Minerals Yearbook can be downloaded for free from the following web address, it contains mineral production and mineral reserve data. https://www.geology.sk/service/publishing-activity/nerastne-suroviny-slovenska/?lang=en

## *SLOVENIA*

### Codes/standards/classifications used

The national reporting code for mineral resources and reserves used in Slovenia is very similar to the Russian system for estimating mineral resources and reserves. This means Slovenian mineral resource/reserve data can be easily converted to the CRIRSCO system based on the following:

Where **A+B** corresponds to **Measured Mineral Resources**;

Where **C1** corresponds to **Indicated Mineral Resources**;

Where **C2** corresponds to **Inferred Mineral Resources**;

Where **D1+D2** corresponds to **hypothetical resources**;

And where **D3** corresponds to **speculative resources** (**¡Error! No se encuentra el origen de la referencia.**).

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

In Slovenia there is a statutory obligation for mining and exploration companies to report mineral resource and reserve data; this is in accordance with Mining Act No. 61 (2010), which includes reporting forms for mineral resources and reserves, production, and exploration areas.

### Level of data available

Slovenia collects national-level mineral resource and reserve data for all onshore mineral commodities. This information is collected on a yearly basis by both the Geological Survey of Slovenia and the Ministry for Infrastructure and Spatial Planning. National-level mineral resource and reserve data are held in a centralised databased maintained by the Ministry for Infrastructure and Spatial Planning; however, data relating to individual deposits are not made publicly available. This information comprises:

The compilation and maintenance of a national- level Mining Register and Cadastre;

Records and statistics that cover a wide variety of data on the production, reserves and resources of mineral commodities;

Land-use planning documents and spatial datasets showing the designation of mining areas (including areas with mining rights for exploration and commercial exploitation);

The storage and/or archiving of closed mine documentation.

### Existing harmonisation

In Slovenia there has been no attempt made to routinely convert mineral resource and reserve data to the UNFC classification. However, during the Minerals4EU project the Geological Survey of Slovenia converted Slovenian mineral resource data from the national classification into the UNECE-2009 classification to ensure data could be entered into the EU-MKDP (European

Minerals Knowledge and Data Platform). Because mineral resource/reserve data for single deposits are not publicly available in Slovenia, the data reported to the Minerals4EU MKDP were summarised based on the type of mineral resources and/or reserves. For example, crushed stone data were reported at the national level.

### Recommendations for harmonisation

Harmonisation of mineral resource and reserve data in Slovenia should be possible given these data are reported in accordance with the national reporting code, which is very similar to the Russian classification system.

### Useful links and references

Mineral resource and reserve data can be accessed, or requested from the Geological Survey of Slovenia website. http://www.geo-zs.si/index.php/en/

Mineral resource and reserve data can also be accessed, or requested from the Ministry for Infrastructure and Spatial Planning website. http://www.mzi.gov.si/en/

## *SPAIN*

### Codes/standards/classifications used

Spain does not have a national reporting code for mineral resources and reserves, nor is there any requirement to report mineral resource and reserve information to a single international code. However, National Statistical Information Legislation and policy does require the collection of data on primary raw material production. Under this policy it is compulsory to provide the Spanish Institute of Statistics with data on production, employment, production value and material consumption (e.g. explosives, energy, water, etc.). This applies to all mineral resources produced in Spain. Data is gathered through an obligatory annual questionnaire, which is sent to all mining operations.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

In Spain there is not a legal/regulatory requirement to collect and maintain a national inventory of mineral resources and reserves – based on national-level statistics policy. There is not a requirement to report to a single national, or international code.

### Level of data available

Spain publishes national-level information on primary raw material production for most onshore mineral resources. The information is held in a centralised, national-level database, in which data are organised by provinces and autonomic communities. This information is collected annually by the General Directorate of Energy Policy and Mines, Provincial Mining Authorities, and by Autonomic Mining Authorities. This information is published by the General Directorate of Energy Policy and Mines on behalf of the Ministry for the Ecological Transition. Information about offshore sand, used for beach reclamation and port building, is

gathered and published by the same Ministry. This raw information, together with annual trade statistics, is edited by the Spanish Geological Survey (IGME) in an annual report titled "Mining Panorama"

### Existing harmonisation

Spain does not have a national reporting code for mineral resources and reserves, nor is there any requirement to report mineral resource and reserve data to a single international code. A national-level database on primary raw material production is held by the General Directorate of Energy Policy and Mines on behalf of the Ministry for the Ecological Transition. However, the data are not harmonised, instead they are reported in the format in which they are received.

### Recommendations for harmonisation

At a national-level mineral resource and reserve data are not available. There are historical estimates of some mineral resources and occasionally some data from major mining companies, harmonisation may prove difficult due to the lack of a national reporting code, and also the lack of any requirement to report to a single international code.

### Useful links and references

Primary raw material production data can be found on the Ministry for the Ecological Transition website: https://energia.gob.es/mineria/Estadistica/DatosBibliotecaConsumer/2017/Estadistica_Minera_%20anual_2017.pdf

## *SWEDEN*

### Codes/standards/classifications used

In Sweden the majority of mineral resource and reserve figures are reported in line with either the Fennoscandian Review Board (FRB) Standard, which is very similar in scope to the CRISCO system of reporting, or they are reported according to internationally recognised reporting codes such as JORC, PERC, NI 43-101, etc.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

In Sweden there is no legal requirement for mining companies to report mineral resource and reserve data, and there is no institution currently mandated by the Swedish Government to collect these data. However, it is stipulated by national law that if an exploration permit expires and no concession permit has been applied for the relevant area, the exploration results must be reported to the Mining Inspectorate, were they become publically available. Companies are also obliged to register mine maps/plans with the Mining Inspectorate. The use of the FRB Standard for reporting mineral resources and reserves is entirely voluntary; however, its use is recommended by the Swedish Association of Mines, Mineral and Metal Producers (SveMin).

### Level of data available

In Sweden the Geological Survey (SGU) is responsible for gathering and collating national-level mineral resource and reserve data for both metallic minerals, and the industrial minerals. Data are gathered from a variety of sources, including annual reports, press releases, company websites, and from exploration reports. Data are constantly updated and are reported on an annual basis by the Geological Survey in the form of the Swedish Minerals Yearbook. The data are also freely available to download from the Fennoscandian Ore Deposit Database, which is hosted by the Finnish Geological Survey (GTK).

### Existing harmonisation

There does not appear to have been any attempt to convert mineral resource/reserve data in Sweden to the UNFC classification; however, all data are reported in line with CRISCO reporting codes, or reporting codes that are very well aligned to the CRISCO system. For example, the Swedish Association of Mines, Mineral and Metal Producers (SveMin) recommend reporting to the FRB Standard. The Geological Survey actively participate in initiatives to improve data harmonisation and dissemination. For instance, the Swedish Geological Survey in cooperation with Norwegian, Finnish and Russian organisations, have made their mineral resource/reserve publicly data available via the Fennoscandian Ore Deposit Database. A bridging document has been jointly published by GTK (Finland), NGU (Norway), SGU (Sweden) and SveMin (Swedish Association of Mines, Mineral and Metal Producers) that outlines how Scandinavian mineral resources can be mapped to the UNFC classification (UNECE, 2018).

### Recommendations for harmonisation

Harmonisation of mineral resource/reserve data to the UNFC classification should not, in theory, be a problem in Sweden as all data are reported in line with either CRISCO reporting codes (e.g. PERC), or the FRB Standard, which is very well aligned with standard CRISCO reporting codes.

### Useful links and references

Mineral resource and reserve data can be accessed, or requested from the Geological Survey of Sweden (SGU) website. https://www.sgu.se/en/mineral-resources/

General information and news about mineral resource reporting can be found on the Swedish Association of Mines, Mineral and Metal Producers (SveMin) website. https://www.svemin.se/

Mineral resource and reserve data are available via the Fennoscandian Ore Deposit Database website (hosted by GTK in Finland).http://en.gtk.fi/informationservices/databases/fodd/

United Nations Economic Commission for Europe (UNECE). 2018. Guidance for the Application of the United Nations Framework Classification for Resources (UNFC) for Mineral Resources in Finland, Norway and Sweden.

https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc_egrc/egrc9_apr2018/INF.3_Agenda_item_10.pdf

## *UNITED KINGDOM*

### Codes/standards/classifications used

The United Kingdom has no national reporting code, nor specific mining act. Planning for the extraction of domestic, non-energy minerals is undertaken via the land-use planning system which is based on the Town and Country Planning Act (1947; 1990). This policy aims to ensure efficient and effective use of land in the public interest, but also to reconcile the competing needs of development and environmental protection. All countries (i.e. England, Scotland, Wales and Northern Ireland) in the United Kingdom have specific planning policies that include guidance for the extraction of minerals. In England, national planning policies relating to mineral extraction are set-out in the National Planning Policy Framework (NPPF), which was published in 2012. For Wales land-use planning policies are found in Planning Policy Wales (2001), which is supported by a series of Minerals Technical Advice Notes (MTAN). For example, planning policy surrounding the extraction of aggregates in contained in MTAN1 (2004), and for coal in MTAN2 (2009). Scottish planning policy is centred on the National Planning Framework 3 (2014); however, specific planning policies related to mineral extraction are contained in Scottish Planning Policy (SPP) also published in 2014. In Northern Ireland the Strategic Planning Policy Statement for Northern Ireland (SPPS), which was published in 2015, provides policy and guidance for local councils and regional government. However, none of these planning policies specify the need for mineral resource and reserve information to be reported; only that future supply of minerals should be maintained.

### Legislation and legal/regulatory framework relating to use of codes/standards/classifications.

There is no specific legislation, nor legal or regulatory requirement in the United Kingdom to hold a national inventory of mineral resources and reserves. Similarly, there is no legal requirement for companies to report mineral resource and reserve data. There is also no requirement to report to a single national, or international code.

### Level of data available

Mineral resource and reserve data are not routinely collected, nor reported for the United Kingdom. The exception is for aggregate minerals, including offshore aggregates, where data on sales and reserves are collected annually by local planning authorities (onshore) and the Crown Estate (offshore). However, these data are largely provided by mineral operators on a voluntary basis. With the exception of aggregate minerals the United Kingdom has no harmonised national inventory of mineral resources nor reserves. Mineral resource and reserve figures are sometimes reported by private companies in the United Kingdom, typically in-line with CRISCO reporting codes (e.g. JORC and NI 43-101), although there is no legal requirement for companies to disclose this information. However, as part of the Minerals4EU project mineral resource and reserve data for the UK were compiled for entry into the EU-MDKP (European Minerals Database and Knowledge Platform). Data were either compiled from company reports, where available, or were estimated based on geological information (e.g.

surface extent) and assumptions such as average density (t/m$^3$), typical working depth (m), and typical product to waste ratio (i.e. stripping ratio).

### Existing harmonisation

In the United Kingdom there is no harmonised national inventory of mineral resources nor reserves, and no attempt has been made to convert existing resource/reserve figures to UNFC. Given the United Kingdom does not have a national resource reporting code, nor specific mining act, bridging documents currently do not exist. Although, as part of the ORAMA project mineral resource and reserve data for the UK, including CRISCO reported resource estimates, historic estimates and estimates calculated during the Minerals4EU project, have been converted to the UNFC classification.

### Recommendations for harmonisation

The lack of a national reporting code, and there also being no requirement to report to a single international code, may make harmonisation of mineral resource and reserve data for the United Kingdom difficult. With the exception of aggregates, much of the mineral resource and reserve data available for the United Kingdom are non-compliant, historic estimates based on poor-quality, or incomplete data. These historic nature of these mineral resource and reserve figures may further add to the difficulties of a national-level harmonisation exercise.

### Useful links and references

Information about UK minerals planning policy and legislation is available via the BGS MineralsUK.com website. https://www.bgs.ac.uk/mineralsuk/planning/legislation/home.html

Data depicting the distribution of mineral resources (along with limited statistical information on production, resources and reserves) in the UK are available via the BGS MineralsUK.com website. http://www.bgs.ac.uk/mineralsuk/maps/maps.html

For England and Wales, four yearly data on sales and reserves of construction aggregates at a sub-national (regional) and national scale are published by Government. http://webarchive.nationalarchives.gov.uk/20121030202828/http://www.communities.gov.uk/publications/planningandbuilding/aggregatesurvey2009

Similar data on construction aggregates are available for Scotland but collection and publication are less frequent. Latest data available pertains to 2005. http://www.scotland.gov.uk/Publications/2007/11/26104244/14

Annual data on sales and reserves of construction aggregates are published at a sub-national (regional) scale by Government in annual monitoring reports. https://www.gov.uk/government/organisations/department-for-communities-a...

Limited resource and ‘reserve’ (licensed tonnage allowed to be dredged) data for offshore aggregate minerals are publically available on a regional basis and are published jointly by The Crown Estate and the British Marine Aggregate Producers Association. http://m.thecrownestate.co.uk/energy-infrastructure/aggregates/our-portfolio/