MICA
Minerals Intelligence Capacity Analysis

FACT SHEET

Panorama of the European MR Industry

An overview of the European Mineral Resources Industry

Scope (conceptual model & main characteristics)

The Minerals4EU Web portal www.minerals4eu.eu provides the access point to the EU's Mineral Intelligence Network which contains a knowledge data platform, a European Minerals Yearbook and numerous foresight studies.

Europe's relatively restricted land mass has a remarkable variety of geological terranes. It includes ancient crystalline rocks, complex younger fold-belts penetrated by igneous intrusions, deep sedimentary basins containing coal, petroleum and other minerals, and landscapes profoundly modified by a recent ice age. As a consequence Europe has a rich endowment of all the major groups of minerals. In the nineteenth century the continent's burgeoning industrial economies were built on its resources of metals and coal. The productive capacity of those resources was, with some exceptions, largely outgrown in the twentieth century but Europe continues to obtain a high proportion of its needs for industrial and construction minerals from within its own borders. In addition, a recent bonanza has been the discovery and exploitation of the offshore resources of petroleum and natural gas beneath the North Sea and other areas of the continental shelf.

For many countries, from antiquity, the ownership of precious metals has been vested in the state or the sovereign and for the majority of European countries state ownership extends to all metals and high-value industrial minerals. Chiefly as a result, in Europe and the world as a whole, there is a direct correspondence between the unit value of a mineral commodity, the amount and accuracy of official statistical information available on it and hence the knowledge base surrounding that commodity.

Mineral Resources can be broadly divided into 4 categories, construction minerals, industrial (non-construction) minerals, metals and energy minerals.

Construction minerals, comprising aggregates (predominantly used in concrete and fill), clay and shale (typically for bricks, pipes & tiles), gypsum (plaster products), limestone and dolomite (crushed rock, industrial and agricultural uses) and building stone

All European countries consume construction minerals, generally in proportion to the size of their individual economies. The majority of the EU member countries are self-sufficient in supply of aggregate minerals but while some produce approximately equal quantities of sand and gravel and crushed rock aggregates others are, for obvious geological and topographic reasons, deficient in one or the other. For example, Netherlands lacks resources suitable for the production of hard rock aggregates while Austria, landlocked and without broad alluvial lowlands, is a net importer of sand and gravel. Simple statistical analysis, especially if only 'gross' national trade positions are examined, can be misleading: aggregates are low-cost minerals and are, as a result, sensitive to transport costs. They may be imported via a short cross-border route at lower cost than if they were carried a much greater distance within national borders. For countries bordering the North Sea production of marine-dredged sand and gravel is a significant part of supply. Crushed rock produced from onshore sites is also conveyed by sea from Norway and Scotland. It should also be borne in mind that recycled and secondary aggregates have become an increasingly important part of supply, in response to environmental constraints on the production of primary (quarried) material

Industrial (non-construction) minerals, comprising a wide range of non-metallic, non-energy minerals used as feedstocks for manufacturing or industrial processing aids, exemplified by barytes, apatite, fluorspar, magnesite, kaolin (china clay), talc, mica, and salt. The category includes metallic minerals used for non-metallic products, e.g. bauxite, chromite, ilmenite and also 'construction minerals' used for non-construction purposes, e.g. limestone.

Unlike metals, where, whatever the extracted ore, the ultimate refined marketable product is produced to a few accepted standards for use in a variety of applications, industrial minerals depend to a great extent on their intrinsic 'as mined' physical and chemical qualities. Thus, for industrial minerals the two most significant variables are the grade of the deposit, that is how much useful mineral it contains, and the quality of the mineral, that is its suitability for specific end-uses. The quality may be a combination of physical properties such as particle size and shape, brightness, viscosity in suspension, specific gravity, hardness, strength and insulating properties. Several industrial minerals are valued purely for their chemical composition, for example, the essential plant nutrients potassium and phosphorus or the halogens chlorine and fluorine and many other elements used as chemical feedstocks.

Until the middle of the nineteenth century the metal demands of industry in Europe were met by indigenous mines but thereafter it became clear that the resources of other continents would become an important source of supply, having, as they did, very large and rich ore bodies that could be worked at relatively low cost. Initially, ores and concentrates were transported to Europe for processing. Many high volume ores, notably iron ore, are still imported but smelting and refining of base metal concentrates has been increasingly undertaken at or near the sites of the overseas mines. Europe as a whole is now heavily dependent on extra-European sources of virtually all metals

although recycling makes an important contribution and, as the statistical tables show, several European countries still have significant mine production of one or more metals.

European smelting and refining of imported ores and concentrates provides the bulk of supply for many metals. Refining in Europe of semi-processed materials from other continents is also significant. Ferroalloys of a number of metals are produced in Europe but imports of the major types are an indispensable part of total supply. The balance of metals supply is made up of imports of refined metal. It is emphasised that the situation of individual countries may vary widely from one to another, as the statistics indicate. Certain European countries are major mine producers of particular metals, but the majority of European countries depend chiefly on imports from other continents. The overall EU36 position of mine production of selected metals in 2014 is shown in Table 1.

Metal	% world	EU36 countries with > 1% of world output in 2014
Chromium	19.4	Turkey, Finland, Albania
Silver	8.1	Poland, Sweden
Zinc	7.3	Ireland, Sweden, Turkey
Titanium	6.6	Norway
Lead	6.4	Poland, Sweden, Turkey
Copper	5.5	Poland
Tungsten	2.9	Spain, Austria
Nickel	2.8	Greece
Gold	1.9	Turkey
Iron	1.7	Sweden

Table 1 EU36 mine production of selected metals as world percentages

Energy minerals comprise petroleum, natural gas, coal and uranium. Statistics for production and trade of petroleum and coal are fairly complete and present few problems to compilers. However, the data for petroleum conceal the distribution of differing grades of crude oil. For example, although there are exports of petroleum from the EU36 countries, there is also a significant import of heavy crude which is a necessary requirement that cannot be supplied by the North Sea and other offshore fields. ‘Black coal’ or ‘hard coal’ is normally taken to mean bituminous coal and anthracite. ‘Brown coal’ comprises sub-bituminous coal and lignite. Black coals have a higher calorific value and lower volatile content than brown coals; the use of the latter is almost confined to burning in electricity generating stations. Within black coals a fundamental division is made into ‘steam coal’, for power generation, and ‘coking coal’, used for metallurgical purposes, predominantly iron smelting in blast furnaces.

Contexts of use, application fields	-> contexts (e.g., environmental, economic, social assessment) -> which types of stakeholder questions are concerned? -> link to published studies that implement the method

An overview of European Mineral resources is critical for Europe's future social, environmental and economic planning strategies.

Input parameters	-> which parameters are needed to run the method

Nationally held data from geological surveys and government departments is vital in forming any assessment of mineral resources.

Type(s) of related input data or knowledge needed and their possible source(s)	-> which types of data are needed to run the method, from which sources could they come… -> could be qualitative data or quantitative data, and also tacit knowledge, hybrid, etc.

Nationally held data from geological surveys and government departments. Publicly vailable company data from mining and exploration companies.

Model used (if any, geological mathematical, heuristic…)	-> e.g., geological model for mapping -> e.g., mathematical model such as mass balancing, matrix inversion, can be stepwise such as agent -based models, dynamic including time or quasidynamic specifying time series… -> can also be a scenario

System and/or parameters considered	-> **the system can be described by its boundaries**. These can refer to a geographic location, like a country, or a city, the time period involved, products, materials, processes etc.

	involved, like flows and stocks of copper, or the cradle-to-grave chain of a cell phone, or the car fleet, or the construction sector, or the whole economy… -> **parameters** could possibly refer to geographic co-ordinates, scale, commodities considered, genesis of ore deposits and others…

Time / Space / Resolution /Accuracy / Plausibility…	-> to which spatio-temporal domain it applies, with which resolution and/or accuracy (e.g., near future, EU 28, 1 year, country/regional/local level…) -> for foresight methods can also be plausibility, legitimacy and credibility…

The scale is on a continental level, specifically applicable to Europe, with global level implications.

Temporally, the European MR Industry is concerned with the present and future domains.

Indicators / Outputs / Units	-> this refers to what the method is actually meant for. Units are an important part but that is most of the time not sufficient to express the meaning. For example, **the indicators used in LCA express the cradle-to-grave environmental impacts of a product or service**. This can be expressed in kg CO_2-equivalent. But also in €. Or in millipoints. Or in m^2year land use. -> for foresight methods the outputs are products or processes

Treatment of uncertainty, verification, validation	-> evaluation of the uncertainty related to this method, how it can be calculated/estimated

MR estimation and calculation is covered by the various CRIRSCO international reporting codes for mineral resources, e.g NI 43-101, JORC and PERC.

Main publications / references	-> e.g. , ILCD handbook on LCA, standards (e.g. , ISO) -> can include reference to websites/pages -> references to be entered with their DOI

BRITISH GEOLOGICAL SURVEY. 2016. *European mineral statistics 2010–14.* (Keyworth, Nottingham: British Geological Survey

Related methods	-> List of comparable methods, their particularities… -> link to one or several other existing fact sheet(s)

Some examples of operational tools (CAUTION, this list is not exhaustive)	-> e.g., software… Only give a listing and a reference (publication, website/page…) -> **should be provided only if ALL main actors are properly cited**

Key relevant contacts	-> list of relevant **types** of organisations that could provide further expertise and help with the methods described above.

The Minerals Intelligence Network for Europe provides data, information and knowledge on mineral resources around Europe.