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Analysis of the competitiveness of the non-energy extractive industry in the EU

TABLE OF CONTENTS

EXECUTIVE SUMMARY

In 2004 (latest year for which complete statistics are available) the non-energy extractive industry (NEEI) in the EU 25 generated a turnover of about 40 billion € and provided employment to about 250,000 people. The data on production and use and markets for minerals in the EU underline the importance of the industry as a supplier of high quality raw materials to much larger downstream sectors, most of which are consumed within the EU.

In particular for *metallic minerals*, despite the presence of an active metal mining industry in the EU, there is significant import dependency for most metallic minerals. The EU had net imports of 203 billion tonnes of minerals in 2004 with a trade deficit of 11 billion €; metallic minerals accounted for 90% of the deficit. Many metallic minerals are being extracted in relatively small volumes compared with global production, e.g. copper (5%), iron ore (2%), nickel (1.7%) and zinc (8.5%). The underlying reasons for this concern the EU's geology, the absence of some mineral types, the emergence of new players such as China and the exhaustion of deposits in the past. Nevertheless, there is potential to optimise production in the EU through for instance modern extraction and processing techniques.

The EU produces a wide range of *industrial minerals*, and for mineral types such as feldspar, kaolin, magnesite, perlite and salt, the EU is either the largest or second largest producer in the world. Overall, EU production of most industrial minerals has remained stable over the last 10 years, and for some, increases of over 20% were recorded. These minerals are traded globally, but most are processed and used in manufacturing within the EU, supplying a very wide range of industrial sectors. One of the main strengths seems to be the close working relationship between the industrial minerals sector and the companies it supplies.

The situation is quite different for *construction minerals* (in particular aggregates) which is the largest sub-sector in terms of value and volume. There are many suitable resources in the EU and despite the large quantities used (3 billion tonnes annually), industry is able to meet demand. Transport costs dominate the price of aggregates which means that most markets are local or regional and there is relatively little international trade.

Different factors that are considered to have the biggest potential impact on the competitiveness of the NEEI were assessed: exploration, investment and operating costs, the regulatory framework, access to resources within the EU, the availability of a skilled workforce, research and innovation and health & safety requirements.

Many stakeholders consider the *access to land* as the key challenge for the industry. It has to be recognised that, in contrast to other industrial sectors, the NEEI is confined to locations which possess known and commercially viable deposits of minerals. Its need to develop new mines and quarries to replace exhausted deposits brings it into conflict with other land uses.

Concerns have been raised about the impact of the *regulatory framework* on the competitiveness of the industry. The analysis considered those EU legislative provisions that potentially affect its ability to gain access to land and operational costs, in particular those of the Habitats Directive and its requirement to designate areas of land as Sites of Community Importance and form a network of protected areas (Natura 2000).

Access to new resources requires knowledge through *exploration*. Exploration expenditure in Europe is low compared with major mining countries such as Canada and Australia. The analysis pointed at the importance of achieving improvements in exploration technology for new discoveries of deeply buried resources. It also highlighted a number of approaches in Europe and elsewhere to encourage exploration activities.

The section dealing with *investment and operating costs* pointed at the cost of energy as an important factor. For industrial and metallic minerals the energy costs can account for 10-20% of total operating costs. Industry is concerned about the significant increase in energy costs in recent years. Transport is also an important cost factor, in particular for the bulky lower value minerals such as aggregates.

The NEEI is faced with a growing problem of *skills shortage*. The number of graduates in subjects that are relevant to the sector is falling as is the number of graduates taking up positions in the industry. At the same time the average age of the workforce is increasing, with a significant percentage of professionals likely to retire over the next 5-10 years.

The NEEI is becoming increasingly *innovative* in order to remain competitive in a global market. Recently the industry launched a European Technology Platform on Sustainable Mineral Resources, which aims to provide a focal point for the industry’s research efforts. Developments in exploration techniques help to find new resources, modern rehabilitation techniques enable sites to be returned to other beneficial uses, while automation makes the working environment in mines safer. It is quite clear that this initiative will need to be fully in line with the EU’s competition rules.

The latter is particularly important, as the NEEI remains one of the more dangerous industrial sectors in terms of *health and safety* with one of the highest rates of accidents at work of all occupations.

This factual analysis is an essential input to a wider consideration of the question of availability and efficient use of raw materials which should encompass the international dimension, including trade and development aims, as well as internal policies, including environmental, social, and research and development aims within the framework of a coherent approach to raw materials.

1. INTRODUCTION

1.1. Background

The non-energy extractive industry provides many of the basic raw materials required by Europe's manufacturing and construction industries. A wide range of minerals, including metallic ores, clays and aggregates[1], are mined or quarried to build infrastructure, such as roads, homes, schools and hospitals, and produce many of the industrial and consumer products which are often taken for granted in a modern economy, such as computers, cars and household appliances.

Globally, demand for minerals has been increasing steadily for many decades, but the rate of increase has accelerated significantly in recent years, mainly because of the rapid industrialisation of highly populated countries such as China and India. This has resulted in large increases in the cost of some raw materials and bottlenecks in supply. This has raised questions about whether Europe's manufacturing industries will be able to obtain reliable and steady supplies of raw materials at competitive prices. A longer-term concern expressed by some stakeholders[2] is that, without a strategic resource policy for the EU, some minerals could become unavailable to European industry as developing countries make increasing use of their indigenous resources and/or secure access to resources in third countries, for example in Africa, by purchasing mineral rights or by entering into joint ventures. One potential effect is an avoidable loss of some sectors of manufacturing to countries outside the EU. Concerns have also been voiced that in some parts of the EU the sector's ability to optimise domestic production is being unnecessarily constrained by factors such as over-regulation and inefficient, costly and inconsistent decision-making.

At political level, these issues fall under the general umbrella of industrial policy. The cornerstone of EU industrial policy is the relaunched Lisbon Strategy which seeks to provide the right framework conditions for enterprises to develop and innovate in order to make the EU an attractive place for industrial development and job creation. The European Economic and Social Committee recently published an Opinion on "Risks and problems associated with the supply of raw materials to European industry"[3] which recognised the importance of raw materials supply to European industry and recommended that achieving the Lisbon objectives requires an innovative industrial policy which involves making the value-added process more mineral-efficient, making sparing use of all resources and progressively replacing finite resources by renewable ones.

More generally, a series of Communications from the Commission have set out an integrated approach to achieving the objectives of industrial policy, which includes more supportive, business-friendly regulations ("better regulation"), developing knowledge through research, innovation and skills, and harnessing synergies between competitiveness, energy and the environment. It is recognised that, in order to optimise policy development, it is often necessary to take the specific characteristics of individual sectors of industry into account and,

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1 These terms are explained in Section 2.

2 E.g. the European Economic and Social Committee, the non-energy extractive industry panel, EuroGeoSurveys and the UNICE.

3 http://eescopinions.eesc.europa.eu/EESCopinionDocument.aspx?identifier=ces\ccmi\ccmi028\ces964-2006_ac.doc&language=EN.

where appropriate, to develop tailor-made policies which fit the particular opportunities and challenges they face[4].

This report aims to provide an objective overview of the non-energy extractive industry operating in the EU, its markets and its main competitors. It also identifies and assesses the factors which could potentially have the greatest impact on the competitiveness of the sector. It is intended to provide a sound platform for any future policy discussion concerning the non-energy extractive industry and access to mineral resources in the EU. This includes the work of the High-Level Group (HLG) on Competitiveness, Energy and the Environment which was set up by the European Commission to ensure synergy in European policy-making[5]. The HLG will consider access to raw materials in 2007. This analysis supplements and was undertaken in parallel with other sectoral competitiveness studies, including on the EU metals industry and the ceramics and glass sectors, all of which are major users of mineral resources.

In May 2007 the Competitiveness Council called for further actions in the domain of industrial policy. It requested the Commission in particular to develop a coherent political approach with regard to raw materials supplies for industry, including all relevant policy areas (foreign affairs, trade, environmental, development and research and innovation policy) and to identify appropriate measures for cost-effective, reliable and environmentally friendly access to and exploitation of natural resources, secondary raw materials and recyclable waste, especially concerning third-country markets. This report has to be seen as an essential input into the wider consideration of these issues.

This report was produced by European Commission staff working closely with the Raw Material Supply Group (RMSG), a stakeholder forum chaired by the Directorate-General for Enterprise and Industry, which brings together representatives of Member States, the EU non-energy extractive industry, European Geological Surveys[6] and other organisations (including environmental NGOs and trade unions). Presentations on the work in progress were made in numerous fora. The Commission also made various requests for contributions to the analysis. The University of Leoben was contracted to assess the different mineral planning policies in the EU-25 Member States, and an evaluation of the Communication from the Commission on "Promoting sustainable development in the EU non-energy extractive industry"[7] provided further views from stakeholders relevant to the assessment.

1.2. Definition of competitiveness

In this assessment competitiveness is defined as "the performance of the sector represented by changes in its level of production and international market share". A number of indicators are used to measure performance and market share in order to compare the sector with the non-energy extractive industry operating in other countries and with other sectors of European industry.

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4 Communication on "Industrial policy in an enlarged Europe" (COM(2002) 714).
5 Further details on the Group's work can be found at: http://ec.europa.eu/enterprise/environment/hlg/hlg_en.htm.
6 Via EuroGeoSurveys.
7 COM(2000) 265.

1.3. Data availability and accuracy

Many of the economic data used in this study were published by the Statistical Office of the European Communities (Eurostat) which collates and reports data provided by the National Statistical Offices (NSO) and other national statistical authorities in each Member State. Other key sources were the British Geological Survey (BGS), the United States Geological Survey (USGS) and the Austrian Federal Ministry for Economic Affairs and Labour[8] (World Mining Data), each of which publishes comprehensive annual statistics on production of individual minerals. Trade federations and individual mining and quarrying companies in turn provided data, while relevant statistics were also obtained from commercial companies, including Minecost.com and Raw Materials Data.

A number of limitations were encountered with the data on the size and economic importance of the sector. One difficulty is that many quarrying companies also manufacture intermediate products, such as cement, lime and plaster. These vertically integrated companies operate their own quarries in the vicinity of their production plant. In such cases, Eurostat will often record the whole extraction and manufacturing operation under the main economic activity. As most of the value added is generated at the manufacturing stage, this unavoidably leads to the whole activity being recorded under the relevant manufacturing code and not as mining. This results in some under-representation of the economic value of the extractive industry. Unfortunately, even at company level operators are often unable to separate activities accurately, as some workers carry out multiple tasks involving both extraction and production operations. One notable point is that some national statistical offices (e.g. in Australia and Canada) include the value of such intermediate products in their figures for the extractive industry and not as manufacturing.

Where an industrial sector within a Member State is comprised of a large number of small companies (e.g. with fewer than 20 workers), the NSO may sometimes provide Eurostat with data derived from a representative survey of that sector. This is understood to be the case with the construction minerals sub-sector (particularly aggregates producers) in some Member States. In such circumstances, the NSO would not seek information from every company, but would obtain data from a representative sample[9].

In its annual statistical reports the BGS also refers to the difficulties of collecting accurate production data, particularly for the aggregates sub-sector. This is not only because of the large number of small aggregates companies spread across Europe but also because different countries have different systems for producing statistics. The terminology used in Member States for materials such as sand, gravel, crushed rock, building stone or limestone can also vary, leading to some materials which are not aggregates sometimes being recorded as such and vice versa. To help address some of these potential shortcomings, the European Aggregates Association (UEPG) undertook a survey of its national members (federations) to obtain estimates by the industry of <u>total</u> aggregates production (i.e. not only that of its member companies) in the 16 Member States in which it is represented.

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8 In cooperation with the Association of Mining and Steel (Vienna) and the national committees for organising the World Mining Congresses.

9 This may answer the concerns of some representatives of the industry that the national figures are inaccurate because many of their members are not asked to provide data by the national authorities.

Organisations such as the OECD and UNCTAD[10] also publish data on the extractive industry, but in most cases they combine the figures for the energy and non-energy sectors. The very different nature and scale of the two sectors and the policies affecting them meant that much of that information was of limited use for this exercise.

Despite these shortcomings, the data presented in this report are thought to provide a reasonably accurate picture of the non-energy extractive industry operating within the EU.

1.4. Content and structure of the report

As indicated above, the aim of this report is to present an analysis of the non-energy extractive industry in the EU. It attempts to describe the industry in the EU, to identify its main markets and global competitors and to understand the specific needs of the sector, so that the particular opportunities and challenges it faces can be taken into account in future policy-making.

Section 2 provides an overview of the general structure of the industry in the EU, describing its main sub-sectors, the wide range of types of mineral worked and the general location and land-use requirements of the industry. A brief assessment is then made of different patterns of ownership of minerals, the regulatory framework governing their extraction and approaches to forward planning to secure future supplies of minerals in different Member States.

Section 3 looks at minerals production, use and markets in the EU. It reflects the importance of minerals as vital raw materials for Europe's continued development and the complex links between mining and the downstream manufacturing and construction industries. It examines recent trends in production of more than 20 of the main types of mineral extracted within the EU and draws a comparison with global production. Consideration is also given to minerals that are not extracted within the EU and for which the EU depends totally on imports.

Section 4 provides recent international trade statistics on the sector, illustrating the levels of imports and exports for each sub-sector and the main countries of origin or initial destination of the minerals traded.

Section 5 examines the economic activity of the industry and compares it with key sectors of manufacturing and the construction industry. It looks at the number of enterprises in the sector in the EU and the importance of the industry as an employer. It then considers a number of other economic indicators, such as turnover, value added, labour costs and productivity, and draws comparisons, where possible, with other major mining regions.

Section 6 then considers the main factors that stakeholders identified during the study as potentially affecting the competitiveness of the industry within the EU. It covers:

– the level of exploration activity;
– costs, including the level of investment required for a new site and energy and transport costs;
– the regulatory framework within which the industry operates;
– planning for future minerals supplies and land-use;
– the availability of a skilled workforce;

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[10] E.g. Handbook of World Mineral Trade Statistics.

– research and innovation; and
– health and safety.

Section 7 attempts to draw the key findings of the report together in order to bring out the main issues for the future competitiveness of the industry.

2. OVERVIEW OF THE NON-ENERGY EXTRACTIVE INDUSTRY (NEEI) IN EUROPE

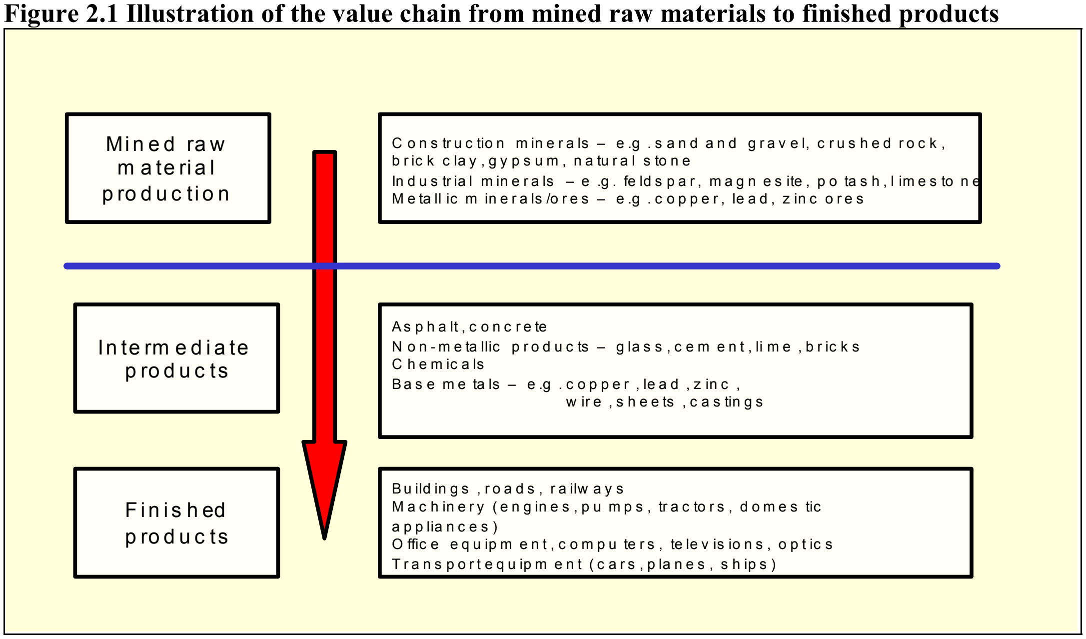
2.1. Definition and scope

"Extractive industry" is defined as "all establishments and undertakings engaged in surface or underground extraction of mineral resources for commercial purposes, including extraction by drilling boreholes, or treatment of the extracted material". "Mineral resource" is defined as a "naturally occurring deposit in the earth's crust of an organic or inorganic substance, such as energy fuels, (metal) ores, industrial minerals and construction minerals, but excluding water"[11].

This report deals with the "non-energy extractive industry" (referred to as the "NEEI" in this report), which mines and quarries[12] over 50 broad categories of mineral within the EU[13]. It also considers a number of other minerals which are not currently mined within the EU, but for which demand is met by a combination of imports and use of recycled materials.

The sector is usually considered to consist of three main sub-sectors - "construction", "industrial" and "metallic" minerals, depending on the physical and chemical characteristics of the minerals produced and, in particular, on their uses and on the downstream industries they supply.

Figure 2.1 Illustration of the value chain from mined raw materials to finished products



11 Directive 2006/21/EC on the management of waste from extractive industries and amending Directive 2004/35/EC.

12 The terms "mine" and "quarry" mean different things in different Member States. For the purpose of this assessment and to simplify the discussion, the term "mining" is used to mean the general extraction process, unless otherwise indicated.

13 The actual number of minerals worked is higher as "types" such as "aggregate" or "natural stone" can include a variety of minerals, such as limestone, dolomite, sandstone, slate and marble, while a metal can often be derived from a variety of metallic ores.

Figure 2.1 provides a basic illustration of the supply chain for a range of minerals from extraction, through transformation into intermediate products to incorporation into finished products.

2.2. Description of the sector

The European Statistical Office (Eurostat) classifies the whole of the extractive industry (i.e. extraction of both energy and non-energy minerals) under NACE[14] code C. It records the non-energy extractive industry, which is the subject of this assessment, under code CB, separating it from the energy minerals sector. The NEEI is further divided into categories CB13 and CB14 to differentiate mining of metal ores from other forms of mining and quarrying, and at lower levels still into small groupings of mineral types, as indicated in Box 2.1.

Box 2.1 Eurostat classification of non-energy minerals

CB Mining and quarrying except energy-producing materials

CB 13 Mining of metal ores

CB 13.1 Mining of iron ores

CB 13.2 Mining of non-ferrous metal ores, except uranium and thorium ores

CB 14 Other mining and quarrying

CB 14.1 Quarrying of stone

CB 14.11 Quarrying of ornamental and building stone

CB 14.12 Quarrying of limestone, gypsum and chalk

CB 14.13 Quarrying of slate

CB 14.2 Quarrying of sand and clay

CB 14.21 Operation of gravel and sand pits

CB 14.22 Mining of clays and kaolin

CB 14.3 Mining of chemical and fertiliser minerals

CB 14.4 Production of salt

CB 14.5 Other mining and quarrying n.e.c.

In this report Eurostat's economic data on the sector have been broken down (where possible) to allow individual assessment of the performance of the three main sub-sectors[15].

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14 NACE (Nomenclature statistique des Activités économiques dans la Communauté Européenne).

15 The often small number of companies extracting particular minerals in some Member States means that Eurostat is sometimes unable to present data at these lower levels of aggregation to protect commercial confidentiality. However, the confidential figures are usually included in the sector's total for the Member State and in the relevant EU-25 totals.

Construction minerals are usually considered to include aggregates such as sand, gravel and various types of crushed rock (e.g. limestone, sandstone, chalk, granite and slate), natural stone (also known as dimension, ornamental or building stone) such as marble and granite, plus a range of clays, shale and gypsum. They are therefore more or less covered by sub-categories CB14.1 (quarrying of stone) and CB14.21 (operation of gravel and sand pits). **Industrial minerals** can loosely be classified as "physical" minerals (e.g. calcium carbonates, borates, diatomite, kaolin, plastic clays, bentonite, feldspar, silica and talc) or "chemical" minerals (e.g. salt, potash and sulphur). However, they also include metallic minerals used for non-metallic purposes, such as ilmenite, and "construction minerals" used for non-construction purposes, such as silica sand and limestone. In Eurostat's nomenclature they are most closely defined by NACE classes CB14.22 (clays and kaolin), CB14.3 (chemical and fertiliser minerals), CB14.4 (production of salt) and CB14.5 (other mining and quarrying). **Metallic ores,** as indicated above, fall within class CB13.

Individual companies may operate in more than one sub-sector, and some minerals do not always fall into just one category. Some sands and clays, for example, would be regarded as industrial minerals when used to produce glass or ceramics, but as construction minerals when used as aggregates or to produce bricks. Similarly, limestone and dolomite are mainly used as an aggregate by the construction industry, but are also important industrial minerals. Unfortunately, it is not possible to draw such distinctions when using Eurostat data. Nor is it always possible to obtain separate data on operation of gravel and sand pits (CB14.21) and clay and kaolin (CB14.22) within NACE category CB14.2.

2.3. Location of the industry

2.3.1. Introduction

The extractive industry can only operate where the geological resources are present in sufficient quantity and quality and at depths that can be worked economically with the available technology. As the resource in a particular area is finite, and often of variable quality, the industry occupies an area of land for a limited time – even if this period spans from just a few years to many centuries. The industry therefore has to discover and work new resources to replace those that are becoming, or have become, exhausted if it is to remain in operation. Most new resources are found close to existing operations as exploration activities tend to concentrate around the same areas. Most new operations are therefore extensions of existing sites, although new "greenfield" sites are also developed.

The location of many downstream industries (and human settlements) has long been a direct consequence of the presence of locally available mineral resources, and local stone used in buildings has given many villages, towns and cities their unique characteristics. The steel industry and the towns built up around it, for example, were traditionally located near to the iron ore and coal mines which produced the basic raw materials for steel production (e.g. the Saar, the Ruhr, Lorraine, Wallonia, Silesia, South Wales and the English Midlands)[16]. However, since the 1970s the availability of cheaper iron ore and coal from developing countries and the relatively low cost of overseas transport have meant that new steel plants are now usually located along coastlines near to harbours enabling companies to minimise the

16 Commission Staff Working Document SEC (2006) 1069. "Analysis of economic indicators of the EU metals industry: the impact of raw materials and energy supply on competitiveness." http://ec.europa.eu/enterprise/steel/comm_sec_2006_1069_1_en_document_travail.pdf.

transport of imported raw materials. The ceramics industry is still concentrated in regions such as Staffordshire in the UK, Bavaria in Germany, Limousin in France, Maastricht in the Netherlands, Sassuolo in Italy and Castellón in Spain because of the locally available supplies of suitable raw minerals and fuels[17]. However, ceramics manufacture is increasingly moving to new locations which are closer to the markets rather than to the supplies of raw materials. The specific characteristics of some minerals makes them particularly sought after.

A number of downstream sectors are vertically integrated with the extractive industry and are also present at particular locations because of the availability of suitable geological resources. Companies producing cement, lime and plasterboard, for example, usually operate their own quarries in the vicinity of their manufacturing plant in order to reduce the cost of transporting raw materials (although some new plasterboard manufacturing capacity is being established in the vicinity of coal-fired power stations to make use of synthetic gypsum produced as a by-product of flue gas desulphurisation). The heavy investment required for infrastructure such as calcination plant for gypsum manufacture or kilns for cement and lime manufacture is another important consideration when planning a site. This has wide-reaching implications for the volume of resources which need to be available to such industries. The European Lime Association (EULA), for example, has indicated that geological reserves of limestone need to be sufficient for between 30 and 60 years of operation to justify the high capital investment costs of starting up a lime production plant[18].

This interdependence of different sectors of EU industry can be seen all along the production chain. Parts of the non-ferrous metals processing industry (e.g. companies manufacturing semi-finished products) are thought to be able to continue to operate at their current levels within the EU because of the size and proximity of the downstream industries that they supply in the EU (e.g. the automobile, aerospace, electrical and mechanical machinery sectors)[19]. This interdependence means that if one link in the chain relocates production out of Europe, it is likely to affect those above and below it.

The extractive industry also makes a significant contribution to the local economy in remote and economically depressed areas in the form of both direct and indirect employment. Many mines and quarries are located in remote areas, such as the metal mines in the Arctic regions of northern Sweden and Finland, or in depressed regions such as the Alentejo marble region in Portugal, Castro-Verde in the Iberian pyrite belt and the Maciço Calcário Estremenho limestone region[20].

Because different geological deposits are unevenly distributed across Europe the industry is highly dispersed and different types of mineral are extracted in each Member State. The next few paragraphs look in greater detail at the distribution of each of the three sub-sectors of the industry across the EU.

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17 Internal working paper on the competitiveness of the EU ceramics industry. DG Enterprise and Industry.

18 The UK Government guidance recommends providing new cement works with a permitted reserve of minerals of at least 25 years (MPG10 – Provision of raw material for the cement industry).

19 Commission Staff Working Document SEC (2006) 1069 – see footnote 16 for full reference.

20 EuroGeoSurveys – direct communication.

2.3.2. *Construction minerals*

Extraction of minerals, and particularly aggregates[21], for the construction industry accounts for by far the largest proportion of the industry's activity within the EU (see section 3.2). The wide distribution of minerals suitable for use as aggregates, combined with the high demand for them and their relatively low cost per tonne, means that markets tend to be relatively close to the production sites[22]. This requires a tight network of pits and quarries in order to reduce transport distances and, therefore, the cost and environmental impact of transport. There are therefore a large number of sites across Europe (currently over 22 000), many of which are close to built-up areas[23]. There are also a number of very large sites (often referred to as "super-quarries") which are usually closely linked to rail or harbour facilities and serve more distant markets. The aggregates industry is therefore present in every Member State, although the amount produced varies greatly between countries. Germany, France, Italy, Spain and the UK combined account for 66% of all production in EU-25.

Construction minerals also include clays used in the manufacture of bricks, plus gypsum and natural stone (also known as "ornamental", "dimension" or "building" stone). As indicated in Table 2.1, natural gypsum is extracted in at least 15 Member States, although France, Germany and Spain produce about three quarters of the EU's output. Brickworks are also widely distributed, usually making use of locally sourced raw materials.

Table 2.1. Location of other construction minerals in the EU

Mineral type	Member State
Brick clay	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Slovakia, Spain, Sweden, UK
Gypsum	Austria, Cyprus, Czech Republic, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Poland, Portugal, Slovakia, Spain, UK
Natural stone	All Member States except the Netherlands but, in particular, Italy, Greece, Spain and Portugal.

2.3.3. *Industrial minerals*

Many different types of industrial mineral are extracted within the EU. The EU is the world's largest producer of feldspar, perlite and salt and the second largest producer of bentonite, Fuller's earth, kaolin, magnesite, potash and talc (see Section 3.3). The geographical distribution of suitable resources is very uneven across the EU (see Table 2.2). While the industry extracts minerals such as kaolin, industrial limestone and talc in around half of the Member States, others, such as fluorspar, mica, phosphate rock and sulphur, are extracted in

21 Crushed rock plus sand and gravel.

22 Although in recent years production for large conurbations such as London and Paris has increasingly been coming from more distant locations.

23 However, in the Netherlands and adjoining parts of Flanders, due to the relatively limited aggregate reserves and the availability of navigable rivers and canals, the usual situation in this market is transport by barge over somewhat longer distances. Similarly, highly populated cities such as London and Paris obtain much of their aggregates supply from more distant sites, from which it is transported by river or rail.

just one or two countries. Other industrial minerals, such as iodine, are not mined at all in the EU.

However, natural variability in the quality and characteristics of a particular mineral found in different parts of the EU and the location of different markets mean that, while a number of Member States might extract the same mineral, they may serve quite different markets. Magnesite extracted in Greece, for example, is predominantly used in agriculture, whereas the main markets for magnesite produced in other European countries are refractory products.

Table 2.2. Industrial minerals extracted in the EU in 2003 and Member States involved (countries with >2% of world production in bold)

Industrial mineral	Member State
Barytes	Belgium, France, Germany, Greece, Italy, Poland, Slovakia, Spain, UK
Bentonite and Fuller's earth	Cyprus, Czech Republic, Denmark, **Germany**, **Greece**, Hungary, **Italy**, Poland, Slovakia, Spain, UK
Bromine	France, Germany, Italy, Spain, UK
Diatomite	Czech Republic, Denmark, France, Hungary, Italy, Poland, Spain
Feldspar	Czech Republic, Finland, France, Germany, Greece, Italy, Poland, Portugal, Spain, Sweden, UK
Fluorspar	**France**, Germany, Italy, **Spain**, UK
Graphite	Czech Republic, Germany, Sweden
Kaolin	Austria, Belgium, **Czech Republic**, France, **Germany**, Greece, Italy, Poland, Portugal, Slovakia, Spain, **UK**
Industrial limestone/dolomite	Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Poland, Portugal, Slovakia, Spain, Sweden, UK
Magnesite	**Austria, Greece**, Netherlands, Poland, **Slovakia, Spain**
Mica	Finland, France, Spain
Perlite	**Greece**, **Hungary**, **Italy**, Slovakia
Phosphate rock	Finland
Potash	France, **Germany**, Spain, **UK**
Quartz, silica sand	**Austria, France, Germany,** Greece, **Italy, Poland, Slovakia, Slovenia, Spain, Sweden, UK**
Salt	Austria, Denmark, France, Germany, Greece, Italy, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, UK
Sillimanite minerals	France, Spain
Sulphur and pyrites	Finland, Spain
Talc	Austria, Finland, France, Germany, Greece, Italy, Portugal, Slovakia, Spain, Sweden, UK

Data sources: BGS (2005) European Mineral Statistics; EULA, EuroGeoSurveys (for quartz and silica sand).

2.3.4. Metallic minerals

Metallic minerals include a wide range of ores which, following processing, yield metals or metallic substances. A number of metal ores are extracted within the EU and for some, such as chromium, copper, lead, silver and zinc, the EU is a relatively important producer. The current distribution of active mines is, however, limited to a relatively small number of Member States (see Table 2.3). Only Austria, Finland, Greece, Ireland, Poland, Portugal and Sweden have metal mining industries that contribute more than 1% to global production of one particular metallic mineral.

Table 2.3. Location of metal mining in the EU in 2003 (countries with >1% of world production in bold)

Metal ore	Member State
Arsenic	Belgium, France, Germany
Bauxite	France, **Greece**, Hungary
Cadmium	Belgium, Finland, France, Germany, Italy, Poland, UK
Chromium	**Finland**
Copper	Cyprus, Finland, **Poland**, Portugal, Spain, Sweden
Gold	Finland, France, Italy, Poland, Slovakia, Spain, Sweden
Iron	Austria, France, Germany, Slovakia, Spain, **Sweden**, UK
Lead	Greece, **Ireland**, Italy, **Poland**, Spain, **Sweden**, UK
Lithium	Portugal
Manganese	Hungary, Italy
Mercury	**Finland, (Spain)**[24]
Nickel	Finland, **Greece**
Selenium	Belgium, Finland, Germany, Poland
Silver	France, Greece, Ireland, Italy, **Poland**, Spain, **Sweden**
Strontium	Spain
Tin	Portugal
Tungsten	**Austria**, **Portugal**
Zinc	Finland, Greece, **Ireland**, **Poland**, Spain, **Sweden**

Data source: BGS (2005) European Mineral Statistics.

24 The Almaden mine in Spain which accounted for most of the EU's mercury production closed in 2003.

2.4. Ownership of mineral rights

The ownership of minerals in the ground differs between Member States (see Table 2.4). Higher value minerals, such as metallic ores and energy minerals, plus some industrial minerals are often owned by the State. Other categories of mineral are usually privately owned (mainly by the owner of the land under which they are found). The legislation controlling exploration and extraction activities is often different depending on whether the minerals are State- or privately owned. While the industry has pointed to administrative procedures as a significant issue in determining a company's ability to exploit an area, ownership rights have not been identified as an issue. In some cases there are issues with expropriation, which usually involves compensation or variable royalty payments either to the land owner or to the State (where different), but there is no evidence that this has a profound effect on the industry's competitiveness. Regarding the ability of State- or privately owned companies to access markets, it has been suggested that downstream sectors are indifferent to the source of supply, provided the minerals meet the specifications, perform satisfactorily and are freely available at competitive prices[25].

Table 2.4. Overview of ownership of minerals in different Member States[26]

Member State	Minerals owned by the State	Privately owned minerals	Comments
Austria	Rock salt and all other types of salt occurring together with rock salt, hydrocarbons and natural mineral resources containing uranium or thorium.	Free minerals: All mineral resources from which iron, manganese, chromium, molybdenum, tungsten, vanadium, titanium, zirconium, cobalt, nickel, copper, silver, gold, platinum and platinum group metals, zinc, mercury, lead, tin, bismuth, antimony, arsenic, sulphur, aluminium, beryllium, lithium and rare earth minerals could be extracted technically. In addition, gypsum, anhydrite, barytes, fluorite, graphite, talc, china clay (kaolin), leukophyllite, plus all kinds of coal and oil schists and magnesite, limestone (with calcium carbonate content of more than 95%) and diabase, if these mineral resources occur as hard rock, quartz (with a silicon dioxide	All mining operations are subject to the 1999 "Mineral Resources Law" (MinroG), which requires operators to have a mining licence.

[25] Crowson, P. (2003). "Astride mining. Issues and policies for the minerals industry." Mining Journal Books Ltd, London.

[26] University of Leoben (2004). "Minerals planning policies and supply practices in Europe." Report prepared for DG Enterprise and Industry. Extended executive summary available at: http://ec.europa.eu/enterprise/steel/non-energy-extractive-industry/mpp_extended_summary.pdf.

		content of more than 80%) and clays, if they occur as soft rocks. Landowner minerals: all other minerals.	
Belgium	Metal ores and coal.	Industrial and construction minerals.	Responsibility for land-based extraction lies at regional level. Both specific mining and quarrying laws and land-use planning legislation apply.
Czech Republic	Reserved minerals. Most minerals.	Building stone, gravel and clay.	Mining Act. Access to reserved minerals can be achieved without the consent of the landowner, although compensation is payable.
Denmark	Off-shore minerals and deep-seated minerals such as salt, oil and gas.	Onshore minerals.	Access to State-owned minerals is administered by the Ministry for the Environment and Energy. Land-based mineral rights are owned by the landowner and are acquired by private contract between the landowner and mineral operator.
Estonia	Bedrock clay, dolomite, phosphorite, crystalline building stone, limestone, oil shale, silica sand and minerals under State-owned land.	All other minerals (except bedrock defined as pre-glacial).	A permit is required under the Earth's Crust Act for mining activities and liabilities under a Mining Act.
Finland	Claimable minerals: Metalliferous ores, industrial minerals, gemstones, marble and soapstone.	"Non-claimable minerals": All other minerals.	Claimable minerals are controlled at national level by a Mining Act administered by the Ministry for Trade and Industry. Non-claimable minerals are controlled by permits governed by the Land Extraction Act or Planning and Building Act.
France	Minerals of high value or national importance, including gold, silver, copper and zinc.	"Quarried" substances such as limestone, igneous rock, sand and gravel.	Concessions to mine State-owned minerals are granted by an order from the Council of State following consultation with the General Mines Council. Quarries are left at the disposal of landowners, although in some cases public authorities can issue permits without the consent of the landowner.
Germany	Free minerals: Metals, hydrocarbons, coal and lignite, rock, potassium, magnesia and boron salts, brine, fluorite and barytes. In the former East	All other minerals.	A Mining Act applies to State-controlled minerals and some landowner minerals, including bauxite, bentonite, feldspar, clays for refractory and ceramic use, quartz, kaolin and all minerals

	Germany, also high-grade rock, stone and related products.		mined underground. Permits to exploit "free minerals" must be obtained from the regional mining inspectorate. Agreement from the landowner to use the land is necessary, although compulsory purchase is possible if in the public interest. Land regulations (national and Federal State) apply to other minerals.
Greece	Energy minerals, emery, mineral sodium chloride, metallic minerals and strategically important minerals such as feldspar.	Other minerals.	The Mining Code draws a distinction between mineral ores and quarrying minerals. For non-State-owned mineral ores, the Code establishes a freedom to mine by the private sector. Landowners have the right to extract quarry materials (e.g. marble, industrial minerals and aggregates).
Hungary	All minerals.		The Mining Act controls all aspects of use. The State plans and controls mineral extraction by deciding whether to open certain areas for extraction and calling for tenders.
Ireland	Scheduled minerals (of which 35-40% are privately owned), including chalk and dolomite, china and ball clay, silica sand, gypsum and anhydrite, salt and potash, barytes, fluorspar and metals.	Non-scheduled minerals: Peat, sandstone, other igneous/metamorphic rocks, limestone, sand and gravel and common clay.	The right to extract "scheduled minerals" is vested in the Minister for Transport, Energy and Communication (unless they were already being privately worked by 15 December 1978). A mining licence (as opposed to a mining lease) is required to extract privately owned scheduled minerals. Planning permission is required for working both scheduled and non-scheduled minerals.
Italy	Category 1 minerals: Energy minerals (except peat), metallic ores, non-metallic ores of significant industrial importance (i.e. salt and potash, Fuller's earth, barytes and fluorspar), marine sand and gravel.	Category 2 minerals: All other minerals (which are mainly quarried) – peat, sandstone, igneous rock, limestone, chalk and dolomite, sand and gravel, silica sand, common clay, shale and fireclay, china and ball clay, gypsum and anhydrite.	Permits to work category 1 minerals are issued by the Ministry for Industry, while category 2 minerals are subject to regional administrative regulations.
Latvia		All minerals belong to the landowner which might be the State, local authorities, private individuals or legal entities.	The Subsoil Law requires permits for mining activities. Permits to work land owned by the State or a local authority are put out to open competition.

Lithuania	All minerals.		Landowners can extract minerals for their own use without a permit as long as the area is less than 0.5 hectares and to a maximum depth of 2 metres.
Luxembourg	All mineral resources deeper than 6 metres.	Mineral resources shallower than 6 metres.	Permit issued by the national government.
Netherlands	Off-shore minerals. On-shore non-surface minerals (e.g. salt).	On-shore surface minerals (e.g. construction minerals).	Extraction permit required from the relevant province or regional directorate of the Directorate-General for Public Works and Water Management. For non-surface minerals a permit is required from the Minister for Economic Affairs. For off-shore surface materials a contract with the State Property Directorate is required in addition to the permit.
Poland	Minerals extracted by underground or "hole" mining.	Minerals extracted from open pits.	Permit required from the Environment Minister for "basic" minerals (energy, metallic and chemical minerals) and from the Voivod for most other minerals.
Portugal	Ore deposits (including all metallic and radioactive ores, graphite, pyrites, phosphates, asbestos, talc, kaolin, quartz, feldspar, precious and semi-precious stones, potassium salts and rock salt).	Clays, limestone, marbles, gypsum, granites, sand and ornamental and building stone not included under ore deposits.	Mineral rights for extraction of State-owned minerals are granted by the Minister for Economic Affairs. The Regional Directorate for Economic Affairs or Municipal Council issues licences for quarrying construction minerals.
Slovakia	Reserved minerals: minerals other than construction minerals.	Non-reserved minerals: building/crushed stone, gravel, sand and brick clay.	The Ministry for Economic Affairs is the main body responsible for control over the extractive industry.
Slovenia	All minerals.		A Mining Act regulates exploration, extraction and management of all mineral resources.
Spain	All minerals.		All deposits of natural origin and all other geological resources are "public-domain assets". The State may either work them or assign the rights to private operators under a system of permits and licences in accordance with the Mines Act.
Sweden	Concession minerals: Metallic ores, a wide range of industrial minerals, coal, oil,	Non-concession minerals: Other minerals.	Rights to concession minerals are obtained from the Mining Inspectorate. In the event of lack of agreement with the landowner,

	gaseous hydrocarbons and diamonds.		compulsory purchase is possible. For non-concessionary minerals, agreement to work them is negotiated with the landowner.
United Kingdom	Oil and gas, coal, most seabed minerals, silver and gold.	All other minerals.	Permits granted under land-use planning legislation at local authority level.

Source: Summarised from the Leoben University study on mineral planning policies and supply practices in Europe with additional contributions from EuroGeoSurveys and the Geological Survey of Sweden.

2.5. Land use

Extraction of minerals unavoidably has an impact on land use, even if, following land rehabilitation, this is temporary. The most visible signs of a surface mineral working are usually the hole created by the removal of soil, overburden and the mineral; storage mounds containing soil and overburden; spoil tips and lagoons (also known as dumps and tailings ponds), together with associated plant (e.g. crushers and conveyor belts), buildings and access roads. While underground mining activities, by nature, are less visible, sites are usually marked at the surface by spoil tips and lagoons, buildings and access roads. Many underground mines started as opencast operations and exhibit a combination of visible characteristics.

Eurostat has published data on the area used for mining and quarrying in a limited number of Member States. Most of the figures relate to the situation in 2000 (see Table 2.5), although for Austria and Sweden they are for 1995. The data cover both energy and non-energy extraction and are thought to provide a measure of the surface footprint of the industry (i.e. the operational area on the surface). They therefore exclude areas such as underground tunnels, undisturbed land within the boundary of sites and rehabilitated areas. This suggests that the industry's surface footprint was equivalent to between 0.05% and 0.5% of the total land area of the Member States concerned[27].

[27] Data provided by the German Geological Survey (BGR) put the area of land in Germany used by the non-energy extractive industry in 2001 at 16.2 km^2, equivalent to 0.005% of the total land area (direct communication). This relates to the area required to produce minerals in 2001, and not the total footprint of the industry.

Table 2.5. Area of land used for mining and quarrying in selected Member States in 2000 and as % of national land area

Member State	Area used for mines and quarries (km²)	% of total land area
Belgium	37.1	0.12
Denmark	20.0	0.05
Germany	1 795.8	0.51
France	662.8	0.12
Netherlands	51.0	0.15
Austria (1995)	74.0	0.09
Poland	380.0	0.12
Portugal	217.0	0.24
Slovenia	14.8	0.07
Sweden (1995)	350.0	0.09
UK	555.0	0.23

Data source: Eurostat.

Modern working methods, including progressive extraction and rehabilitation (including new concepts like "function combination"[28]), can often minimise the area of land being worked at any one time (i.e. the industry's surface "footprint"), while careful landscaping and screening of operations (e.g. using trees or bunds) can limit the visibility of sites. However it should be pointed out that the actual 'footprint' (i.e. total land and associated functions affected by mineral workings) can be much broader (e.g. acid drainage from mine voids or waste tips affecting downstream water bodies) and they require careful short and long term measures and planning.

Besides land management issues, the industry is likely to have an environmental impact (e.g. water pollution, changes in groundwater flow patterns, loss of biodiversity, air pollution, dust and noise). Managing these impacts effectively requires that activities are in line with all relevant legislation that covers these areas. It has also to be pointed out that the industry has made very large strides in recent years to improve its environmental performance, and there is general acceptance within companies that they have to reconcile their activities with sustainable development and environmental concerns. For example, the European Aggregates Association UEPG has joined the Countdown 2010 Initiative[29] of the World Conservation Union (IUCN) to contribute to halting the loss of biodiversity by 2010. There are several examples of individual companies like Rio Tinto and Lafarge that have embarked on joint projects with environmental organisations. The International Mining and Minerals Council[30] has also produced guidelines for the mining industry to incorporate biodiversity considerations into corporate strategies and practices.

28 http://www.verkeerenwaterstaat.nl/onderwerpen/water/water%5Fen%5Fbouwen/bodemschatten/.

29 http://www.countdown2010.net/

30 http://www.icmm.com/

2.6. Regulatory framework

Much of the legislation used to regulate the industry is national or regional. It has developed over many years, often in response to specific incidents, such as mining accidents, but also to minimise the environmental and health effects of extraction and processing activities. If not adequately controlled, mining and quarrying have the potential to cause significant damage to the environment and to human health. It is beyond the scope of this analysis to consider in any detail the wide range of national legislation in place in each of the Member States. However, Table 2.4 provides some insight and further information can be found in the report on mineral planning policies in the EU produced for the European Commission by the University of Leoben[31,32].

A significant body of legislation has also been adopted at EU level which affects the activities of the extractive industry. Most of this legislation is horizontal and was not specifically developed to control the extractive industries. This includes Directives dealing with environmental protection, health and safety and consumer health. As the industry considers that some of the horizontal EU legislation has an impact on its competitiveness, key provisions are considered further in Section 6.4.

The only Directives developed specifically for the extractive industry are:

– Directive 2006/21/EC on the management of waste from extractive industries (which will come into force in 2008);

– Directive 92/91/EEC concerning the minimum requirements for improving the safety and health protection of workers in the mineral-extracting industries through drilling (eleventh individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)[33]; and

– Directive 92/104/EEC on the minimum requirements for improving the safety and health protection of workers in surface and underground mineral-extracting industries (twelfth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)[34].

The last two Directives lay down minimum requirements for the health and safety of workers in the surface and underground mineral extractive industries and are discussed further in Section 6.8.

2.7. Control over extraction and approaches to forward planning for mineral supply

The fourth column in Table 2.4 provides an indication of the different approaches to gaining access to mineral resources in each Member State (this is summarised in greater detail in the report by Leoben University). All Member States usually require at least one permit for extraction operations, although some have more than one permitting authority and multiple permits may be required before operations can begin. The higher value minerals, such as metallic and industrial minerals, often fall within the jurisdiction of national authorities, such

31 See footnote 26 for reference.
32 Some of the information taken from the Leoben University report has been revised in response to specific comments from national authorities.
33 OJ L 348, 28.11.1992, p. 9.
34 OJ L 404, 31.12.1992, p. 10.

as a government department or mining authority, while in many Member States permits to extract aggregates and similar materials are a matter for lower tiers of government. The national legislation is often contained within a Mining Act (or similar act) or within land-use planning legislation. When the Mine Waste Directive comes into force in 2008 it will require operators to produce waste management plans and to obtain a permit from the relevant competent authority before they can operate eligible waste management facilities. This is discussed further in Section 6.4.

One of the most frequently cited concerns of the industry is the difficulty it has with obtaining new permits to replace exhausted sites. Particular concern has been expressed that some governments do not appreciate the importance of the extractive industry and, more generally, that the permit regime in some Member States is often cumbersome, inefficient and inconsistent when it comes to decision-making. The Leoben study reports cases where applications for permits to operate new sites took longer to work their way through the permitting procedure than the lifetime of the permits that were eventually granted. The reluctance of competent authorities to grant permits may also reflect the low acceptance by the public due to possible cases of poor environmental record.

Matters affecting use of land for activities such as mining are not within the competence of the EU institutions. It is therefore up to Member States to decide if and where mining activities should take place within their national borders – subject to compliance with the relevant directives and their own national and local legislation, as explained above. One of the main conclusions of the Leoben study was that some Member States do not appear to have a coherent system for planning future extraction activities or an effective system for considering proposals for new sites. This often results in uncertainty on the part of the applicant plus unnecessary costs and delays. Representatives of the industry have suggested that this is one reason for companies not investing in exploration or mining in some Member States.

The Leoben study also concluded that the main difference between Member States is the degree to which land-use plans are produced and provide detailed prescriptive information on where mineral extraction might be acceptable. Some Member States provide national policy guidance which has to be taken into account by lower tiers of government responsible for planning and permitting mineral extraction in their area.

Overall, a number of different approaches by national governments were identified, including development of:

– national minerals policies (e.g. Austria, the Czech Republic and the UK);

– national mining plans (e.g. Austria and Portugal);

– policy guidance (e.g. Denmark, Portugal, Slovenia and the UK);

– specific requirements in legislation (e.g. France, Germany, the Netherlands, Poland and Sweden); and

– indirect measures, in the form of exclusion of mining in defined areas via other legislation – for example, nature conservation designations (most Member States).

It is not the purpose of this assessment to identify particular Member States operating what might be considered good practice or others where practices are inefficient or bad. Instead, the aim is to draw attention to general approaches which many stakeholders consider to have the potential to enable the industry to operate where it is possible within the general framework of sustainable development. This is discussed further in Section 6.5.

3. MINERAL PRODUCTION, USES AND MARKETS

3.1. Introduction

One important component of the analysis was to identify the links between the non-energy extractive industry in the EU and the downstream sectors it supplies with raw materials. This not only provides continuity with other sectoral analyses, but also reflects the important issue that the demand for minerals is largely driven by downstream industries. The importance of the industry is therefore much greater than its direct contribution to the national and European economies. The level of production of minerals within the EU is therefore also likely to depend on the competitive success of key manufacturing sectors in the EU and, for construction minerals in particular, the cyclic behaviour of the economy in different Member States.

Table 3.1 provides a very general overview of the wide range of applications for minerals and of the economic importance of the downstream manufacturing and construction industries supplied.

Table 3.1. Example of the economic importance of EU industries consuming non-metallic minerals

Application	Value added (€ million)	Employment	Mineral content
Construction			
Glass	16 336	375 400	100%
Ceramic tiles and flags	4 253	94 900	100%
Bricks, tiles and construction products	3 891	78 300	100%
Concrete	10 515	256 600	100%
Cement, lime and plaster	8 717	77 700	100%
Natural stone production	5 492	189 300	100%
Non-construction			
Rubber products	17 057	359 400	up to 50%
Plastic products	55 534	1 310 400	up to 50%
Paints and varnishes	10 601	179 400	up to 70%
Paper and paper board	17 429	223 800	up to 30%
Ceramics used for non-construction uses	6 514	199 100	100%
Basic chemicals	64 928	584 500	variable
Basic pharmaceuticals	6 812	66 700	variable
Mineral filters			100%
Sugar			process aid

Source: Based on "Good Environmental Practice in the European Extractive Industry: A Reference Guide", with figures for value added and employment updated to 2002-2003 by DG Enterprise and Industry using Eurostat data.

As the markets for different minerals vary significantly, the following sections look at the three sub-sectors in turn. They explain in more detail the types of mineral in each sub-sector, their uses and recent production trends.

3.2. Construction minerals

3.2.1. Aggregates

Aggregates are a granular material used in construction. Most are of mineral origin and they include sand, gravel and crushed rock (often referred to as "primary aggregate"). However, a relatively small, but increasing, amount of aggregate is produced from by-products of other industrial processes, such as blast and electric furnace slags or residues from mineral processing such as china clay sands and left-overs from stone quarrying ("secondary aggregates") and from reprocessing of materials previously used in construction, including construction and demolition waste and railway ballast ("recycled aggregates"). In 2004 over 5% of the aggregates used in the EU were recycled, although the relative contribution varied greatly between Member States. At the low end, some countries report that they use no secondary or recycled aggregates, while others report that over 20% of their national consumption is met from such sources[35].

Aggregates have a wide range of uses, including in construction of buildings, roads and railways. They are used directly as railway ballast and armourstone and also as raw materials in the manufacture of other construction products such as ready-mixed concrete (which contains 80-90% aggregates), pre-cast products, asphalt (which contains 95% aggregates), lime and cement[36]. It is estimated that a typical new home can require around 400 tonnes of aggregates[37], a high-speed railway up to 9 000 tonnes of aggregates per kilometre and a motorway up to 30 000 tonnes of aggregate per kilometre.

Figure 3.1 illustrates some of the many uses of aggregates in the UK construction industry in 2004. Approximately 16% were used for housing, 22% for road-building and maintenance, 27% for private industrial and commercial development and 11% for other public works. Lafarge Granulats[38] estimates that of the 400 million tonnes of aggregates used in France in 2003[39], 17% were used in ready-mixed concrete, 6% in concrete products, 9% in other types of concrete, 13% in asphalt and 55% in applications such as road sub-base layers, ornamental purposes and filtration. Broadly similar figures were provided for Finland (50% for roads, 10% in asphalt, 10% in concrete, 15% in house-building and 15% for other uses)[40].

Demand for aggregates is therefore closely related to the level of new house-building, maintenance and repair of existing buildings and the scale of civil engineering projects[41]. During periods of weak economic growth, repair and maintenance of the existing building stock is thought to dominate demand, although this also depends on the extent of the existing building stock and the number of national and local urban renewal programmes. In the Netherlands, Germany, France and Italy, renovation of the existing stock accounts for the majority of the market, while in the UK and Belgium there is parity between new construction and renovation. In Portugal, Ireland and Spain, and also in many new Member States, new construction predominates.

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35 UEPG figures.

36 UEPG (2005) Annual Report.

37 In the form of concrete or other products.

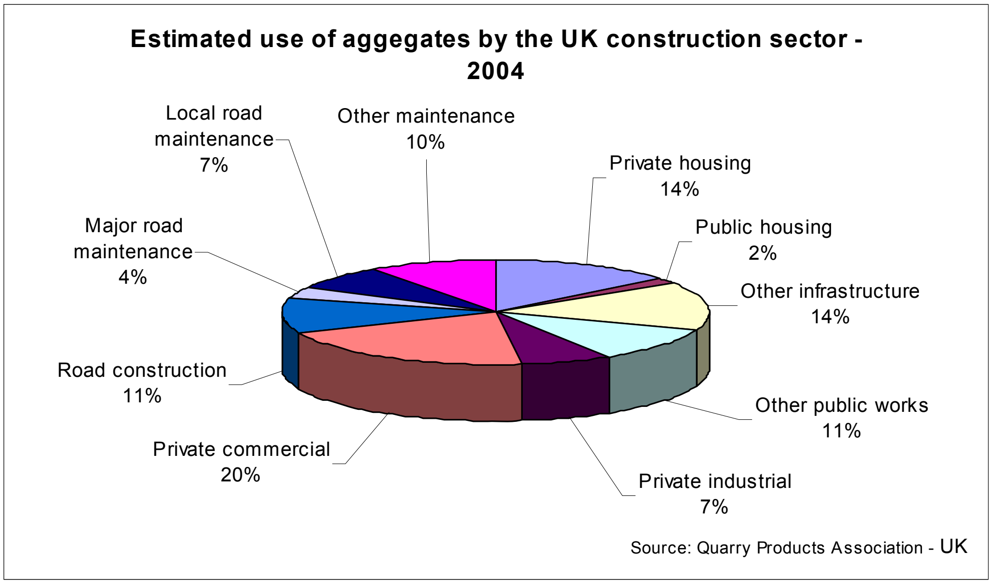
38 Lafarge Granulats (2005). "Quarrying and sustainable development."

39 Comprising 39.5% sand and gravel, 29% igneous rock, 26% limestone, 4% recycled aggregates and 1.5% marine aggregates.

40 Finnish aggregates producers. Direct communication.

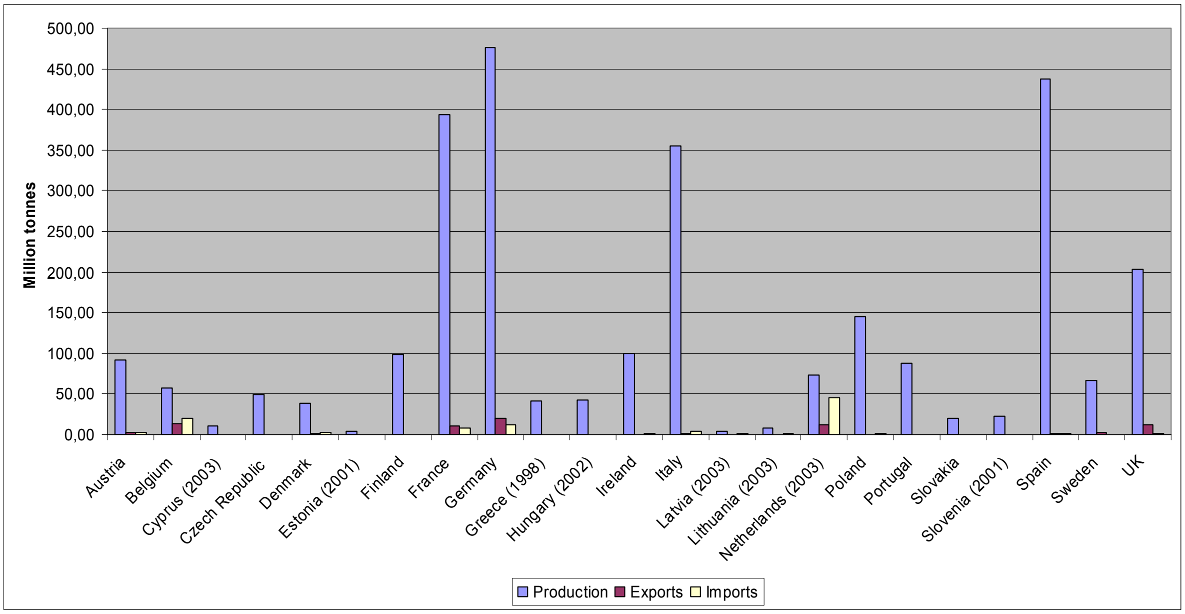
41 The UEPG reports estimates by Euroconstruct which predict that in the years ahead the housing repair and maintenance markets will be the strongest segment for the industry, with a gradual slowdown in new house-building and civil engineering work.

Figure 3.1. Estimated use of aggregates by the UK construction sector in 2004



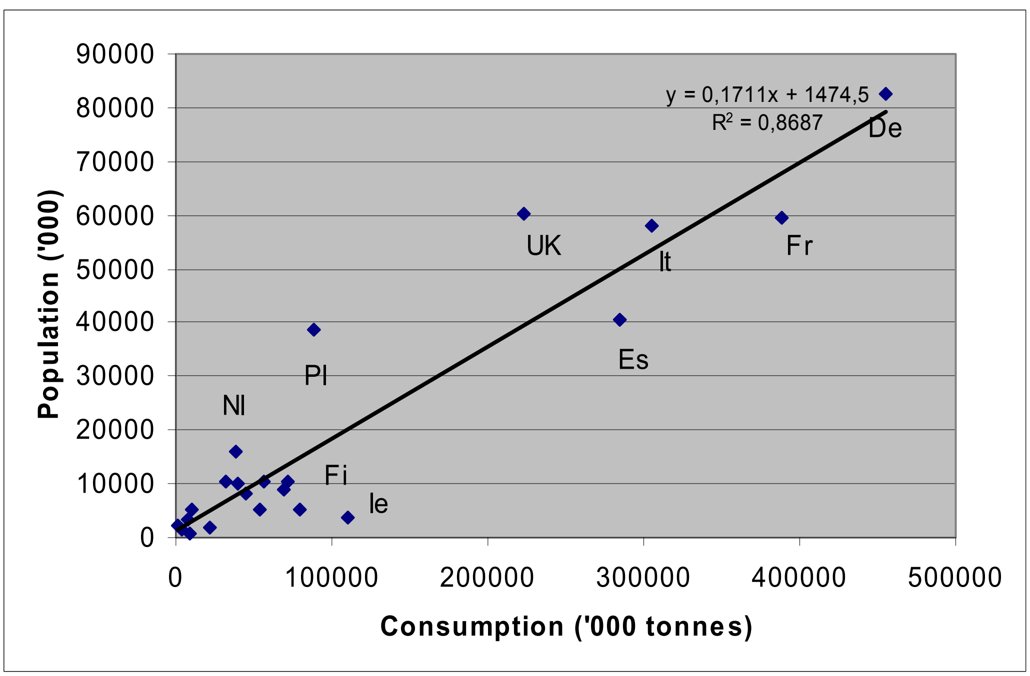
As indicated earlier, the aggregates industry is present in every Member State. Annual production in 2004 was estimated to be in the region of 2.8 billion to 3.0 billion tonnes, although production varies significantly in each Member State (see Figure 3.2). The same figure also illustrates the relatively limited international trade in aggregates compared with domestic production (with the exception of Belgium and the Netherlands) and the generally local nature of the industry and its markets. In view of the generally national and local level of consumption of aggregates, it is perhaps not surprising to see a general relationship between consumption and population (see Figure 3.3).

Figure 3.2. Production, imports and exports of aggregates (sand, gravel and hard rock) by Member State in 2004 (except where stated otherwise)



Data source: UEPG (all 2004 data); Department of Public Works and Water Management, Road and Hydraulic Engineering Institute (Netherlands data) and BGS (all other data).

Figure 3.3. Relationship between consumption of aggregates and population

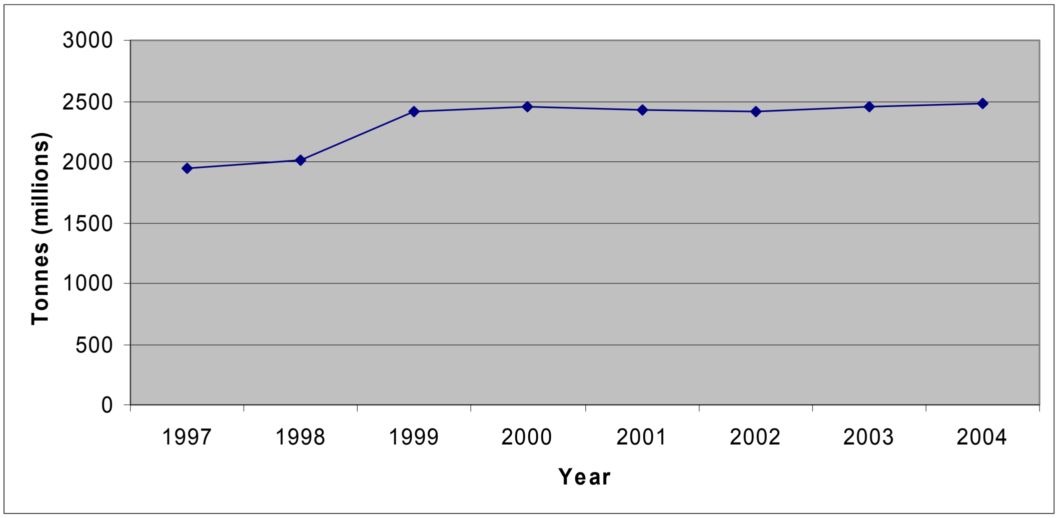


Consumption data based on BGS figures for production, imports and exports of aggregates in 2003.

Production trends

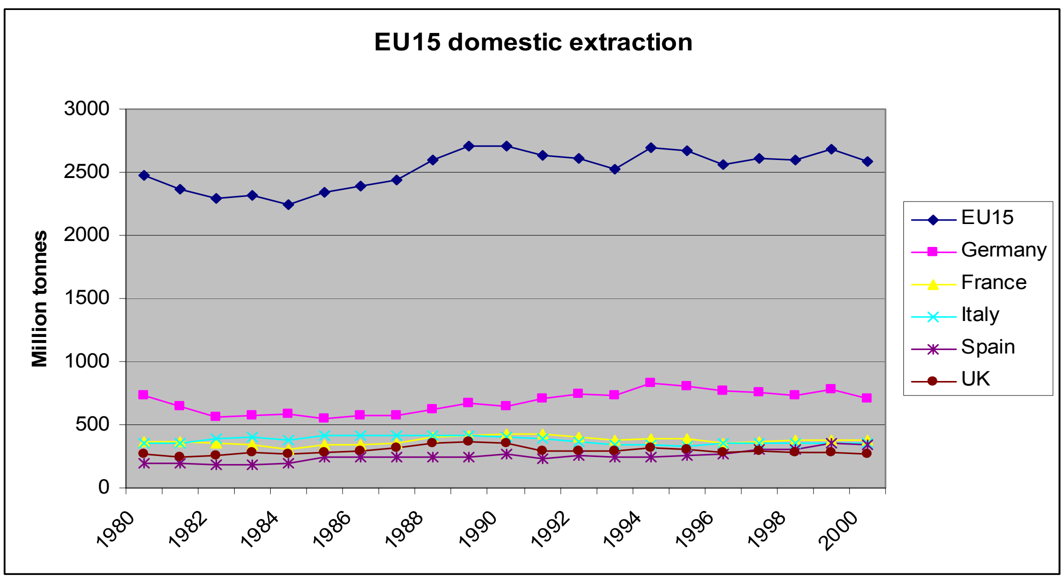
Despite being the largest sub-sector of the industry in the EU, construction minerals have proved to be the hardest on which to obtain accurate and comprehensive data. The BGS was the first organisation to publish figures for production, imports and exports in each of the 25 Member States, but these (currently) cover only the period 1997-2004 (see Figure 3.4) and, as discussed earlier, are thought to under-represent the industry's activities. Figure 3.5 provides a longer time series (1980 to 2000) for the former EU-15 Member States which suggests a generally stable picture, at least since the late 1980s[42], although this masks fluctuations over that period within individual Member States.

Figure 3.4. Reported production of aggregates within EU-25 (1997-2004)



Data source: BGS.

Figure 3.5. Extraction of aggregates in EU-15 (1980-2000)



Data source: "Material Use in the European Union, 1980-2000".

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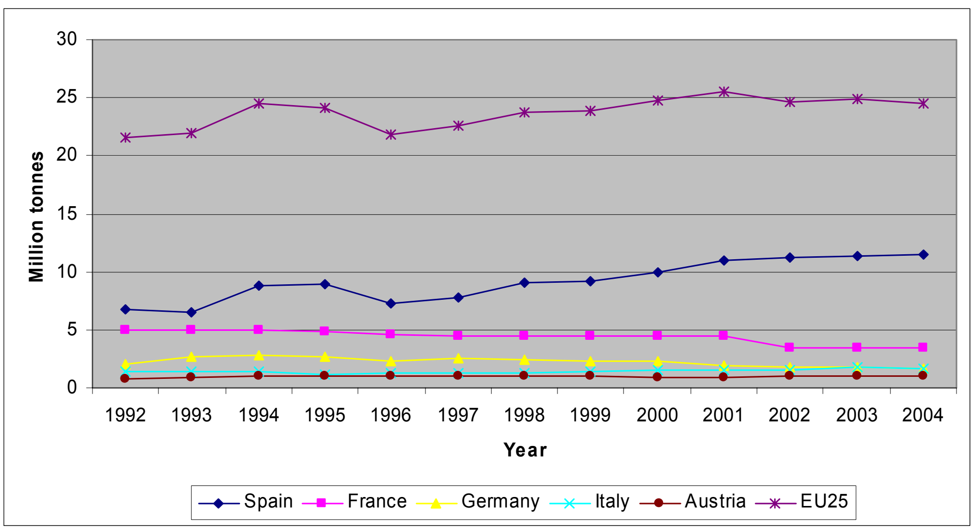
42 The original source and accuracy of these data are not known.

3.2.2. Gypsum

Gypsum is widely used in the construction industry as plaster or in plasterboard products. It is also an important ingredient in the manufacture of cement and other products. Until the late 1990s most of the gypsum used in the EU was mined. However, alternative sources, and in particular synthetic gypsum produced at coal-fired power stations as a by-product of flue gas desulphurisation (FGD), are increasingly being used. There is a high degree of vertical integration between the extraction side of the industry and the processing and manufacture of plaster products. The industry estimates that 22% of its total costs relate to mineral extraction and the remainder to manufacturing plaster products[43]. In the past, plasterboard production facilities were located close to natural gypsum deposits and the market for building materials. An increasing number of production facilities are now being established across Europe close to large coal-fired power stations and new gypsum markets have opened up[44].

Despite the increased use of synthetic gypsum, EU mine production has generally increased since the early 1990s (see Figure 3.6) and, in 2004, totalled around 25 million tonnes. Spain is by far the biggest producer of mined gypsum (over 10 million tonnes a year) and, with France and Germany, accounts for two thirds of EU production. The EU is the largest producer of mined gypsum in the world (see Figure 3.7), accounting for about 25% of the global total (see Figure 3.8). Other major producing countries are the USA, Canada and Iran.

Figure 3.6. Mine production of gypsum in EU-25 (1992-2004)



Data source: BGS. Graphs produced by DG Enterprise and Industry.

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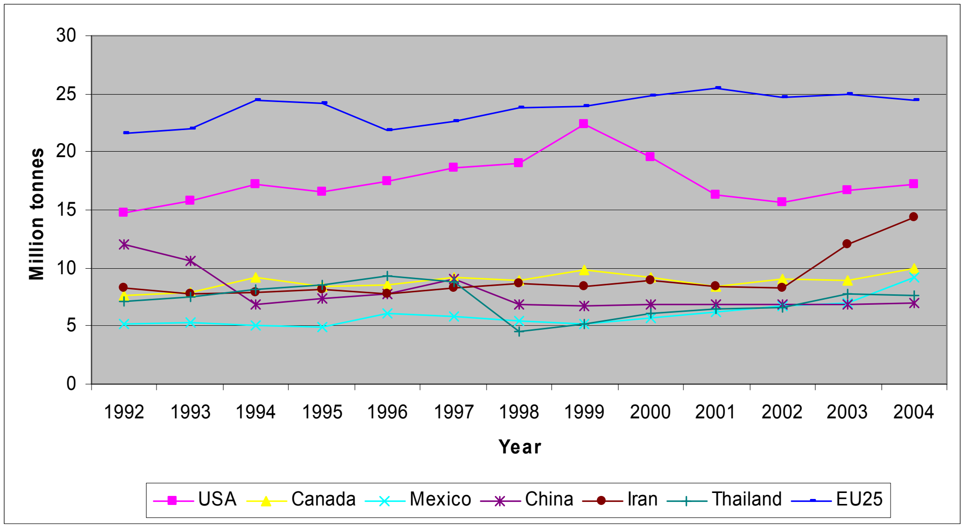
43 Eurogypsum – direct communication.

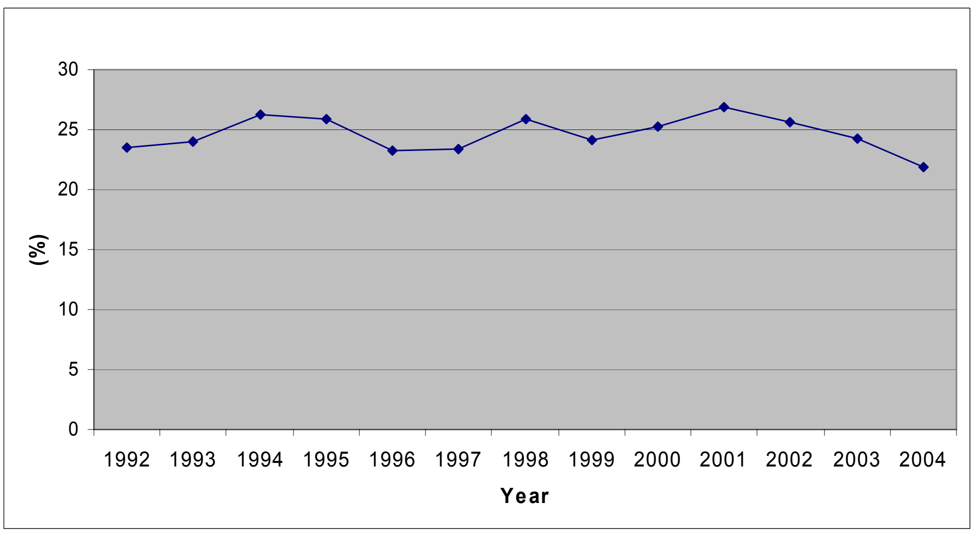
44 Rolf Hüller (2004). "25 years experience gained in the European gypsum industry with the use of FGD gypsum." Eurogypsum XXVth Congress.

Figure 3.7. EU-25 and global production of mined gypsum



Data source: BGS. Graphs produced by DG Enterprise and Industry.

Figure 3.8. EU-25 production of mined gypsum as a percentage of global production



Data source: BGS. Graphs produced by DG Enterprise and Industry.

Recycled gypsum

In addition to synthetic gypsum, about 10% of annual plasterboard production is thought to be lost as scrap, while significant amounts are also present in construction and demolition waste. At least one company has developed the technology to recycle gypsum waste. It has been suggested that increasing supplies of synthetic gypsum, tighter controls on the landfilling of gypsum wastes and increased recycling of gypsum products could lead to a reduction in demand for natural gypsum in the future. Representatives of the industry, however, have expressed concern about relying too heavily on FGD gypsum, particularly as the quantities available are closely linked to the activities of power generators. Any change in energy policy which reduced the need for FGD (e.g. increased use of low-sulphur coal or alternatives such as natural gas) could affect the availability of future supplies of synthetic gypsum.

3.2.3. Natural stone

Natural stone (also known as ornamental, dimension or building stone) is a natural rock material which is quarried to obtain blocks or slabs that meet specifications such as size and shape. It includes a range of igneous, metamorphic and sedimentary rocks, such as marble, granite, sandstone, slate and limestone. Factors such as colour, grain texture and pattern along with the surface finish of the stone are important requirements, as are durability, strength and the ability of the stone to take a polish[45].

Approximately 35% of global stone production is in Europe, of which over 80% is in Italy, Greece, Spain and Portugal. The sector has been facing increasing competition in recent years from countries such as China, India and Brazil which have much lower labour costs. A number of recent initiatives, such as the Thematic Network on Ornamental Stones (OSNET)[46] and I-Stone[47], have significantly improved the competitiveness of the sector. They have improved production processes to reduce waste, and much of the waste which is produced is now processed to produce aggregates and other saleable products.

EU production trends between 1997 and 2001 are shown in Figure 3.9, illustrating the dominance of production in Italy, but also a steady increase in annual production in France, Portugal and Spain. However, much of this is traded within the EU, as raw stone, semi-finished or finished products - with 84% initially being consumed in Italy, Germany, Spain, Belgium, the UK and the Netherlands (see Figure 3.10). Much of this is then exported to other Member States or globally[48]. The Netherlands and Belgium, for example, are major traders in natural stone. Globally, the EU consumes 40% of all the natural stone produced, well ahead of any country elsewhere (e.g. China 11%, USA 7% and India 6%).

Consumption patterns appear relatively similar in different Member States, with approximately 36% being used in flooring and paving, 32% in special works, 12% in funerary art and the remainder in internal and external cladding and structural works (see Figure 3.11).

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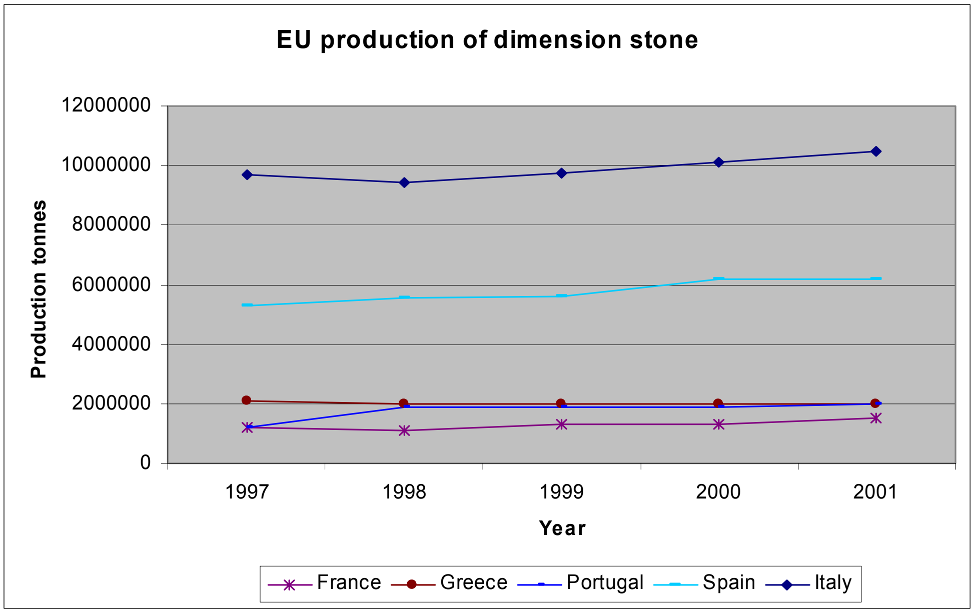
45 USGS Minerals Yearbook (2004): http://minerals.usgs.gov/minerals/pubs/commodity/stone_dimension/dstonmyb04.pdf.

46 http://ec.europa.eu/research/infocentre/article_en.cfm?id=/comm/research/industrial_technologies/articles/article_3589_en.html&item=Industrial%2520research&artid=1415.

47 http://www.istone.ntua.gr/.

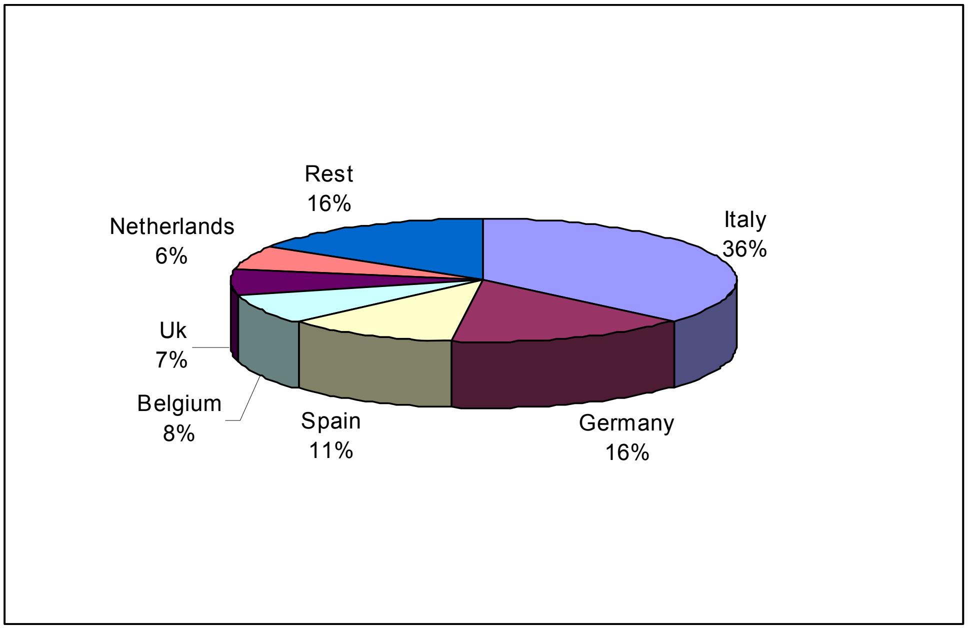
48 Euroroc – direct communication.

Figure 3.9. EU production of natural stone (1997-2001)



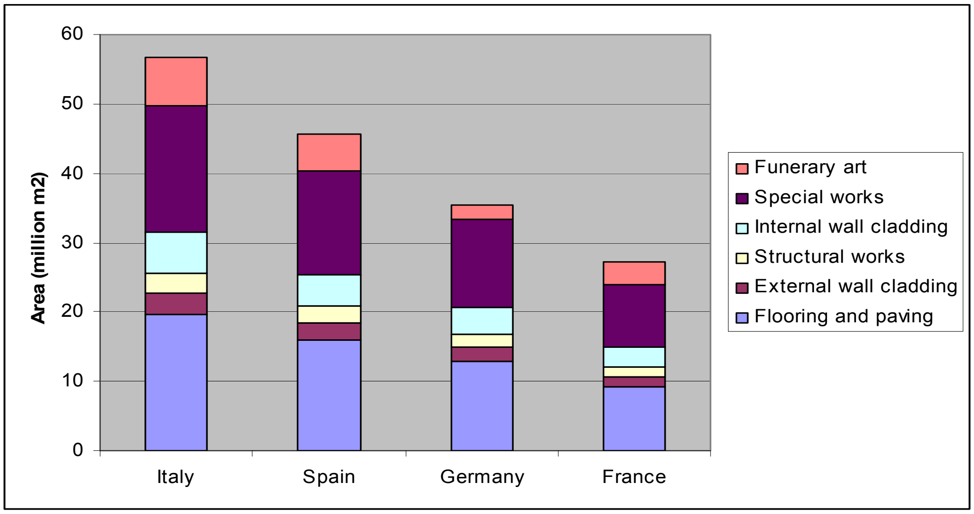
Source: OSNET website.

Figure 3.10. Initial consumption of natural stone in the EU (2005)



Data source: Euroroc.

Figure 3.11. Uses of natural stone in selected Member States



Data source: Euroroc.

One of the strengths of the industry within the EU is the very large number of old historic buildings requiring renovation. According to Euroroc, estimates of the number of stone monuments, buildings and pavements being considered for restoration range from 12 to 18 times the present annual consumption of stone within the EU.

3.3. Industrial minerals

Many industrial minerals are extracted within the EU to supply a very wide range of industries. Industrial minerals are generally low-priced ex-works commodities. In contrast to base and precious metals (see below), industrial minerals are not marketed or sold as standardised products via centralised markets, such as the London Metal Exchange (LME), but are sold directly to the formulator or end-user. The price of industrial minerals is usually negotiated between the buyer and the seller. A number of factors influence the negotiated price[49], including the:

- source of the mineral;
- volume required;
- grade/end-use;
- quality of the mineral, dictated by the desired end-use (some minerals can comprise 50 or more grades suitable for different end-uses);
- additional processing requirements;
- freight/shipping costs;
- port handling fees;
- warehousing/storage;
- mineral inspection costs;
- insurance; and
- relationship between buyer and seller.

[49] Mike O'Driscoll (2004). "The Economic Importance of Industrial Minerals". Proceedings of the IMA-Europe Conference "Industrial Minerals: Growing with Europe". Brussels, 2004.

The relatively high cost of transport has a significant impact on the delivery price to the end-user. This situation effectively limits the geographic availability of suitable resources.

As indicated earlier, industrial minerals are selected because of their particular physical and/or chemical properties. Some are important as sources of specific chemical elements or compounds, others because of a combination of physical properties, such as particle size and shape, natural and fired brightness (whiteness), plasticity, viscosity in suspension and density or a combination of physical and chemical properties (see Table 3.2). Some minerals have many grades – more than 50 in some cases (e.g. limestone) – which serve different markets and command different prices[50].

Table 3.2. Summary of some of the key physical or chemical properties of a range of industrial minerals[51]

Industrial mineral	**Physical properties**
Kaolin	Whiteness, fine particle size, rheology
Ball clay	Plasticity, unfired strength, white firing
Fuller's earth	Plasticity, bonding strength
Ground calcium carbonates	Whiteness, fine particle size, rheology
Barytes	High density, relative inertness and non-abrasiveness
Silica sand	Particle size and shape
Gypsum	Whiteness
	Chemical properties
Salt (NaCl)	Source of chlorine and soda
Potash	Source of potassium
Gypsum	Rehydration properties
Limestone	Source of lime and carbon dioxide
Dolomite	Source of magnesia
Fluorspar	Source of fluorine
Kaolin and ball clays	Low iron content
Silica sand	Source of silica
Fuller's earth	Cation-exchange capacity, chemically active surfaces

50 O'Driscoll, M. (2004). See footnote 47.

51 Source: Bloodworth et al. (2004). "Industrial minerals: Issues for planning." British Geological Survey Report CR/04/076N.

The EU is the world's largest producer of a number of industrial minerals and the second or third largest producer of a number of others (see Table 3.3). It accounts for 39% of the world's production of perlite, 36% of world production of feldspar and approximately a fifth of the world's mine production of bentonite, kaolin, salt and talc. Another notable point is that for the limited range of industrial minerals considered in Table 3.3, the two other dominant producers are China and the USA.

Table 3.3. Top three producing regions for selected industrial minerals

	First		Second		Third	
Bentonite	USA	32%	**EU**	**19%**	Turkey	7%
Feldspar	**EU**	**36%**	China	13%	Turkey	12%
Fluorspar	China	52%	Mexico	17%	**EU**	**8%**
Fuller's earth	USA	72%	**EU**	**12%**	Senegal	4%
Gypsum[52]	**EU**	**24%**	USA	16%	Iran	12%
Kaolin	USA	34%	**EU**	**23%**	Brazil	19%
Magnesite	China	47%	**EU**	**17%**	Turkey	15%
Perlite	**EU**	**39%**	China	20%	USA	15%
Potash	Canada	32%	**EU**	**16%**	Russia	16%
Talc	China	46%	**EU**	**20%**	USA	13%
Salt	**EU**	**21%**	USA	20%	China	16%

Source: DG Enterprise and Industry calculations based on BGS data.

Table 3.4 provides a brief summary of production, uses and competitiveness issues associated with the main industrial minerals extracted within the EU.

52 Included as an industrial mineral here.

Table 3.4. Summary of production of selected industrial minerals, their main downstream markets and factors identified as affecting demand

Mineral	EU mine production (and as % of global mine production) in 2003	Main uses/ downstream industries supplied	Factors affecting demand
Barytes	350 300 tonnes (5.6%)	Oil industry (drilling mud), chemicals, tiles and glass bricks. As a filler in paints, plastics, rubber and inks.	Growing demand for drilling quality barytes. In Europe the chemical and filler industries account for almost half the barytes consumption. In the USA over 90% of consumption is by the oil industry. Leading world producers: China, India and the USA.
Bentonite and Fuller's earth	3 380 400 tonnes (20%)	Used as a bonding material in preparation of moulding sands for production of iron, steel and non-ferrous castings; as a binding agent in production of iron-ore pellets; in civil engineering applications as a thixotropic, support and lubricant agent in, for example, diaphragm walls and foundations; as a sealing material in construction and rehabilitation of landfills; in the oils/food markets as a purifier; in agriculture, pharmaceuticals, cosmetics and medical markets; in detergents, paints, dyes and polishes; in cat litter; in paper manufacture and as a catalyst in a range of applications.	A fall in demand for iron-ore pelletisation in the early 1990s affected demand for bentonite.
Feldspar	5 456 900 tonnes (36.4%)	Ceramics, glass and also paints, plastics and rubber.	The performance of the ceramics and flat-glass industries are closely linked to construction activity and, therefore, general economic development. A very abundant mineral, therefore theoretical reserves are unlimited. Low value and abundance can make transport costs important.
Fluorspar	344 900 tonnes (7.8%)	Production of hydrofluoric acid which is used to produce other chemicals used in production of aluminium, steel pickling, enamelling, glass etching, etc. Glass and ceramics industries (as an opacifier) and metallurgy (fluxing agent for electric steel plants).	Uses have changed rapidly in response to technological developments. Changes in the smelting process for the iron and steel industry and aluminium production were predicted to reduce demand from these sectors. Chinese export quota identified as an issue.

Kaolin	5 080 200 tonnes (22.8%)	Manufacture of paper, ceramics, refractories, rubber, plastics, paint, cement and glass fibres.	Competition from other white minerals, particularly calcium carbonate and talc. Although widely distributed globally, only a small number of deposits are suitable for production of high-quality paper-coating grades (e.g. in the USA, UK, Brazil and Australia).
Industrial limestone	50 000 000+ tonnes	Production of lime – used in iron and steel production; cement, flue gas desulphurisation, drinking water treatment, chemicals industry, paper, food and healthcare.	
Magnesite	3 755 600 tonnes (17.5%)	Manufacture of refractory products (e.g. bricks). Also chemicals, paper and pulp, flue gas treatment and pharmaceuticals. Industries using fused magnesia.	Increasing quality demands of consumers in refractory industries have led to longer kiln life and therefore limited consumption growth. Chinese imports are seen as a problem (anti-dumping duty on imports from China since 1990s and new regulation adopted in May 2006), along with imports from Australia. Extractive industry in direct competition with identical products derived from chemical processes using brine and seawater as a basic material. If land-based resources were to become depleted, most products could be manufactured from brine and seawater.
Perlite	1 251 100 tonnes (38.5%)	Formed construction products, plasters, mortars, agribusiness/ horticulture, industrial filtration (food, beverages, wine, beer, pharmaceuticals, etc.), cement and thermal insulation products.	Linked mainly to construction activity. Trend towards lighter/insulating products on the construction markets. Although perlite is mainly mined and initially processed in Greece, Hungary and Italy, expansion (secondary processing) takes place closer to the final markets (all European countries). Logistics play an important role. Europe is a major exporter of perlite to the east coast of the USA, being more competitive than mines located in the west of the USA.
Potash	4 690 000 tonnes (16.5%)	Agriculture (fertiliser production). Also glassware, ceramics, batteries, drilling muds, soaps and detergents, pharmaceuticals and chemicals.	Agricultural land policies (e.g. CAP) affect use of fertilisers. Climate and farming practices also affect use. World markets are predicted to change as lower use of fertilisers in the EU contrasts with increased use in

			developing countries. Use of potash fertilisers in EU-25 fell from about 7.5 million tonnes in 1979 to approximately 3.5 million tonnes in 2002[53]. Use has increased in developing countries due to the increasing demand for food for a steadily growing population.
Talc	1 285 400 tonnes (20%)	Paper, plastics and paints. Also agribusiness, pharmaceuticals, ceramics, pesticides and fillers in rubber and asphalt roofing products.	Use of talc in the paper industry is being replaced by precipitated carbonates and kaolin which are cheaper. Production of plastics is using increasing amounts of talc, particularly for automobile construction and household appliances. There is competition from mica and other substitutes. Large reserves within the EU (particularly in France) and globally (China, India, Japan, USA and Brazil). Imports into the EU are mainly from China and Australia.
Salt	46 122 200 tonnes (21%)	Chemical industry (chlor-alkakli and other sectors), winter maintenance (de-icing), water treatment (softening and disinfection), food and feed industry and many other uses.	Economic situation of the chemical industry, winter weather, overcapacity within the EU and high imports into the EU. The industry is under pressure from overcapacity, high imports (about 25%), especially from eastern Mediterranean countries but also from South America. High energy costs for production (mining and evaporation) and transportation of salt (about 30 million tonnes) and for the industry's main customer - the chemical industry - with energy-intensive electrolysis.

Sources: European Minerals Yearbook 1996-1997; EULA; K+S-Schätzung; the Industrial Minerals Association website (http://www.ima-eu.org/en/index.htm); EuSalt.

53 FAO statistics.

Production trends

Mine production trends between 1992 and 2004 for each of the 12 industrial minerals covered in Table 3.4 can be seen in Annex 1, which shows the following details for each mineral:

(i) annual mine production in each of the main producing countries within the EU;

(ii) annual mine production in the EU and in the main non-EU producing countries; and

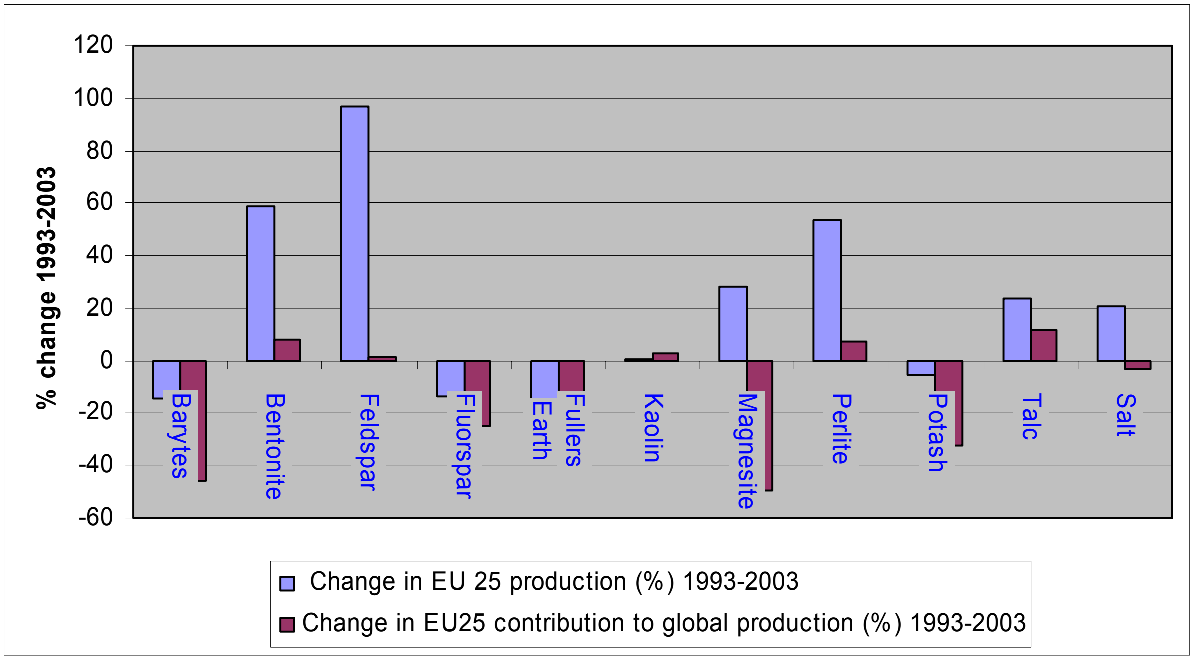
(iii) the contribution that the EU made to global mine production in those years.

To provide a general indicator of recent changes in EU mine production and the contribution that the EU made to global production, data for 2003 were compared with 1993. The results are presented as the percentage change over that period for both indicators in Figure 3.12. Figures above zero indicate an increase in EU mine production (light bar) or an increase relative to changes in global production (dark bar) in 2003 compared with 1993. Figures below zero indicate relative decreases.

The results indicate that EU mine production of bentonite, feldspar, magnesite, perlite, talc and salt were all higher in 2003 than in 1993, while production of barytes, fluorspar, Fuller's earth and potash fell. The trend in the EU contribution to world production over the period was upwards for some minerals (e.g. bentonite, feldspar, kaolin, perlite and talc) but significantly downwards for others, in particular for barytes, fluorspar, magnesite and potash.

The explanations for the observed trends differ for each mineral type, as indicated in the fourth column of Table 3.4. In some cases they are the result of a change in demand from downstream sectors. Demand for barytes, for example, is closely linked to the level of oil well drilling activity, while demand for potash, the main source of potassium in fertilisers, is affected by changing agricultural practices in the EU (a general reduction in use) and in developing countries (a general increase). Demand for potash produced in the EU was also significantly affected by the loss of former eastern bloc markets (e.g. Russia and Ukraine) for East German potash following the reunification of Germany. In other cases increased mine production in some developing countries has not only increased the global supply, putting pressure on EU exports, but also led to direct competition within the EU. Chinese magnesite is a good example of this.

Figure 3.12. Change in EU production (%) of selected industrial minerals between 1993 and 2003 and change in EU's percentage share of global mine production



Data sources: BGS and Euromines (perlite). Calculations by DG Enterprise and Industry.

Overall the results suggest that over the last ten years or so EU production of most industrial minerals has remained relatively stable, while for some increases of over 20% have been recorded. However, it should be recognised that the overall picture at EU level masks variations at national and, particularly, company level. This is probably truer for industrial minerals than for the other two sub-sectors because of the wide variations in the grade of minerals found at different sites and, hence, their applications and markets.

3.4. Metallic minerals

The extractive industry mines metallic ores and usually undertakes the initial processing, such as milling, to reduce the bulk and concentrate the ore before it is transported to a smelter for further processing. There is much more global trade in metallic minerals than in industrial or construction minerals. For many, prices are set by central exchanges, such as the London Metal Exchange (LME).

Global demand for metallic minerals

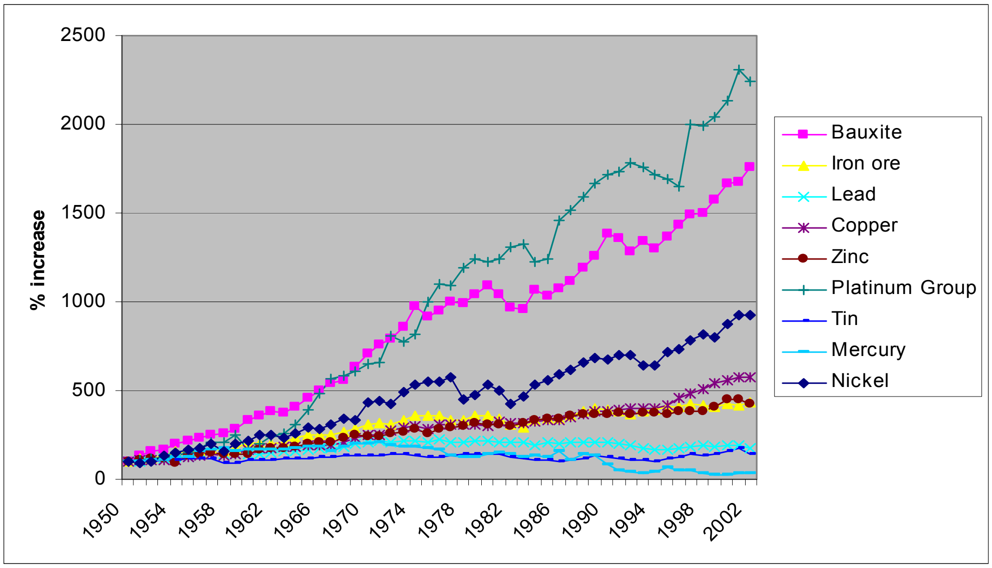
Global mine production of many metallic minerals has increased significantly since the middle of the 20th century (see Figure 3.13). Metal markets have changed rapidly in recent years, as a result both of new producing countries entering the market and fast economic growth in developing countries such as China and India. Huge demand for metals in China has led to big increases in global metals prices, especially since 2003.

There are, however, notable differences between the trends for different minerals. Global mine production of mercury, for example, has fallen to only 36% of 1950 levels, while tin and lead production have increased by relatively modest amounts (140% and 177% respectively). By contrast, mine production of copper, zinc and iron ores has increased by around 400% to

500%, nickel by 900% and mine production of platinum group metals and bauxite by around 2 000% over the same period.

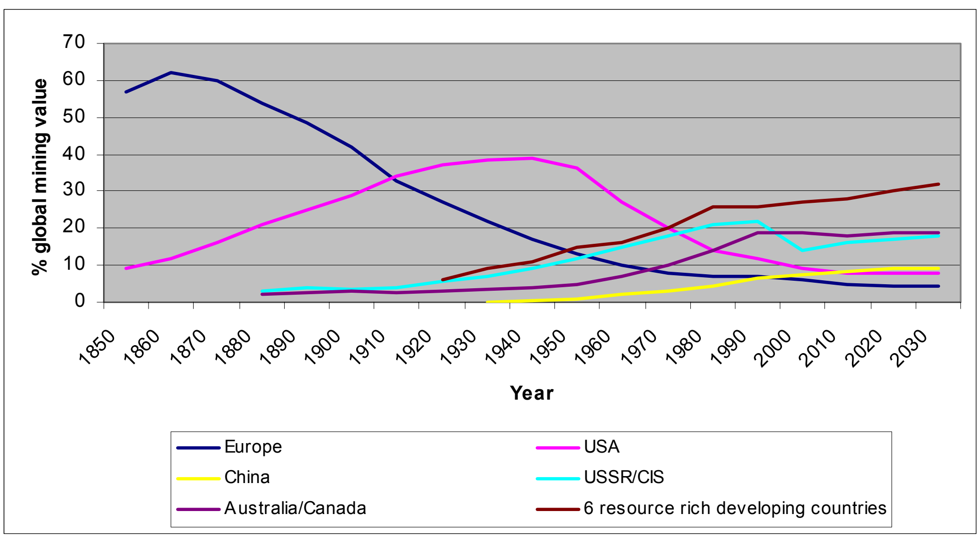
Figure 3.14 illustrates the changing dominance of different metal-mining regions in the world from the mid-19th century to the present and the forecasts (by the Raw Materials Group) to 2030, based on the location of new projects expected to start within the next 10 years. The graph is based on a calculation of the total value of all non-fuel minerals produced globally every 10th year. The growing importance of China, Australia, Canada and a number of developing countries (the six resource-rich countries are Chile, Peru, Brazil, the Congo, Zambia and South Africa) contrasts with the relative decline in production in Europe, Russia and the USA.

Figure 3.13. Relative change in global production of metallic minerals between 1950 and 2002 (1950=100)



Data source: DG Enterprise and Industry calculations based on USGS data.

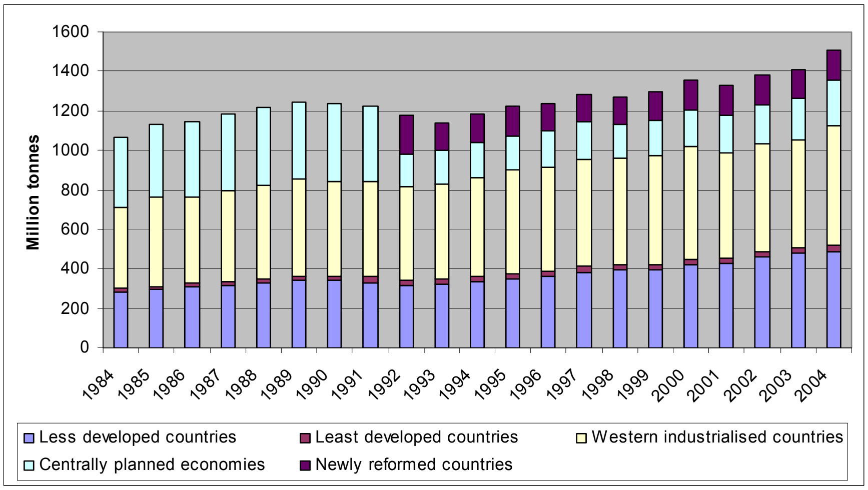
Figure 3.14. Trends in global metal mining since 1850



Data source: W. Sames (to 1975) and Raw Materials Group (to 2000 and forecast to 2030).

Figure 3.15 provides an analysis of annual global production of industrial minerals and metallic ores (measured as metal content and including iron, ferro-alloys and non-ferrous metals), based on the level of economic development of the producing countries (drawn mainly from UNCTAD classifications[54]). The growing importance of the "less developed countries", which include Chile, Peru and Brazil, can clearly be seen, while the "least developed countries" which comprise mainly African countries remain at a low level.

Figure 3.15. World mine production based on the development status of the producer country



Source: Weber, L. and Zsak, G. World Mining Data 2006.

Table 3.5 provides a ranking of the main producing countries of metals which are also extracted in the EU. Australia, China, Peru and South Africa are most frequently listed, although for particular metallic minerals other countries are important producers (e.g. Chile for copper, Brazil for iron ore and Russia for nickel).

Table 3.5. Top three producing regions for selected metallic minerals (2004)

	First		Second		Third	
Bauxite	Australia	40%	Guinea	12%	Jamaica	10%
Cadmium	Japan	22%	China	20%	Mexico	12%
Chromium	South Africa	53%	Kazakhstan	18%	India	8%
Copper	Chile	37%	USA	8%	Peru	7%
Iron ore	Brazil	23%	Australia	20%	China	14%
Lead	China	30%	Australia	21%	USA	14%
Manganese	China	24%	Gabon	17%	South Africa	13%
Mercury	**EU**	43%	Kyrgyzstan	26%	China	23%
Nickel	Russia	24%	Australia	14%	Canada	14%
Silver	Mexico	16%	Peru	15%	Australia	12%
Tungsten	China	87%	Russia	6%	**EU**	4%
Zinc	China	26%	Peru	14%	Australia	14%

Data source: World Mining Data (2006).

54 See World Mining Data 2006 for a full list of countries included in each category: http://www.bmwa.gv.at/NR/rdonlyres/575E7B7D-A453-4FE3-BDAC-2BA15980DA87/0/WMD2006.pdf.

Demand and production in the EU

The main initial markets for metal ores and concentrates in the EU are the refining and processing sectors which produce semi-finished and finished products for many sectors of manufacturing industry. The EU is the second largest producer of iron and steel products, after China, and also has large refining capacities for processing non-ferrous ores and concentrates and for recycling secondary metals. Demand from manufacturing industry and the construction sector in the EU has been strong and increasing in recent decades. In 2003 the EU metals industry, for example, employed over 1 million people and had a turnover of €227 billion[55].

The summary of the main metallic minerals extracted in the EU and their uses in Table 3.6 illustrates that many metallic minerals are extracted within the EU, although for most the amounts are relatively small compared with total global production. Graphs showing annual production of 12 of these metals (asterisked in Table 3.6) from 1992 to 2004 in different Member States and globally are presented in Annex 1.

Table 3.6. Mine production of selected metals in the EU, the EU's contribution to global mine production and examples of the wide-ranging uses of metals

Metal	EU mine production (metal content) in 2003 (tonnes)	EU production as % of global mine production (2003)	Uses
Arsenic	2 100	5.7%	Wood preservatives, fertilisers, fireworks, herbicides and insecticides. Alloy in ammunition and solders. Semi-conductors for telecommunications, solar cells and space research.
Bauxite*	3 251 900	2.1%	Production of aluminium. Important in the automobile industry and also in the building sector, aircraft manufacture, pharmaceutical and hospital equipment, food packaging, high-voltage cables and wires.
Cadmium*	1 674	9.6%	Batteries, pigments, coating and plating, plastic stabilisers and non-ferrous alloys.
Chromium*	549 040	3.4%	Chemicals, metals and refractory materials. Used in iron, non-ferrous alloys and steel to enhance hardness and resistance to corrosion. Also steel alloys, catalysts, leather processing, pigments and plating of metals.
Copper*	682 311	5.0%	Production of electrical cables and wires, plumbing, heat-exchangers in fridges, in roofing and building construction, chemicals, pharmaceuticals and electrical machinery, in alloys, alloy castings and electroplated protective coatings.
Gold	15	0.6%	Jewellery, bullion and industrial applications, including high-quality electrical circuitry.

55 Eurostat.

Iron ore*	24 340 028	2.0%	Steel production.
Lead*	163 127	5.4%	Lead-acid batteries, sheathing cables and roofing, pigments, glass, ammunition and ceramics.
Lithium	418	3.0%	Ceramics, glass, aluminium production, lubricants and greases, rechargeable batteries and synthetic rubber.
Manganese*	48 763	0.2%	Steel production, dry batteries, additives in paints, brick colouring, fertilisers and pet food.
Mercury*	770	38.5%	Electrical and electronics uses, production of chlorine and caustic soda and batteries.
Nickel*	22 800	1.7%	Production of stainless steel, non-ferrous alloys, steel alloys, foundry products, plating, rechargeable batteries and catalysts.
Selenium	430	25.2%	Glass manufacture, chemicals and pigments, electronics, agriculture and metallurgy.
Silver*	1 750	9.3%	Precious metal and photography.
Strontium	152 383	28.3%	Television tubes, magnets and fireworks.
Tin	203	0.1%	Tinplate for food and beverage containers, alloys and solders.
Tungsten*	2 096	4.6%	Electrical applications, super alloys, cutting tools for metal working, drilling for oil and gas, mining and construction.
Zinc*	816 099	8.5%	Production of galvanising and die-casting alloys. Constituent of brass and bronze. Used to protect steel and as sheets for roofing and rainwater systems. Electric fuel zinc-air battery.

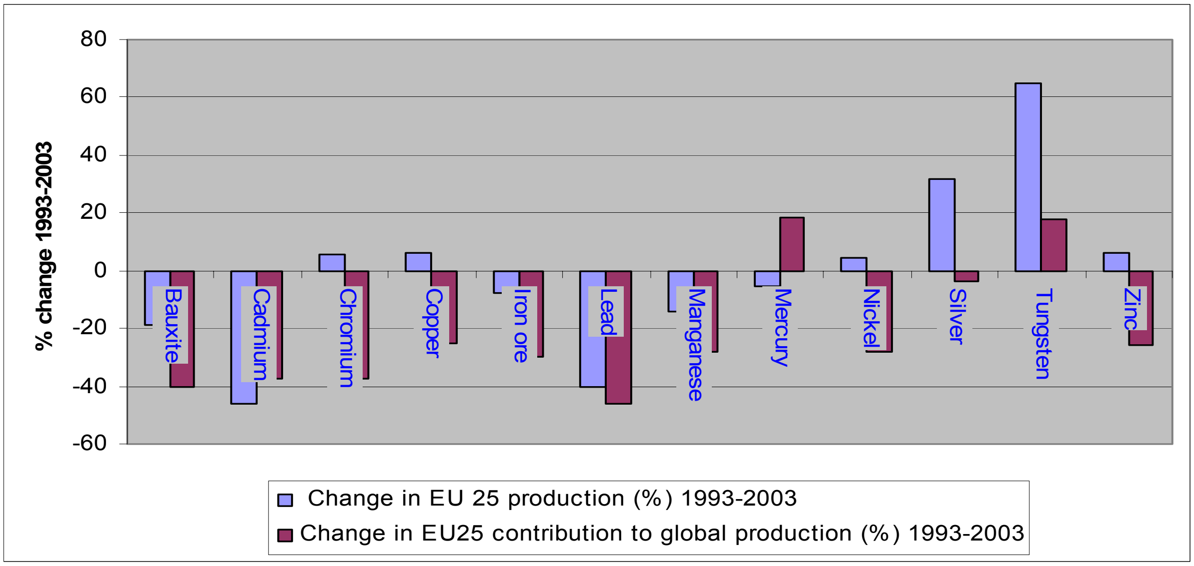
Statistical data source: BGS. Summary of uses taken from various sources.

Analysis of changes in mine production of these 12 metals in the EU and globally between 1993 and 2003 indicates that production of chromium, copper, nickel, silver and tungsten was higher in 2003 than in 1993. Production of bauxite, cadmium, iron, lead, manganese and mercury all fell (see Figure 3.16). Gold production within the EU is expected to increase as a number of gold mines will start operations within the next few years. Greece, for example, has identified proven reserves of about 10 million ounces[56].

However, despite increases in EU production of some metals, the rate has been lower than the global rate of increase, with the result that for all but two metals (mercury and tungsten) production in the EU has decreased relative to global production (and EU production of mercury virtually ceased after 2003).

[56] EuroGeoSurveys – direct communication.

Figure 3.16. Change in EU production (%) of selected metallic minerals between 1993 and 2003 and change in the EU's percentage share of global mine production



Data source: BGS. Calculations by DG Enterprise and Industry.

Metals not mined in the EU

A number of other metals required by European downstream industries are not mined within the EU. These include antimony, beryllium, boron, cobalt, molybdenum, niobium, platinum and palladium ores, rare earths, rhenium ore, tantalum, ilmenite, rutile and vanadium. Table 3.7 illustrates the important uses of many of these metals (particularly for "high-tech" applications) and the global distribution of reserves[57]. Most of them have not been found in the EU in quantities economically viable for extraction. The same table also illustrates that the known distribution of some metallic minerals, such as platinum group metals, niobium and vanadium, is highly concentrated in a very limited number of countries. South Africa, for example, is thought to possess almost 90% of the world's reserves of platinum group metals (used as catalysts), Brazil has over three quarters of the world's niobium (used in special steels and super alloys), while Russia, South Africa and China combined share almost all of the world's reserves of vanadium (used in alloys and as a catalyst). China already controls 90% of world tungsten production.

Table 3.7. Metals which are not mined in the EU, indicating the countries with significant known reserves, and summary of their uses

Mineral	Uses and production	Share of global reserves
Antimony	Alloyed with lead to increase hardness and strength, used in semi-conductors and flame retardants. China accounted for 86% of mine production (2002), although antimony can be produced as a by-product of lead refining. Imported into the EU as ore, metal or oxide.	China (43%), Russia (17%), Bolivia (15%), South Africa (12%), Kyrgyzstan (6%)
Beryllium	A lightweight, high-strength metal with high thermal conductivity. Used in electronic components, electrical equipment and aerospace and defence applications. Portugal is thought to possess approximately 0.2% of global reserves.	Brazil (32%), India (15%), China (11%), Russia (11%), Argentina (6%), USA (4%)
Bismuth	Used in pharmaceuticals and as a metal in fusible (low-melting) alloys. Mexico and China accounted for 59% of world production in 2002. Can be produced as a by-product of lead and zinc refining. Bulgaria and Romania both mine bismuth.	China (18%), Australia (16%), Peru (10%), Bolivia (9%), Mexico (9%), USA (8%), Japan (8%)
Boron (Boric oxide)	Glass manufacture (particularly fibreglass) and ceramics. Turkey is the world's largest producer.	Russia (24%), USA (24%), Turkey (18%), China (16%), Kazakhstan (8%), Chile (5%)
Cobalt	Used in steel alloys, super alloys, magnet alloys, batteries, catalysts and as the cement for carbides in tools. Also used in pigments and paint-dryers. Mine production is dominated by just five countries (Zambia, Democratic Republic of Congo, Canada, Russia and Brazil).	Congo (44%), Cuba (22%), Australia (15%), Zambia (8%), New Caledonia (5%)

57 The USGS defines reserves as the recoverable materials in the reserve base that can be economically extracted or produced at the time of determination, where the reserve base is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated, including those resources that are currently economic (reserves), marginally economic (marginal reserves) and some that are currently sub-economic (sub-economic reserves).

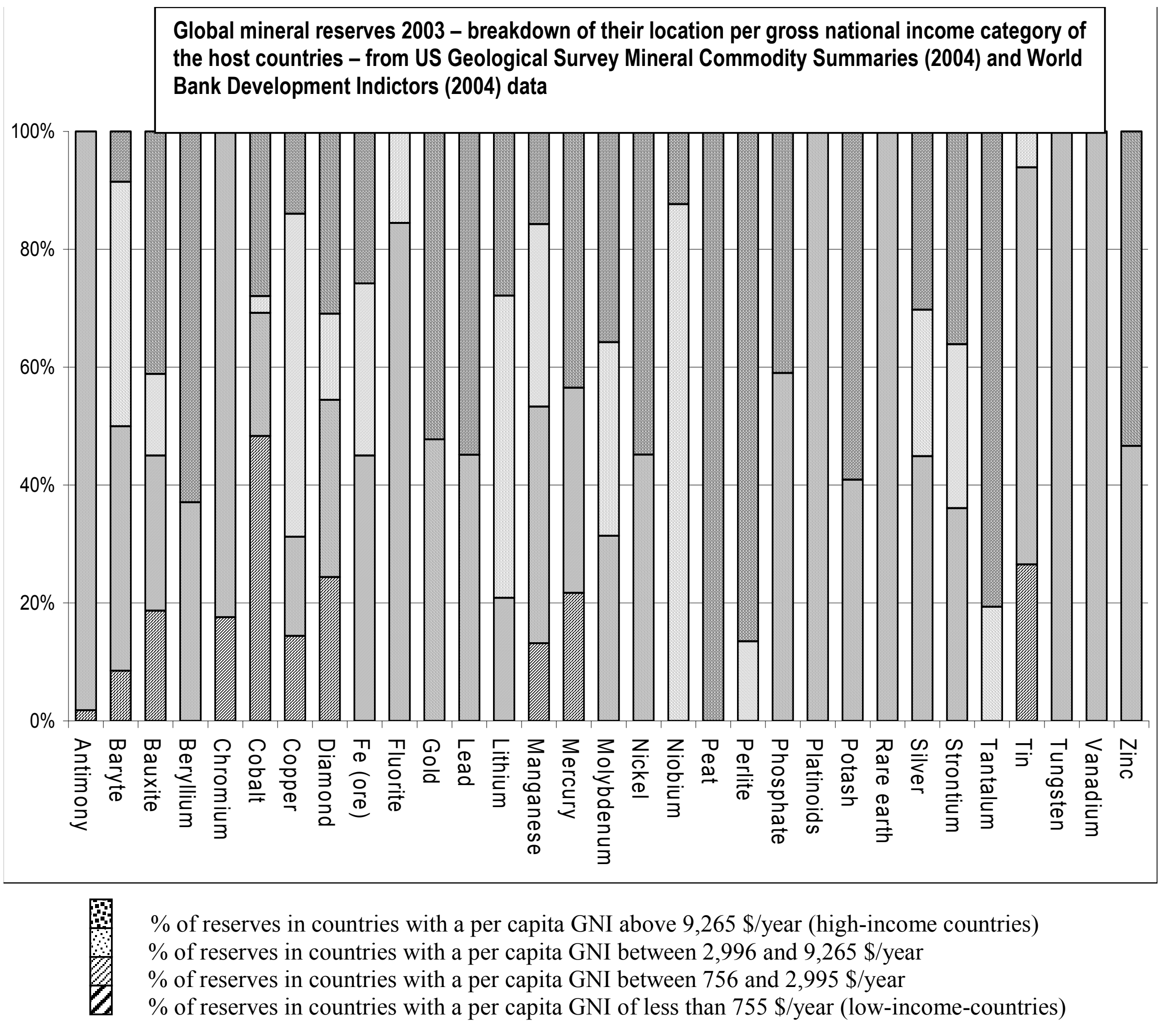
	Belgium and Finland produce significant quantities of cobalt metal from imported ores, while the UK, Finland and France produce significant quantities of cobalt compounds. Often mined as a by-product of other metals (copper, nickel, platinum, silver or zinc). Finland has 0.5% of global reserves.	
Molybdenum	Used in high-tensile steel to impart hardness, tolerance to high temperatures and resistance to corrosion. It is usually produced as a by-product of copper mining. Production in 2002 was confined to 13 countries, of which the USA, Chile and China accounted for 75% of global production.	USA (49%), Chile (20%), China (9%), Canada (8%), Russia (4%)
Niobium	A soft ductile metal used mainly in special steels and super alloys. Brazil produces approximately 85% of the global total.	Brazil (77%), Russia and other CIS countries (16%)
Platinum group	Used as catalysts (e.g. catalytic converters in cars), in electronics and jewellery. The largest producers in 2002 were South Africa (61%, mainly platinum) and Russia (27%, mainly palladium). Finland is thought to possess approximately 0.1% of global reserves.	South Africa (89%), Russia (9%)
Rare earth elements	A group of 15 metallic elements, of which cerium, lanthanum and neodymium are the most commonly used. Used in automobile catalysts, as metallurgical additives and in glass and ceramics. China produces more than 90% of the global total. Finland and Sweden combined are thought to have relatively small amounts (<0.01% of global reserves).	China (42%), Russia and the former Soviet Union (18%), USA (17%), Australia (5%)
Rhenium	The main uses are in high-temperature super alloys and petroleum refining.	Chile (52%), USA (15%), Russia (12%), Kazakhstan (8%)
Tantalum	A heavy, very hard, ductile metallic element with a very high melting point (2 996°C) and strong resistance to chemical attack. Used in electronic applications, especially miniature capacitors. Global production dominated by Australia (60%).	Australia (41%), Nigeria (18%), Canada (17%), Congo (11%), Brazil (5%)
Tellurium	Mainly recovered from the anode slimes obtained from the electrolytic refining of copper. Used in iron and steel products, non-ferrous metal alloys, electronics and photoreceptors, catalysts and chemicals, including rubber.	Chile (28%), USA (15%), Zambia (10%), Zaire (9%)
Titanium (ilmenite) (Rutile)	A low-density, strong and corrosion-resistant metal used in the aerospace industry. Most (94%) is used as titanium dioxide as a pigment in paint, plaster, rubber and paper. Finland is thought to possess approximately 0.3% of global reserves.	Australia (25%), South Africa (19%), Norway (12%), Canada (9%), China (9%), Brazil (5%), USA (4%) Australia (39%), South Africa (19%), India (15%), Sri Lanka (11%), Sierra Leone (7%), Ukraine (6%)
Vanadium	A soft ductile metallic element that is highly corrosion-resistant. Mainly used as an additive in steel alloys to which it imparts strength and corrosion resistance. Also used in titanium alloys and as a catalyst. China produces 50% of the global total.	Russia (50%), South Africa (30%), China (20%)

Data and information sources: Crowson – Minerals Handbook 2000-2001; USGS and BGS.

A number of other metals are recovered as by-products of other activities. Gallium, for example, can be recovered as a by-product of production of alumina from bauxite and smelting of zinc ores. Germanium is obtained as a by-product during processing of zinc or copper-zinc ores and some coals, while indium is a by-product of processing zinc ores and is also found in some copper, lead and tungsten ores.

The United States Geological Survey Mineral Commodity Summaries[58] show the location of the known reserves of 28 minerals considered essential to the economy[59]. Figure 3.17 shows the location of these reserves broken down by the per capita gross national income (GNI) of the countries in which these reserves are located. Over 40% of the known reserves of 22 of these minerals are located in countries with a per capita GNI of less than about €6.5.

Figure 3.17. Location of the reserves of some economically important mineral reserves[60]



58 http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf.

59 EuroGeoSurveys.

60 After Christmann P. "Towards an EU Thematic Strategy on the Sustainable Use of Natural Resources: sustainability issues related to the EU minerals and metals industry." Paper presented at the Second Sustainable Development Indicators for the Mining Industry (SDIMI) Conference, Aachen, 2005.

This raises important policy and sustainable development issues relating to security of supply[61]. There are two specific concerns:

- Geopolitical issues: such countries may acquire distinct bargaining power based on their control of essential resources. They may also be exposed to political instability. Due to its already high, and growing, dependence on mineral imports, Europe is increasingly exposed to the political agendas of its suppliers;

- Sustainability issues: such countries face a wide range of development problems and are less likely to be able to allocate the resources necessary for environmentally and socially efficient regulation of their mineral resources sector.

61 EuroGeoSurveys.

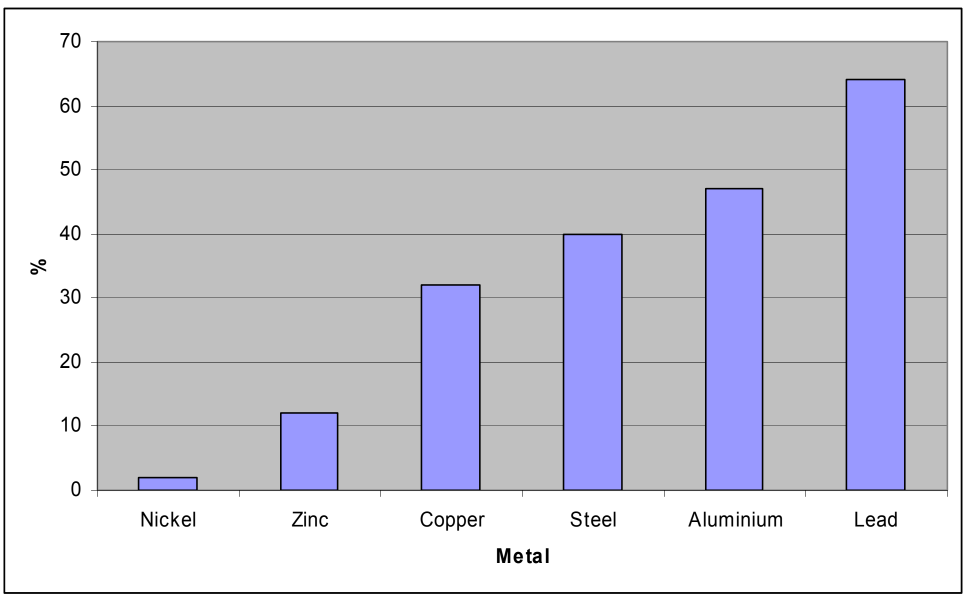
– <u>Role of metal recycling</u>

Of the three sub-sectors, metals present the biggest opportunities for using recycled materials (e.g. scrap). Many metals, including iron and steel, copper, tin, lead and aluminium, are relatively simple to recycle as they can be melted and recast without losing their important characteristics. Lead scrap (e.g. from car batteries), for example, accounts for around 64% of lead consumption in the EU. Recycled aluminium, steel and copper also make significant contributions to total supply within the EU[62] (see Figure 3.18).

The example in Figure 3.19 illustrates the scale of imports of bauxite and aluminium into the EU, but also the contribution that domestic sources of bauxite and recycling of aluminium make to the total supply of aluminium used by EU fabrication plants. It also illustrates the value chain from mining through refining to metal production and fabrication.

While recycled metal can make an important contribution to meeting demand, in a growing economy there is a limit to the extent to which it can contribute to materials supply. It will be affected by the amount of material originally used and by its lifetime in use. Metals contained within articles with a short life and high recovery rates will satisfy more of the demand for a particular material than those present in longer lived articles.

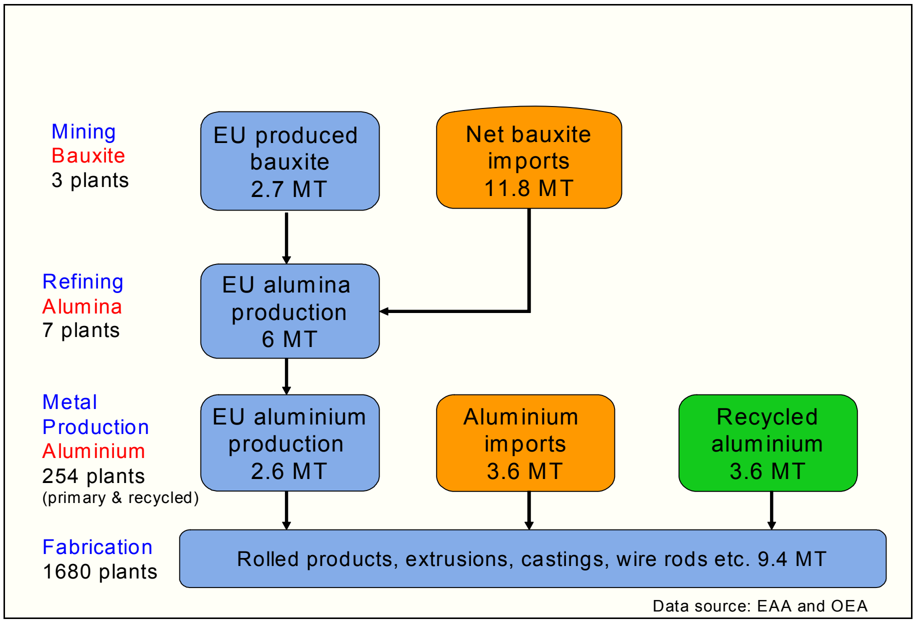
Figure 3.18. Percentage of refined metal in the EU which originated from external scrap in 2003



Source: EUROMETAUX and EUROFER.

[62] Commission Staff Working Document SEC (2006) 1069. See footnote 16 for full reference.

Figure 3.19. Global supply chain of minerals and metals to fabricate aluminium products in the EU



Sources: European Aluminium Association (EAA) and Organisation of European Aluminium Refiners and Remelters (OEA).

4. INTERNATIONAL TRADE IN MINERALS

4.1. Introduction

Section 3 has already illustrated the vital importance of minerals to the manufacturing and construction industries in the EU and highlighted different trends in European production of individual minerals and the extent to which the EU is dependent on imports. This section focuses on trade in minerals between EU-25 and non-EU countries (but not between Member States). It covers the period 1999-2004 and is based on data provided by Eurostat.

The figures include minerals which were imported into the EU and then exported and vice versa. The extent to which this occurs is not known. However, it is thought to have the most effect on NACE class CB14.5 ("other mining and quarrying") which includes very high-value, low-weight minerals such as diamonds which are imported into the EU and then re-exported. Other analyses in this assessment have included category CB14.5 within "industrial" minerals, but in this chapter it is separated to prevent excessive distortion of the picture for trade in industrial minerals mined in the EU.

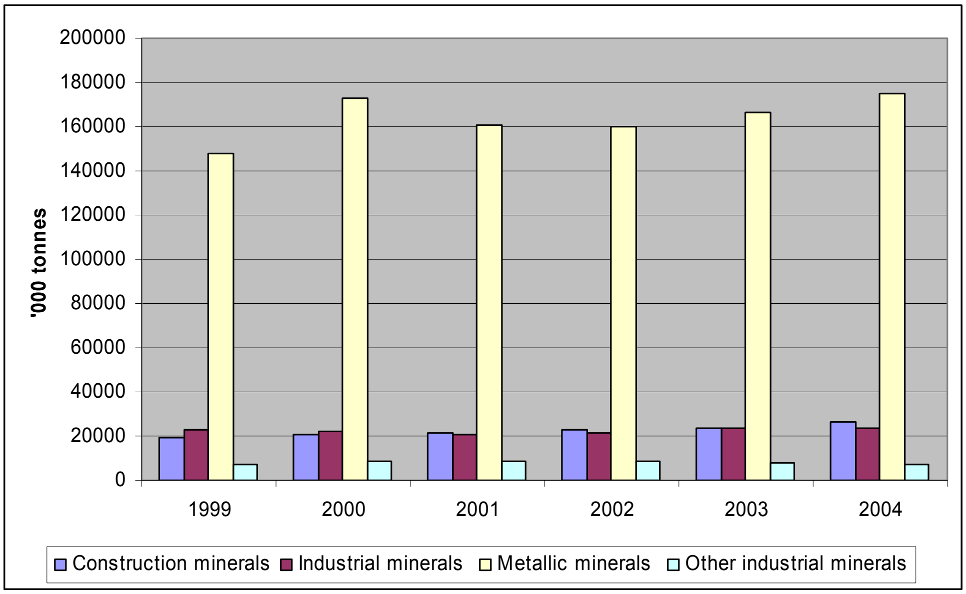
4.2. Imports

General picture

In 2004 over 232 million tonnes of minerals were imported into the EU, worth a total of €23 billion. Metallic minerals accounted for 76% of the weight and 45% of the value. Industrial minerals (excluding NACE CB14.5) accounted for 10% of the weight and almost 6% of the value and construction minerals 11% and 5% respectively. "Other industrial minerals" accounted for 3% of the weight but 44% of the total value.

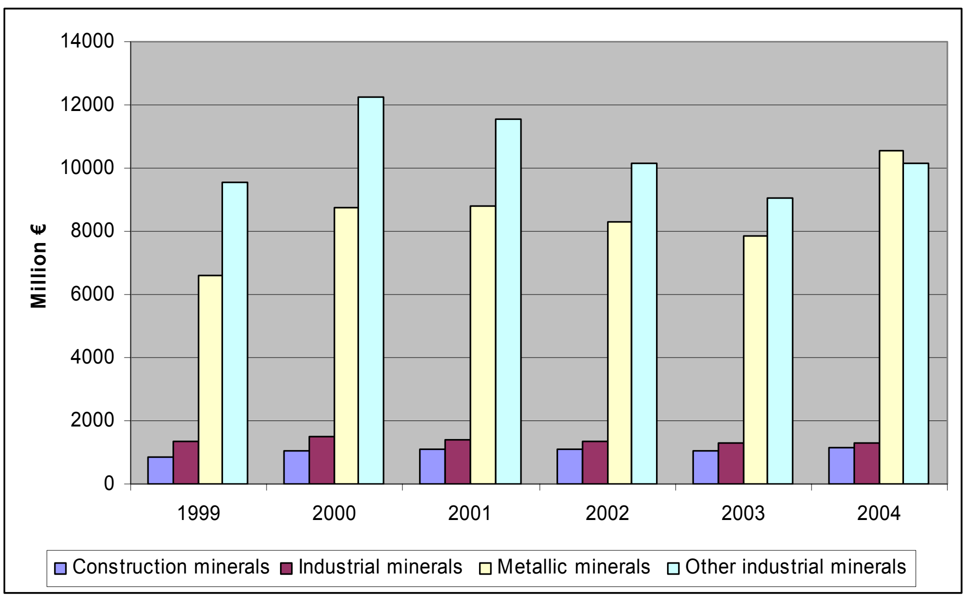
The quantity (weight) of imports was 17.5% greater in 2004 than in 1999, while the value was 26% greater. The most significant increases were in the value of metallic minerals (up by 60%), although the weight increase was only 18% (presumably reflecting recent increases in world metal prices), and in construction materials (37% increase in weight). While there was a modest increase in imports of industrial minerals (less than 4% by weight), the overall value fell by 5% compared with 1999 (see Figures 4.1 and 4.2).

Figure 4.1. Annual imports of minerals into the EU, 1999-2004 – by weight ('000 tonnes)



Data source: Eurostat.

Figure 4.2. Annual imports of minerals into the EU, 1999-2004 – by value (million €)



Data source: Eurostat.

Imports of construction minerals

Assessment of the countries of origin of imported construction minerals (see Table 4.1) indicates that 50% of imports (by weight) originated from Norway (13 million tonnes), with a further 12% from Croatia. In terms of value, the three main exporting countries in 2004 were Norway (29% or €333 million), India (15% or €173 million) and Brazil (10% or €111 million). Table 4.1 also indicates that the value of imports from Turkey, China, Croatia and Egypt has more than doubled since 1999. Although imported construction minerals cover only a small percentage of EU consumption (less than 1% by weight), concerns have been voiced about the increasing level of imports of particular forms of construction mineral, for example natural stone, from countries such as China, India and Brazil.

Table 4.1. Origin of imports of construction materials (NACE 14.1 and 14.22) into the EU in 2004

Country of origin	**Weight**			**Value**		
	Thousand tonnes	% of total imports	% change 1999-2004	Million €	% of total imports	% change 1999-2004
Extra-EU-25	26 283		36.8	1 160		33.3
Norway	13 130	50.0	30.4	333	28.7	42.7
India	1 049	4.0	37.0	173	14.9	15.2
Brazil	501	1.9	-20.3	111	9.6	-29.1
South Africa	473	1.8	-19.9	94	8.1	-7.5
Turkey	619	2.4	349.1	66	5.7	244.8
China	233	0.9	113.5	55	4.8	109.8
USA	299	1.1	-77.2	51	4.4	4.7
Croatia	3 061	11.6	46.2	40	3.5	117.1
Egypt	748	2.8	133.1	32	2.8	103.3
Zimbabwe	97	0.4	1 074.2	22	1.9	990.1

Data source: Eurostat.

Imports of industrial minerals

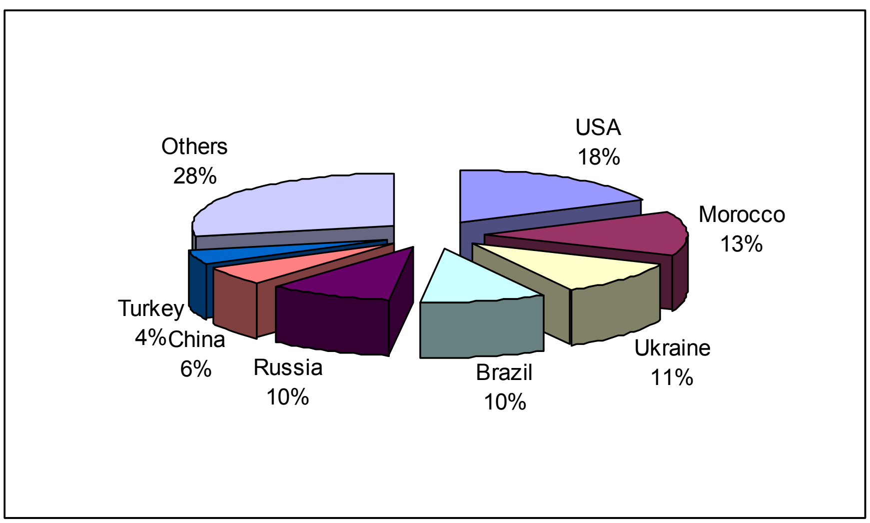
Data on imports of industrial minerals are presented in Table 4.2. Almost 18% of imports came from the USA with a value of €233 million. Morocco, Ukraine, Brazil and Russia each accounted for more than 10% of the total value (see Figure 4.3). Imports from Ukraine, Brazil and Tunisia all increased significantly. Although China supplied only 6% of the imports of industrial minerals in 2004 (by value), this marked a 41% increase since 1999.

Table 4.2. Origin of imports of industrial minerals (NACE 14.22, 14.3 and 14.4) into EU-25 in 2004

Country of origin	Weight			Value		
	Thousand tonnes	% of total imports	% change 1999-2004	Million €	% of total imports	% change 1999-2004
Extra-EU-25	23 724		3.7	1 307		-4.7
USA	1 229	5.2	-22.0	233	17.8	-17.2
Morocco	4 540	19.1	4.5	174	13.3	-19.3
Ukraine	4 081	17.2	92.2	140	10.7	86.4
Brazil	1 205	5.1	62.9	134	10.3	20.4
Russia	2 405	10.1	-24.3	130	10.0	-25.3
China	644	2.7	13.0	75	5.7	41.3
Turkey	584	2.5	-5.3	53	4.0	-40.0
Norway	1 286	5.4	-27.7	49	3.7	3.5
South Africa	236	1.0	-61.4	40	3.0	-26.5
Tunisia	976	4.1	65.5	33	2.5	34.0

Data source: Eurostat.

Figure 4.3. Main sources of imports of industrial minerals[(1)] by value (2004)



(1) Excluding NACE category CB14.5. Data source: Eurostat.

Imports of metallic minerals

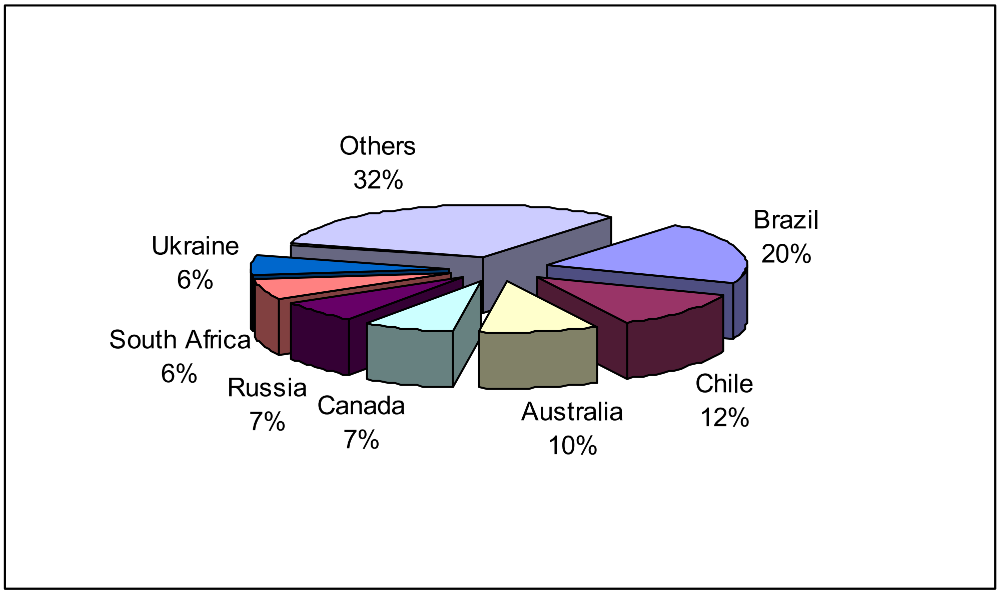
Data on imports of metallic minerals into the EU are presented in Table 4.3. The main supplier of metallic minerals to the EU is Brazil, accounting for 41% in terms of weight and 20% of value. While Chile accounts for less than 1% in terms of weight, it takes almost 12% of the total value. Imports from Australia, Canada, Russia, South Africa and Ukraine are also significant (see Figure 4.4). Perhaps the most significant observation is the change in the value of the imports since 1999. While the overall value increased by 60%, the equivalent figures for China were 357%, for Chile 268% and for Russia 251% (see Table 4.3). In terms of weight, the greatest percentage increases were in imports from Russia (85%), Peru (49%), Brazil (46%) and China (35%). Imports from Australia decreased by almost 22% in terms of weight, but increased by almost 19% in value.

Table 4.3. Origin of imports of metalliferous minerals (NACE 13.1 and 13.2) into EU-25 in 2004

Country of origin	**Weight**			**Value**		
	Thousand tonnes	% of total imports	% change 1999-2004	Million €	% of total imports	% change 1999-2004
Extra-EU-25	175 288		18.3	10 541		60.1
Brazil	71 093	40.6	46.0	2 075	19.7	65.2
Chile	1 097	0.6	-4.0	1 227	11.6	267.5
Australia	17 101	9.8	-21.6	1 046	9.9	18.7
Canada	11 963	6.8	-9.8	781	7.4	2.0
Russia	12 180	6.9	85.2	717	6.8	251.2
South Africa	8 479	4.8	21.9	664	6.3	34.1
Ukraine	13 544	7.7	16.4	625	5.9	148.8
Peru	995	0.6	48.7	411	3.9	109.2
China	651	0.4	34.6	333	3.2	356.7
USA	665	0.4	30.3	322	3.1	35.5

Data source: Eurostat.

Figure 4.4. Main sources of imports of metallic minerals in 2004 based on value



Data source: Eurostat.

4.3. Exports

General picture

The EU exported 28.7 billion tonnes of minerals in 2004 (see Figure 4.5) worth a total of €12 billion (see Figure 4.6). However, over €10 billion (86%) of this was classified as "other industrial minerals" (NACE 14.5) and is thought to reflect the value of re-exported precious stones such as diamonds. Construction materials accounted for 49% of exports by weight but only 6% by value. Overall, exports increased by 17% by weight and 31% by value in 2004 compared with 1999.

Figure 4.5. Annual exports of minerals from the EU, 1999-2004 – by weight ('000 tonnes)

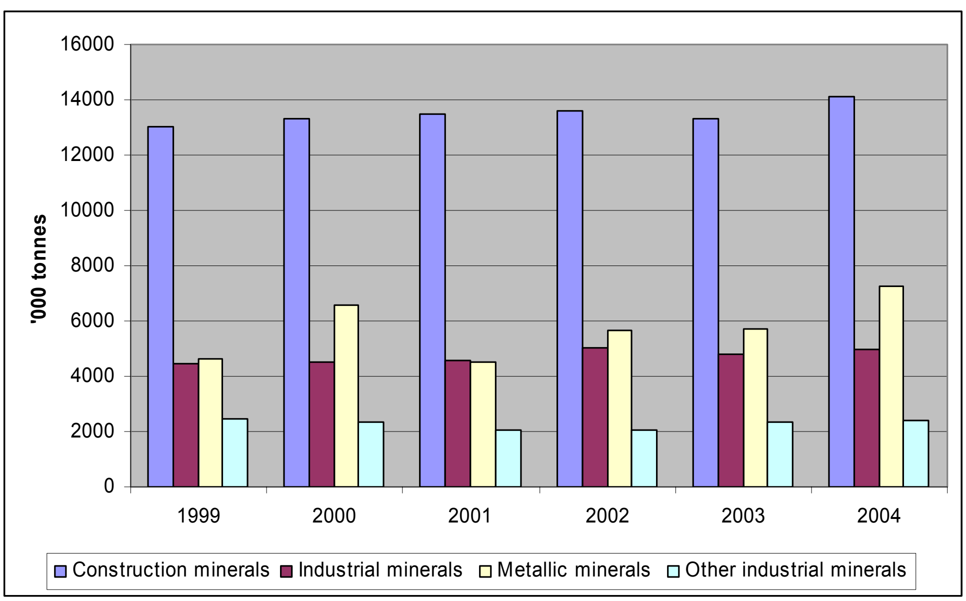
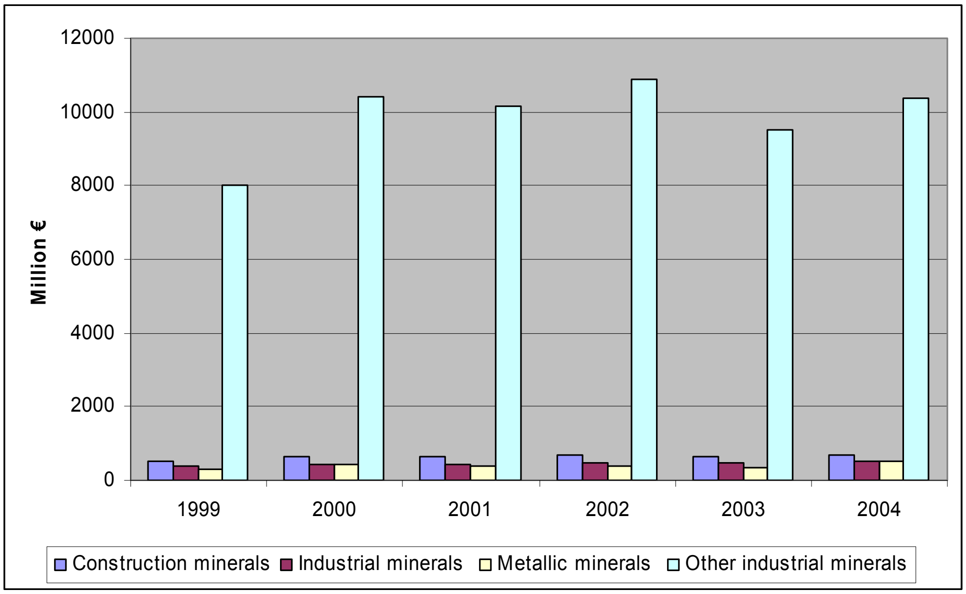


Table 4.6. Annual exports of minerals from the EU, 1999-2004 – by value (million €)



Data source for Tables 4.5. and 4.6.: Eurostat.

Exports of construction minerals

A little over 14 million tonnes of construction minerals were exported from the EU in 2005, worth €704 million (see Table 4.4). Almost half (in terms of weight) went to Switzerland, a further 7% to the USA and 6% to China. Exports to China increased by almost 400% (by weight) compared with 1999. Compared with the total consumption of construction minerals in the EU (over 2.8 billion tonnes), the level of exports is very low (0.6%).

Table 4.4. Destination of construction materials (NACE 14.1 and 14.22) exported from EU-25 in 2004

Country of destination	Weight			Value		
	Thousand tonnes	% of total exports	% change 1999-2004	Million €	% of total exports	% change 1999-2004
Extra-EU	14 103		8.2	704		36.1
Switzerland	6 559	46.5	3.4	119	16.9	24.5
China	832	5.9	366.6	111	15.8	170.4
USA	949	6.7	-15.8	100	14.2	58.0
UAE	46	0.3	208.3	21	2.9	264.0
Russia	325	2.3	138.1	20	2.8	149.9
Turkey	127	0.9	-46.0	20	2.8	129.0
Japan	57	0.4	-28.3	18	2.5	-22.7
Saudi Arabia	47	0.3	39.4	17	2.4	109.6
India	78	0.6	130.5	16	2.2	92.7
Norway	472	3.3	-35.1	15	2.2	-8.3

Data source: Eurostat.

Exports of industrial minerals

The data on industrial minerals (excluding NACE category 14.5) presented in Table 4.5 indicate that almost 5 million tonnes were exported from the EU in 2004 worth €509 million. This is an increase of 12% in terms of weight and 33% in terms of value compared with 1999.

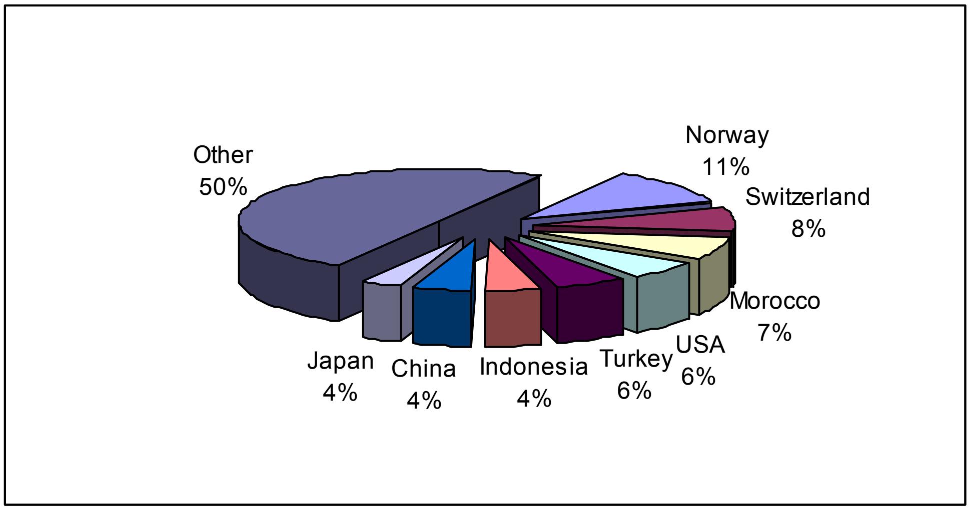
Almost 20% (by weight) went to Norway, with a value of €57 million, while Switzerland, Morocco and the USA were other important destinations (see Figure 4.7). There has been a general increase in the level of exports since 1999 with the greatest relative increases in terms of weight being to the USA (281%), China (222%) and Turkey (86%).

Table 4.5. Destination of industrial minerals (NACE 14.22, 14.3 and 14.4) exported from EU-25

Country of destination	**Weight**			**Value**		
	Thousand tonnes	% of total exports	% change 1999-2004	Million €	% of total exports	% change 1999-2004
Extra-EU	4 963		12.0	509		32.6
Norway	961	19.4	58.9	57	11.3	25.3
Switzerland	242	4.9	27.0	38	7.5	38.7
Morocco	899	18.1	31.4	34	6.8	52.9
USA	479	9.6	281.1	31	6.2	59.6
Turkey	145	2.9	86.0	30	5.9	63.2
Indonesia	142	2.9	N/A	23	4.5	N/A
China	127	2.6	222.0	23	4.5	291.0
Japan	60	1.2	0.7	18	3.5	27.8
Malaysia	169	3.4	21.1	17	3.4	7.5
Canada	161	3.2	45.0	15	3.0	39.6

Data source: Eurostat.

Figure 4.7. Destination of exports of industrial minerals[(1)] by country and value in 2004



(1) Excluding NACE category CB14.5. Data source: Eurostat.

Exports of metallic minerals

Data on exports of metallic minerals are presented in Table 4.6. Over 7 million tonnes were exported worth €516 million. In terms of value, Turkey (€69 million) and Saudi Arabia (€62 million) were the most important destinations (see Figure 4.8).

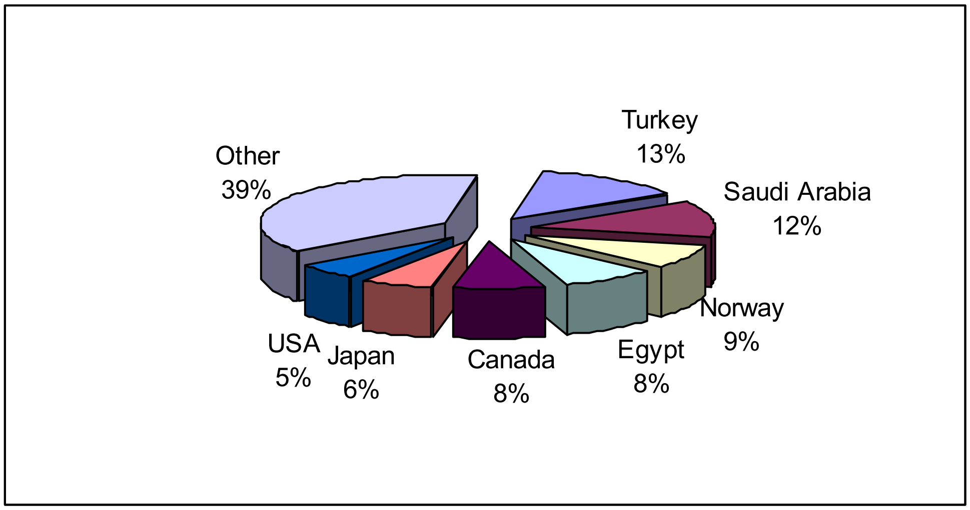
While the level of exports of metallic minerals is considerably lower than imports, there was a 57% increase by weight between 1999 and 2004, with an increase in value of 70%. In terms of weight, exports to Turkey, Saudi Arabia, Egypt, China and Norway were the most important. One noticeable point is that the level of exports of metallic minerals from the EU to China increased by over 1 000%, while exports to Turkey increased by 364%.

Table 4.6. Destination of metalliferous minerals (NACE 13.1 and 13.2) exported from EU-25

Country of destination	Weight			Value		
	Thousand tonnes	% of total exports	% change 1999-2004	Million €	% of total exports	% change 1999-2004
Extra-EU	7 229	-	57.0	516	-	69.9
Turkey	1 504	20.8	363.6	69	13.4	392.3
Saudi Arabia	1 619	22.4	66.8	62	12.1	96.9
Norway	467	6.5	38.5	44	8.5	1.8
Egypt	1 057	14.6	71.9	43	8.4	109.9
Canada	18	0.2	-79.0	42	8.1	76.0
Japan	3	0.0	-81.7	32	6.2	73.4
USA	151	2.1	-64.0	27	5.2	35.1
Brazil	57	0.8	63.6	23	4.5	231.9
China	495	6.8	1 241.3	19	3.8	283.5
Israel	16	0.2	2 588.6	16	3.1	4 288.7

Data source: Eurostat.

Figure 4.8. Destination of exports of metallic minerals by country and value in 2004



Data source: Eurostat.

4.4. Trade balance

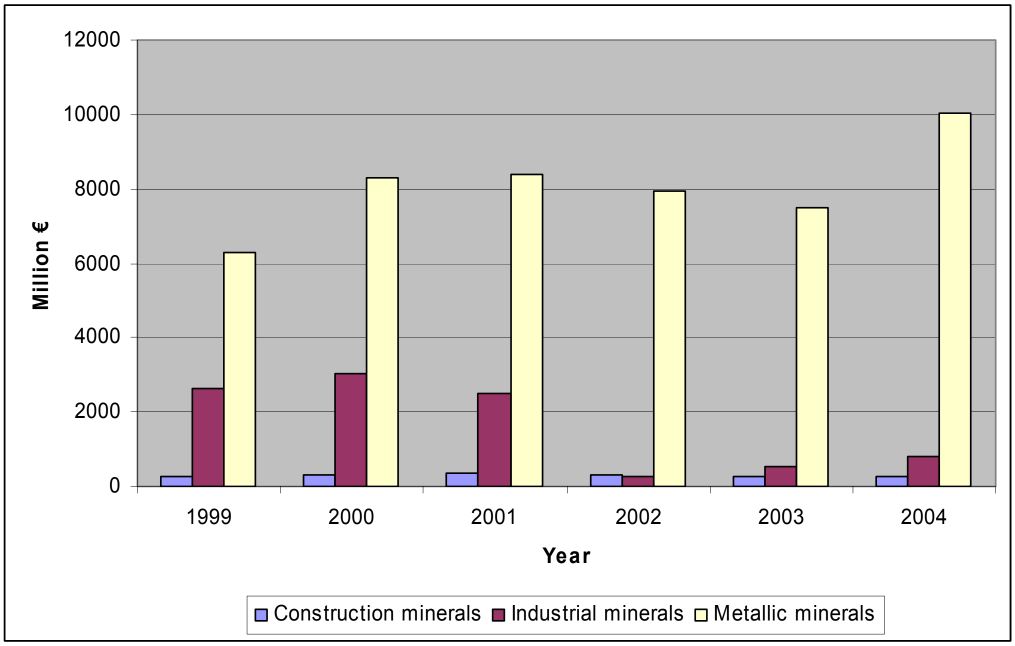
Comparison of the data for imports with the export figures indicates that in 2004 the EU recorded net imports of 203 billion tonnes of minerals, producing a trade deficit of €11 billion (see Table 4.7). Metallic minerals accounted for 90% of the deficit (€10 billion). There were also net trade deficits in construction minerals (€456 million) and industrial minerals (€798 million). Figure 4.9 illustrates recent trends in the trade deficit for each sub-sector.

Table 4.7. Net imports of minerals into EU-25 in 2004

Sub-sector	NACE class	Weight ('000 tonnes)	Value (million €)
Construction minerals	14.1 + 14.21	12 179.8	456.0
Industrial minerals	14.22 + 14.3 + 14.4	18 760.2	798.0
Metallic minerals	13.1 + 13.2	168 059.4	10 024.6
Other industrial minerals	14.5	4 414.2	-184.1
Total		203 413.5	11 094.5

Data source: Eurostat.

Figure 4.9. Net value of imports of minerals into the EU by sub-sector from 1999 to 2004



Data source: Eurostat.

5. ECONOMIC ACTIVITY OF THE INDUSTRY WITHIN THE EU

5.1. Introduction

The previous sections examined some of the many uses of minerals and recent levels of production both within the EU and globally. This section looks at trends in the economic performance of the NEEI in recent years and compares it with other sectors of industry. It looks first at the general characteristics of the NEEI, such as the number of enterprises and people employed. It then examines indicators of production, such as turnover and value added, before considering indicators of price competitiveness. These include measures of the productivity of the sector by considering, for example, the value added per employee (also known as "apparent labour productivity") and the costs to the industry of employing its workforce (e.g. in the form of salaries and social security contributions).

Most of the data used here were obtained from Eurostat. Where possible, an attempt has been made to look at the lowest levels of aggregation (i.e. small groupings of mineral types) but, for the reasons set out in Section 2, often this was not possible. This is unfortunate because, as illustrated in Section 3, the production trends and markets for each mineral type vary and consideration of the data at sub-sector (e.g. industrial minerals) and, particularly, sectoral level (the NEEI) can mask significantly different trends for specific minerals.

Throughout this section, the performance of the NEEI is compared with that of selected sectors of manufacturing industry in the EU (see Box 5.1) and the construction industry. These were selected as the main downstream sectors supplied by the extractive industry, either directly, for example to produce base metals (NACE DJ), or indirectly along the "value-added" chain (e.g. manufacture of machinery or transport equipment from basic metals).

Box 5.1 Summary of manufacturing sectors selected to provide a comparison with the NEEI

Chemicals
NACE DG - Manufacture of chemicals, chemical products and man-made fibres,
e.g. chemical and chemical products, pesticides, paints, pharmaceuticals, soaps, detergents and explosives.

Non-metallic products
NACE DI - Manufacture of other non-metallic mineral products,
e.g. glass and glass products, ceramics, bricks, tiles, cement and plaster.

Base metals
NACE DJ - Manufacture of base metals and fabricated metal products,
e.g. aluminium, lead, zinc and fabricated metal products (tools, cutlery, etc.).

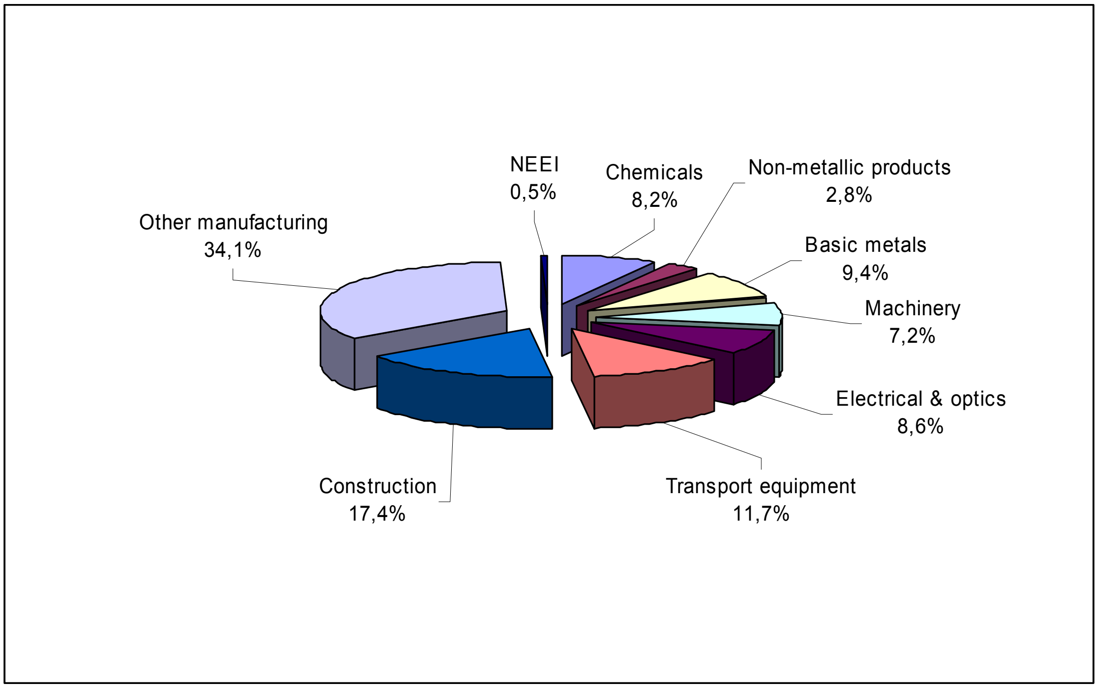
Machinery
NACE DK - Manufacture of machinery and equipment,
e.g. engines and turbines, pumps, agricultural tractors and domestic appliances.

Electrical/optical
NACE DL - Manufacture of electrical and optical equipment,
e.g. office machinery and computers, electric motors, lighting, televisions, optical and photographic equipment.

Transport
NACE DM- Manufacture of transport equipment,
e.g. motor vehicles, ships, railway rolling stock and aircraft.

Figure 5.1 looks at turnover to illustrate the relative sizes of the industries considered. Turnover within the NEEI in 2004 totalled approximately €39.4 billion. This compares with over €1 280 billion for the construction sector and €6 023 billion for all manufacturing. The six sectors of manufacturing industry selected to provide comparisons have a combined turnover of €3 519 billion and account for about 58% of total turnover in manufacturing industry in the EU.

Figure 5.1. Comparison between the turnover of the NEEI and of the construction sector and selected sectors of manufacturing in the EU in 2004

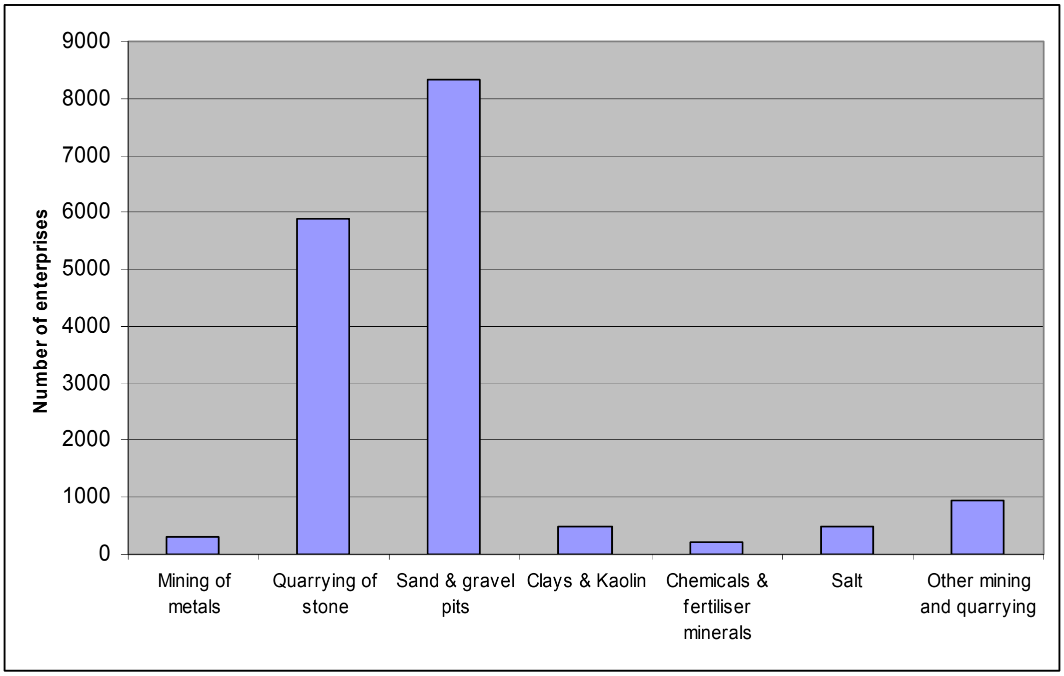


Data source: Eurostat.

5.2. Number of enterprises

In 2004 Eurostat recorded over 16 629 enterprises[63] in the non-energy extractive industry in the EU. Of these, 85% were associated with production of construction materials (stone quarries plus sand and gravel pits), while industrial minerals accounted for approximately 13% and metal mining for less than 2% (see Figure 5.2).

Figure 5.2. Number of enterprises by NACE category in 2004

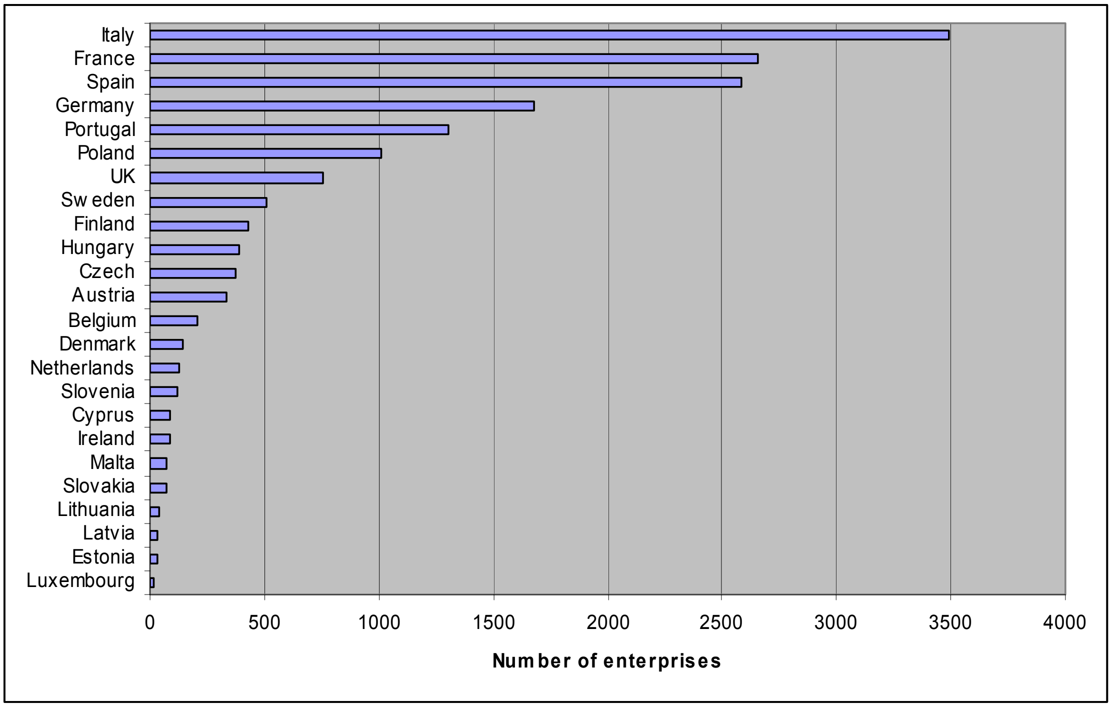


Data source: Eurostat.

The number of NEEI enterprises operating in Member States differs significantly (see Figure 5.3). The high values for Italy, France and Spain reflect the large number of natural stone producers in those countries (see Section 3.2.3) plus aggregate producers. The European Aggregates Association (UEPG) has provided more detailed figures on the number of aggregate companies operating in different Member States. In some Member States, such as the UK, while there are still many small aggregates companies, the majority of production is by a small number of large companies. In others, such as France and Germany, most of the production is still undertaken by small companies.

63 An enterprise is defined as "*any entity engaged in an economic activity, irrespective of its legal form. This includes, in particular, self-employed persons and family businesses engaged in craft or other activities, and partnerships or associations regularly engaged in economic activity*".

Figure 5.3. Number of NEEI enterprises recorded in each country in 2004*



*Except for Luxembourg (2003), Malta (2002) and Portugal (1999). No data are available for Greece. Data source: Eurostat.

Table 5.1. Number of aggregate companies and their activity in 2004

	Number of companies	Number of sites	Production (million tonnes)	Average number of sites per company	Average production per site per year ('000 tonnes)
Austria	900	1 250	92	1.4	73.60
Belgium	87	72	56.9	0.8	790.28
Czech Republic	300	520	49.5	1.7	95.19
Denmark*	400	410	38.3	1.0	93.41
Finland	400	3 600	98	9.0	27.22
France	1 800	-	393	-	-
Germany*	1 878	5 920	476	3.2	80.41
Ireland	350	360	100	1.0	277.78
Italy	1 796	2 480	355	1.4	143.15
Netherlands[64]	83	-	20	-	-
Poland	3 450	1 745	145	0.5	83.09
Portugal*	331	357	95.1	1.1	266.39
Slovakia	128	181	20	1.4	110.50
Spain	1 650	2 250	437	1.4	194.22
Sweden	170	1 940	67	11.4	34.54
UK	350	1 280	203	3.7	158.59
Total	**14 073**	**22 365**	**2 646**	**1.6**	**117.82**

Data source: UEPG, INETI (Portugal).

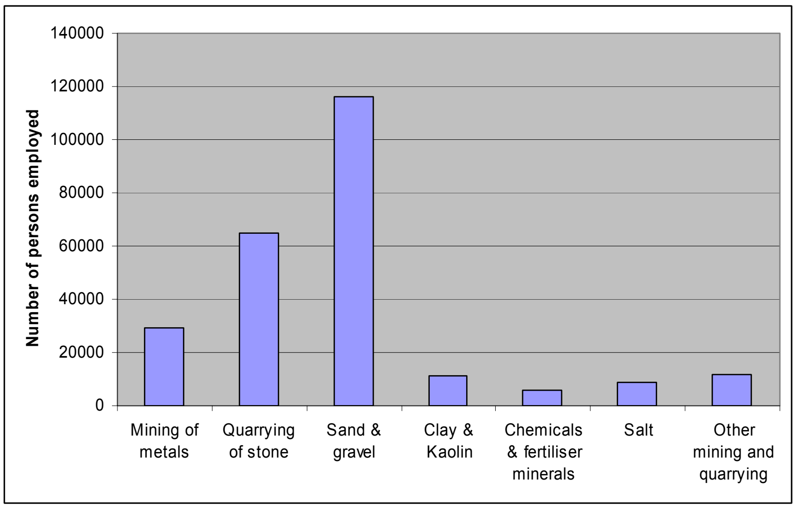
[64] Source: Ministry for Transport, Public Works and Water Management. An additional 62 million tonnes of sand for fill is excavated from the Dutch part of the continental shelf.

Euromines reports that the metal mining sector in the EU is made up of about 250 enterprises[65], which is more or less consistent with the Eurostat data. There are currently around 50 metal mines in operation in the EU[66].

5.3. Number of persons employed

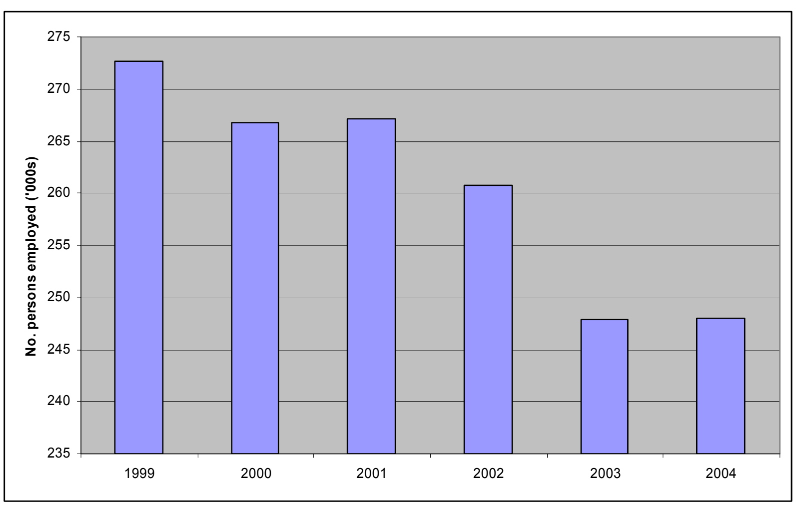
The number of people registered as employed in the NEEI in 2004 was 248 000. Of these, 180 000 were working in the construction minerals sub-sector (see Figure 5.4). The number of persons employed has generally fallen in recent years (see Figure 5.5), with 9% fewer in 2004 than in 1999.

Figure 5.4. Number of people employed in the NEEI in 2004 by NACE category



Data source: Eurostat.

Figure 5.5. Trend in the number of people employed in the NEEI (1999-2004)



Data source: Eurostat.

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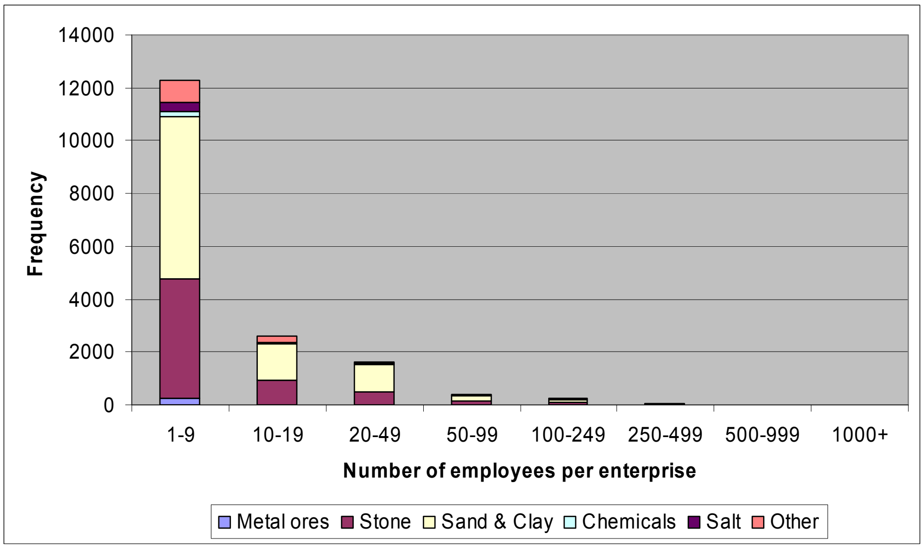
65 Euromines. Annual Report 2004.

66 ETP-SMR Strategic Research Agenda: http://www.etpsmr.org/contents/downloadable-documents/Public%20Download%20Area/SRA_03.2006.pdf.

The average number of employees per enterprise is much higher in the metallic minerals sub-sector, on about 100, than in the industrial minerals and construction minerals sub-sectors, where the average is about 15 per enterprise. However, these average figures hide the true picture of the sector which is dominated by companies with fewer than 10 employees (see Figure 5.5).

Figure 5.6. Size class distribution of enterprises within the NEEI in 2001



Data source: Eurostat.

5.4. Turnover, production value and value added

Turnover, production value and value added are considered together here as they provide similar indicators relating to the productivity of the industry. Turnover measures the market sales of goods, including all duties and taxes (except VAT) and other charges passed on to the customer (e.g. transport and packaging). Production value measures the value of materials produced by the industry, based on sales adjusted for changes in stock and the resale of goods and services. Value added (at factor cost) measures turnover, plus capitalised production, plus other operating income, plus or minus changes in stocks, minus purchases of goods and services, minus other taxes on products which are linked to turnover and which are not deductible, minus the duties and taxes linked to production.

Total turnover within the sector in 2004 was €39.4 billion, while production value and value added were €38.3 billion and €14.5 billion respectively. Extraction of sand and clay accounted for 62% of turnover and 61% of value added (see Figure 5.7). This high value reflects both the large amounts of sand and gravel which are extracted for use as a construction mineral, but also the higher value of some of the speciality sands and clays extracted as industrial minerals. The (ex-works) price of French refined kaolin in January 2007, for example, ranged from €65 to €168 per tonne, while ceramic grade feldspar varied between $60 and $125 a tonne[67]. This compares with approximately €4 to €10 per tonne for the sand and gravel used by the construction industry[68]. The second largest category – stone

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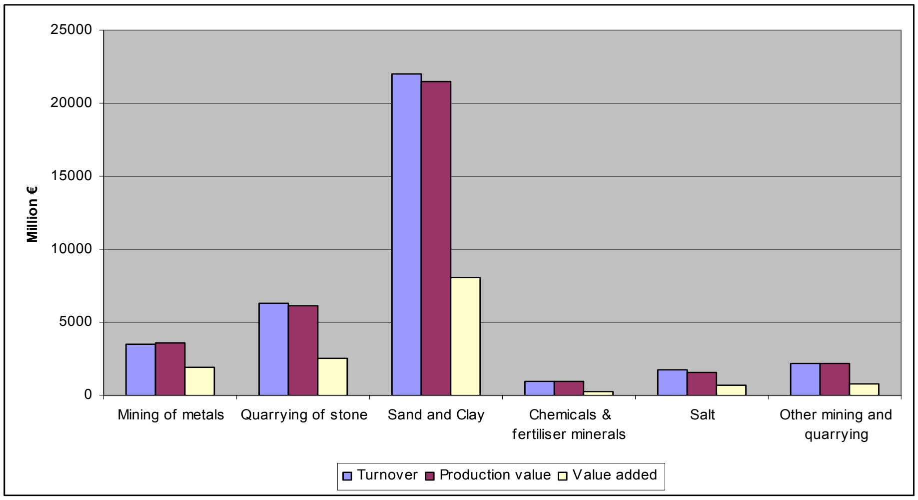
67 Industrial Minerals Magazine, January 2007.

68 UEPG – direct communication.

quarrying – accounted for 17% of the NEEI's turnover and 18.6% of value added. Mining of metals accounted for 8.9% of turnover and 9.8% of value added, with the remainder being made up of those industrial minerals which are not included within "quarrying of sand and clay".

Figure 5.7. Comparison between turnover, production value and value added for different sub-sectors of the NEEI in 2004*



* Data for quarrying of stone relate to 2001 and for sand and clay to 2002.

Eurostat has published aggregated EU-25 data on these three indicators for the years 1999-2004, but there are slightly longer time series (from 1995) for many Member States. Table 5.2 indicates the value added by the NEEI in different Member States in 2004 and the average annual percentage change between 1999 and 2004. The NEEI in the UK generated the highest value added in 2004 with almost €2.5 billion, ahead of Germany (€2.1 billion), France (€1.8 billion), Italy (€1.7 billion) and Spain (€1.6 billion). This compares with figures of €5.9 million for Latvia, €12.9 million for Estonia and €22.5 million for Lithuania. The value added by the sector as a whole increased by an average of 2.1% a year between 1999 and 2004. However, the change in individual Member States varied considerably, from an average annual reduction of 6.8% in Germany to an average annual increase of 87.5% in Estonia. Belgium, Denmark and the UK all recorded average annual increases of less than 1%.

Table 5.2. Value added for the NEEI in EU-25 and Member States in 2004 and percentage change between 1999 and 2004*

Member State	Value added in 2004 (million €)	Average annual % change since 1999[69]
EU-25	14 471.8	2.1
Belgium	286.4	0.1
Czech Republic	173.8	15.5
Denmark	103.7	0.4
Germany	2 134.3	-6.8
Estonia	12.9	87.5
Spain	1 601.5	18.0
France	1 806.4	2.7
Ireland	382.8	6.7
Italy	1 723	3.8
Cyprus	38.8	12.2
Latvia	5.9	25.4
Lithuania	22.5	17.5
Luxembourg	30.3	3.1
Hungary	109.4	19.2
Netherlands	266.6	5.8
Austria	430.8	1.4
Poland	1 116.5	7.6
Slovenia	31.5	10.3
Slovakia	32	2.9
Finland	178.9	8.2
Sweden	804.1	11.2
UK	2 479.1	0.8

Data source: Eurostat. Except Czech Republic (% change 2000-2004); Ireland (% change 2001-2004); Luxembourg (value added in 2003 and % change 1999-2003); Poland (% change 1998-2004).

Figure 5.8 shows the value added by the NEEI in the seven largest producing Member States from 1995 to 2004. Together, these countries accounted for over 80% of the total value added by the sector within the EU. This demonstrates very different patterns, with steady year-on-year increases in Spain, France and Italy, relatively little change in Sweden until 2004, rises and falls in the UK and, based on a more limited dataset, a downward trend in Germany. Assessment of the sub-sectoral data for Germany indicates that the fall was mainly in production of sand and clay which, according to Eurostat figures, fell from a value added of €2.8 billion in 1999 to €1.4 billion in 2004 (average annual reduction of over 10%) and, to a smaller extent, in chemical and fertiliser minerals (average annual reduction of 1.4%). Over the same period, however, the value added by stone production in Germany increased from €139 million in 1999 to €410 million in 2004 – an average annual increase of 39%. The variability in the UK data mainly reflects fluctuations in both stone and sand and clay production.

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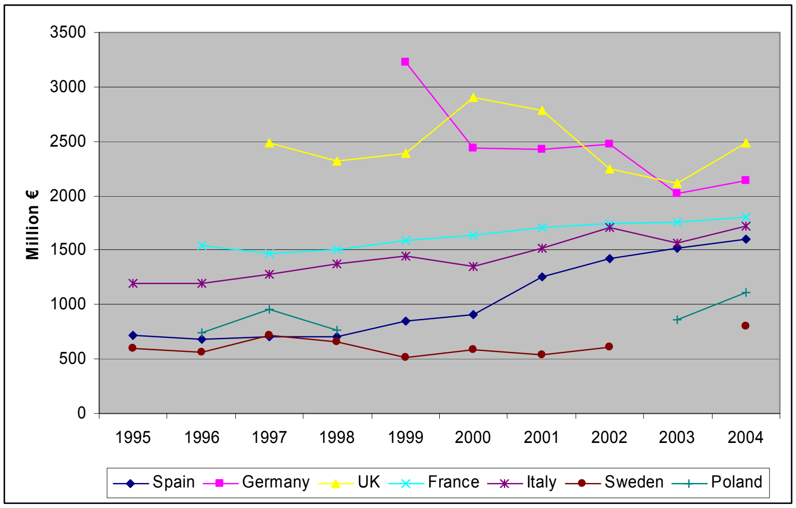
69 Note: these figures relate to the difference between the figures for 1999 and 2004 and take no account of the values in intervening years. Where the trend is non-linear, as is the case, for example, with the UK and Germany (see Figure 5.3), comparing different base years would result in very different percentages.

Figure 5.8. Trends in value added by the NEEI in selected EU-25 Member States, 1995-2004

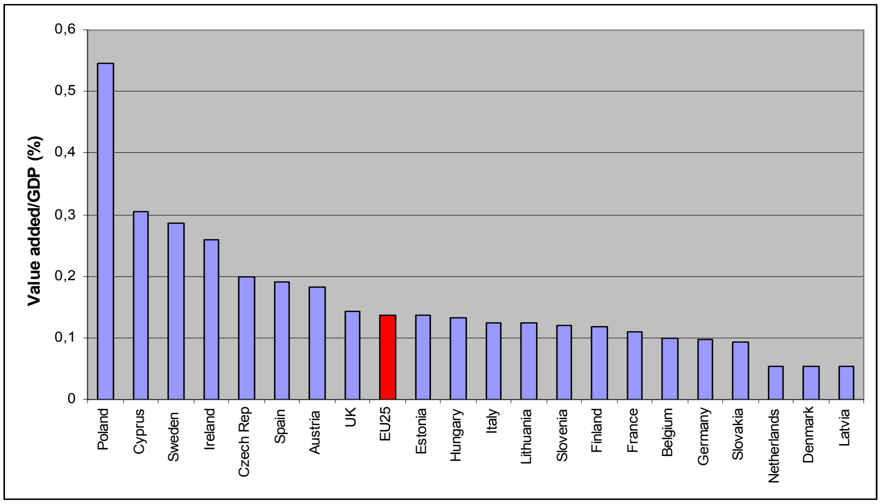


Data source: Eurostat. Gaps reflect incomplete data.

One indicator of the economic importance of an industrial sector is its contribution, in the form of value added, to gross domestic product. Figure 5.8 presents the data for 2004 for each of the Member States[70] and the EU average. With a total value added of €14.47 billion and EU GDP of €10.4 trillion (in 2004), the contribution from the NEEI averaged 0.138%. In the Member States, the figure ranged from a high of 0.55% in Poland to a low of 0.05% in Latvia (see Figure 5.9).

70 Except for Greece, Poland, Portugal and Slovenia for which no data are available.

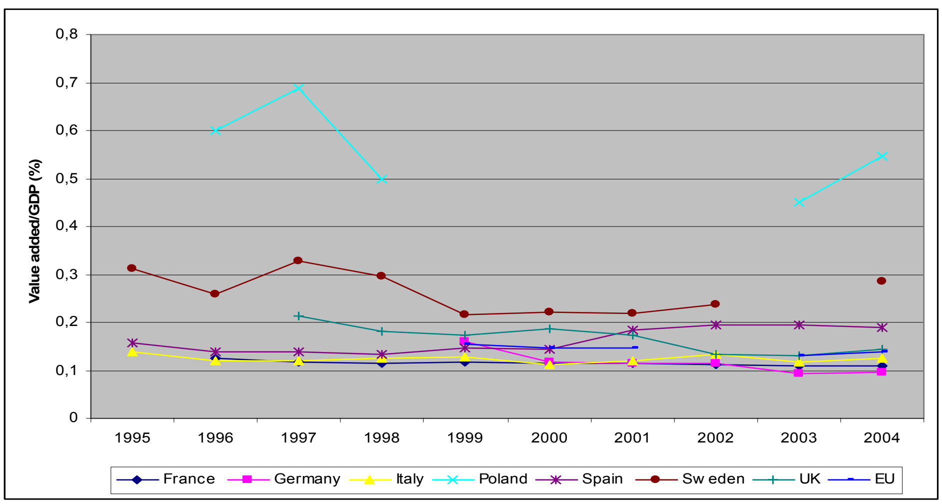
Figure 5.9. Contribution by the NEEI (value added) to gross domestic product in 2004



Data source: Eurostat.

Trends in the contribution made by the NEEI to GDP in the seven Member States considered above illustrate the relative importance of the sector over recent years in different Member States (see Figure 5.10). The sector accounted for almost 0.7% of GDP in Poland in 1997. While the relative importance of the sector in the UK and Germany appears to have fallen in recent years, the opposite is the case in Spain.

Figure 5.10. Value added by the NEEI as a percentage of GDP in the six main producing countries in the EU (1995-2004)



Data source: Eurostat. Data unavailable for France (1995), Germany (1995-98), Poland (1995, 1999-2002), Sweden (2003), UK (1995-96) and EU-25 (1995-98, 2002).

Comparison with other mining regions

To put the figures for the EU into context, data were sought on the economic performance of the NEEI in other countries. While most sources combine data on the energy and non-energy sectors, figures were found on the value added or production value of the non-energy extractive industry in Australia[71], Canada[72] and the USA[73]. Fortunately, it was possible to separate the economic data for the metallic and non-metallic sub-sectors. While the particular indices for each country differ (for example, Australia publishes data on industrial value added, Canada on the GDP of industrial production and the USA on the production value) and are therefore not directly comparable, the annual trends in the value of the industry and its contribution to total GDP allow useful comparisons (see Figures 5.11 to 5.14).

Figure 5.11. Value added by the NEEI and % share of GDP in the EU (1999-2004[74])

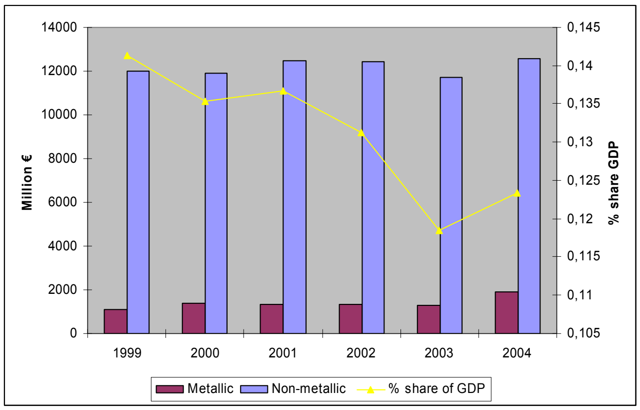
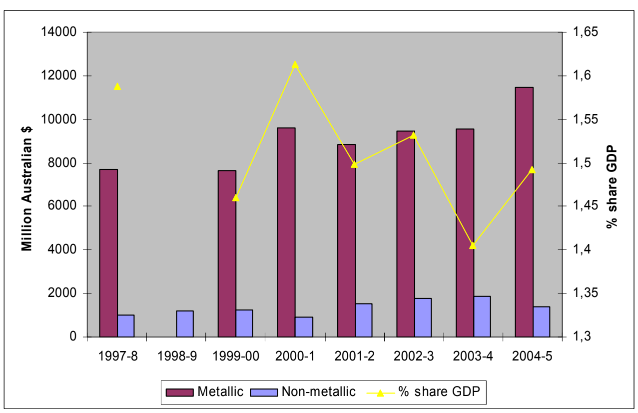


Figure 5.12 Industry value added by the NEEI (AUS$) and % share of GDP in Australia (1997-2005)



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71 Australian Bureau of Statistics: www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/22B1A02F82888351CA257213001A2F39/$File/84150_2004-05.pdf.

72 Natural Resources Canada. Canadian Minerals Yearbooks: www.nrcan.gc.ca/ms/cmy/pref_e.htm.

73 United States Geological Survey. Annual Commodity Summaries: http://minerals.usgs.gov/minerals/.

74 The 2002 EU figure for value added by metal mining was unavailable, so the average of the figures for 2001 and 2003 was used as an approximation in the graph.

The figures illustrate the very different structures of the NEEI in each of the four countries/regions. While metal mining accounted for around 13% of the NEEI's value in the EU in 2004 (the rest coming from construction and industrial minerals), the equivalent figures for Australia, Canada and the USA in 2004 were 89%, 52% and 26% respectively. The most marked trend is the steady increase in the value of the non-metallic extractive industry in Canada, which has progressively caught up with the metallic sector there. This has been largely due to a strong increase in diamond production in recent years together with increases in other industrial minerals, such as potash, gypsum and sulphur[75]. It is also notable that the relative contribution made by the sector to GDP in all four countries/regions fell in the late 1990s and early 2000s, but this trend appears to have reversed in recent years.

Operating expenditure and profitability[76]

In 2003, operating expenditure accounted for 90% of total expenditure in the NEEI in the EU on average, leaving the remaining 10% for gross investment in tangible goods. Within operating expenditure, purchase of energy accounted for 6% of total expenditure, while other purchases of goods and services accounted for 63% and personnel costs accounted for 21% of total expenditure.

Between 2000 and 2003, gross investment declined by 1.9% on average in the EU. In the same period, turnover increased by 4.3%, but other purchases (i.e. excluding energy) and personnel costs increased even more (up by 6.6% and 4.8% respectively), while energy costs went down by 1.1%.

The net effect of this was a reduction in gross operating surplus of 7.6%, which is equal to a 1.9% decline in the gross operating rate[77], which is one indicator of profitability. From a rate of about 18% in 2000, the gross operating rate decreased to around 16% by 2003, which still was clearly above the industrial average (10.3%). Further analysis would be required to analyse the situation since 2003.

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75 Canadian Minerals Yearbook.

76 Eurostat. Statistics in Focus, Industry, trade and services. The non-energy mining and quarrying industry in the EU.

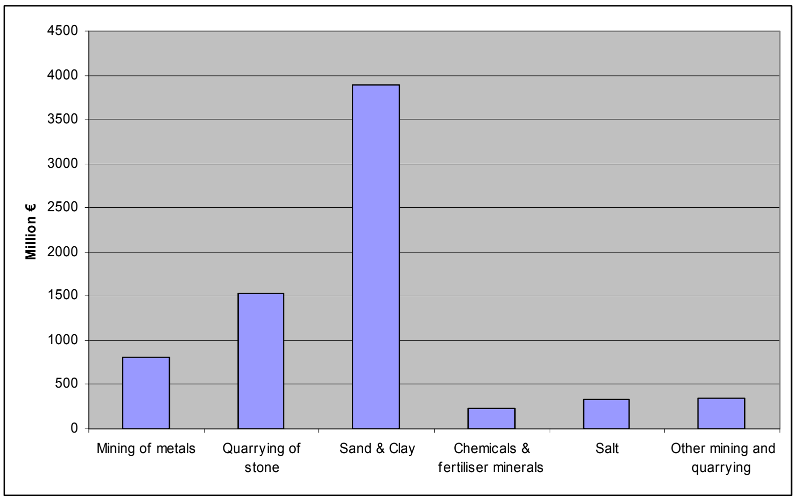
77 Gross operating surplus over turnover

5.5. Personnel costs

Personnel costs are defined as "*the total remuneration payable by an employer to an employee in return for work done. It includes taxes and employees' social security contributions retained by the unit as well as the employer's compulsory and voluntary social contributions*".

The total personnel costs for the sector in 2004 were €7.34 billion, an increase of 2.8% compared with 2003. The distribution of costs across sub-sectors in 2003 (the latest year with a complete dataset) is presented in Figure 5.15.

Figure 5.15. Personnel costs for the different sub-sectors of the NEEI in the EU in 2003



Data source: Eurostat.

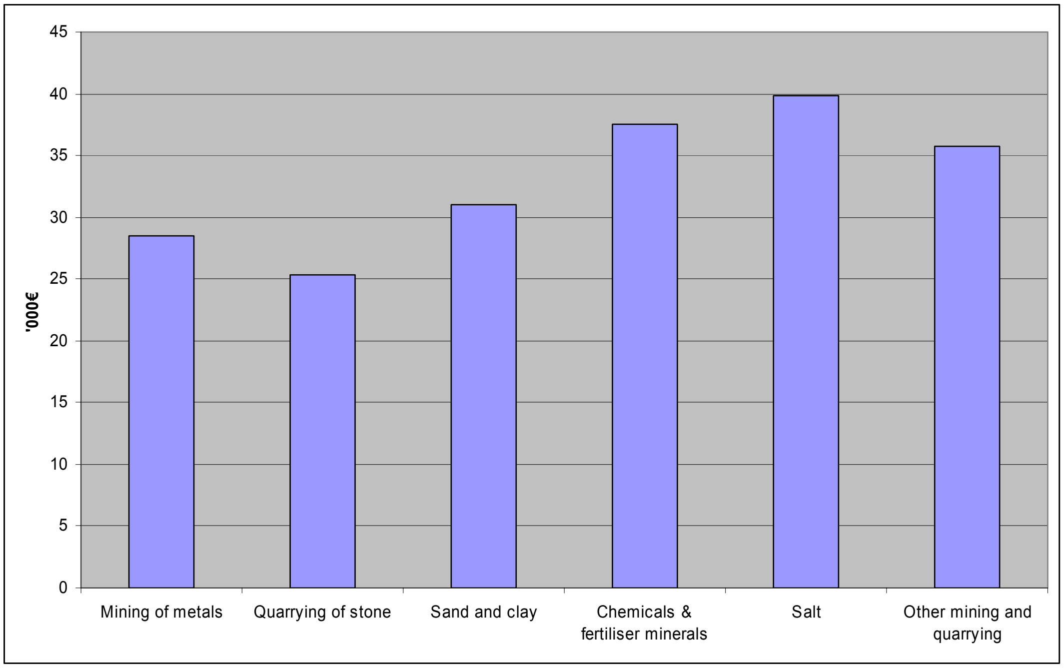
Taken in isolation, these data do not give much insight into the performance of the industry. Increases or decreases in the reported figures could relate either to a change in the size of the workforce or to changes in the cost of employment. A more useful indicator, which is discussed in greater detail below, is the average personnel costs per employee, also known as "unit labour costs".

5.6. Unit labour costs

As indicated above, a more useful indicator than personnel costs to help explain the industry's performance is the personnel costs per employee within the industry (unit labour costs). The analysis below looks only at the position within the EU and includes comparisons between the NEEI and other industries. Section 6.3 provides further information on labour costs in the same sectors in other parts of the world.

In 2004 the average cost per employee in the NEEI was approximately €31 000. However, there appear to be significant differences between the sub-sectors, from a low of €25 300 per person for stone quarrying to €39 800 per person for salt extraction (see Figure 5.16).

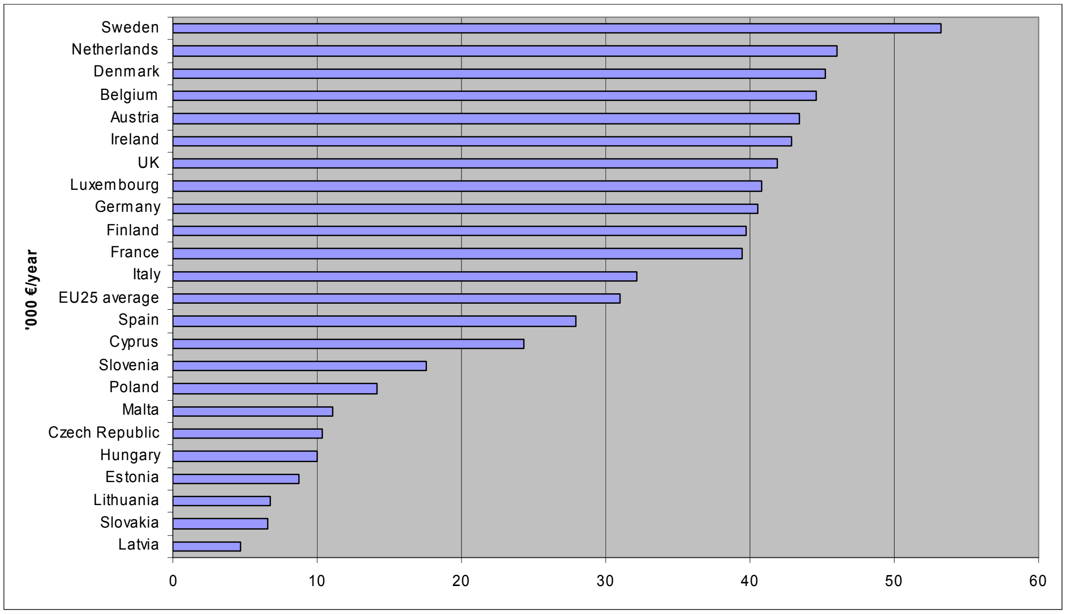
Figure 5.16. Average labour cost per employee for the NEEI and sub-sectors in 2004



Data source: Eurostat. 2003 data for stone and for sand and clay.

However, the unit labour costs also differ significantly between Member States (see Figure 5.17). For the former EU-15 countries, the figures are generally above €40 000 (with Sweden highest on €53 200). In the new Member States the figures range from about €5 000 per person in Latvia to €24 300 in Cyprus.

Figure 5.17. Average unit labour cost in each Member State in 2004*



* Luxembourg, Malta and Slovenia: 2003 data. No data are available for Greece or Portugal.
Data source: Eurostat.

With the limited data available at EU-25 level, it is not possible to consider long-term trends across the industry. However, the dataset for a limited number of Member States covers a longer period (1995-2004). While only nine countries have sufficient data to make a comparison between unit labour costs in 1995 and 2004, the data suggest increases over that period from about 9% (Austria) to almost 70% (Denmark) (see Table 5.3).

Table 5.3 Unit labour costs in 2002 and % change

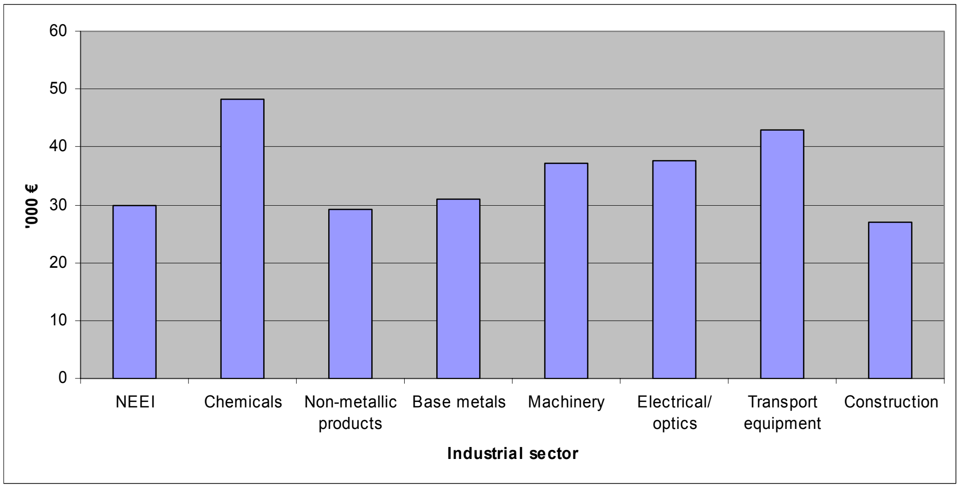
	Unit labour cost ('000 €)	% change 1995-2004
Belgium	44.6	13.2
Denmark	45.2	68.0
Spain	27.9	39.5
France	39.5	16.9
Italy	32.2	35.9
Luxembourg	40.8	14.6
Austria	43.4	9.0
Finland	39.7	23.7
Sweden	53.2	52.4

Data source: Eurostat.

<u>Comparison of unit labour costs between sectors</u>

To obtain an indication of the relative costs of workers in the NEEI compared with other related sectors, a comparison was made between the average unit labour costs for the NEEI, selected manufacturing sectors and the construction industry. The result shown in Figure 5.18 indicates that the costs for the NEEI are generally lower than for the other sectors, with the exception of manufacture of non-metallic products (e.g. glass and ceramics) and the construction industry.

Figure 5.18. Comparison of average unit labour costs in the NEEI and in other industries (2003)

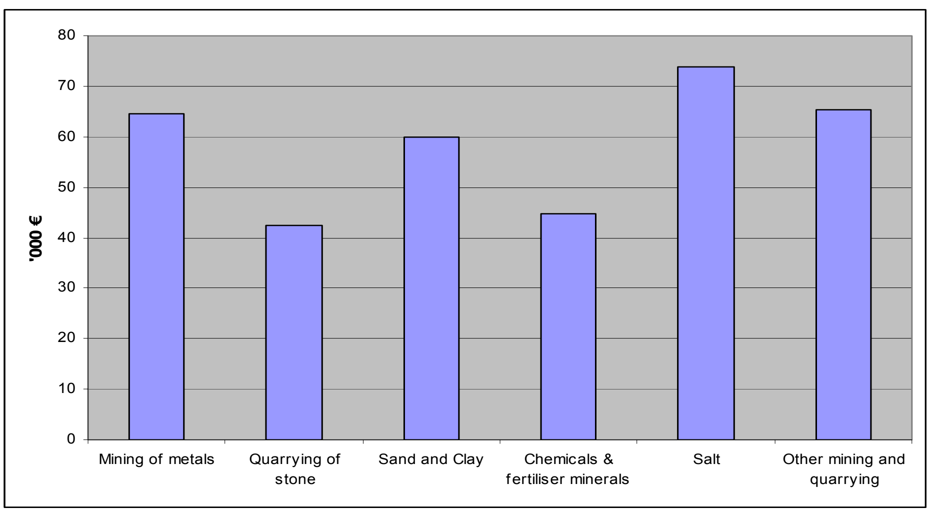


Data source: Eurostat.

5.7. Value added per employee (apparent labour productivity)

Labour productivity is determined here by measuring the value added per person employed. Figure 5.19 illustrates the difference between sub-sectors. While the average for the industry within EU-25 was almost €58 400 per person, salt extraction generates the highest value added per person at over €74 000, while the equivalent figures for stone quarrying and for extraction of chemicals and fertiliser minerals were less than €45 000.

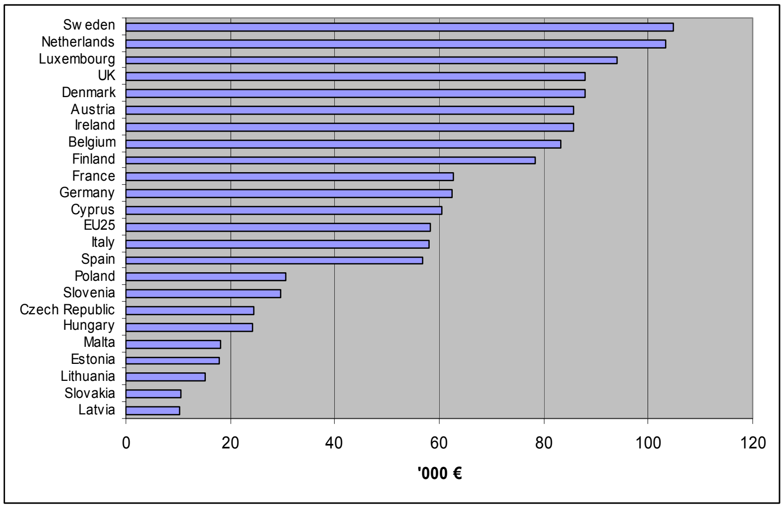
Figure 5.19. Comparison of the apparent labour productivity for the NEEI and sub-sectors (2004)*



* The data for stone relate to 2003 and for sand and clay to 2002. Data source: Eurostat.

However, these EU "averages" hide considerable variability between Member States (see Figure 5.20). The figures range from €10 400 per person in Latvia and Slovakia to over €100 000 in Sweden and the Netherlands.

Figure 5.20. Value added per person employed in the NEEI (2004)



Data source: Eurostat. Data for Luxembourg and Slovenia: 2003.

The apparent labour productivity for each NACE sub-category in each Member State is shown in Table 5.4. The results illustrate the wide variability across the EU, both in terms of differences between Member States and in relation to different categories of mineral produced in individual Member States.

Table 5.4. Apparent labour productivity in each Member State for each sub-category (2004)

	'000€ per person employed						
	NEEI	Metals	Stone	Sand and clay	Chemicals	Salt	Other
EU-25	58.4	64.6	:	:	44.8	73.7	65.4
Belgium	83.3	:	75.9	108.6	27	:	:
Czech Republic	24.5	17.1	16.2	27.6	:	:	:
Denmark	88	:	91.3	86.7	:	:	:
Germany	62.4	:	60.3	59.2	56.5	102.1	77
Estonia	17.9	:	:	21.4	:	:	:
Greece	:	:	:	:	:	:	:
Spain	56.9	56	48.1	62.4	64.7	67.3	65.3
France	62.8	16.7	52.3	69.3	-19	80.2	61.9
Ireland	85.8	114.6	48.3	85.6	:	:	22.4
Italy	58	:	50.4	66.8	:	48.9	53.9
Cyprus	60.4	:	:	68	:	:	:
Latvia	10.4	:	:	10.4	:	:	:
Lithuania	15.2	:	:	14.9	:	:	:
Luxembourg	:	:	:	:	:	:	:
Hungary	24.3	:	:	26.8	:	:	33.9
Malta	:	:	:	:	:	:	:
Netherlands	103.4	:	:	:	:	:	:
Austria	85.8	:	59.7	90.2	:	:	:
Poland	30.7	:	16.9	13.6	:	27.1	23.6
Portugal	:	:	22.7	31.7	:	21.4	37.6
Slovenia	:	:	:	:	:	:	42.2
Slovakia	10.5	6.3	6.6	16.3	:	:	:
Finland	78.3	105.5	37.7	67.6	:	:	148.1
Sweden	104.8	127.2	60.1	61.2	:	:	:
UK	88	:	77.1	93	71.2	91.7	77.9

Note: : = no data available. Data source: Eurostat.

The change in apparent labour productivity in recent years (1995-2004) in different Member States is also very variable (see Table 5.5). While Denmark and Italy recorded increases in productivity of 80% and 59% respectively, the equivalent figures for Austria and Belgium were only 14% and 6%. Care should be taken when interpreting these figures. If the comparison had been between 1995 and 2001, rather than 2004 as in the table, the figures for both Finland and Sweden would have been negative. Recent changes in world metal prices probably account for much of the change between 2001 and 2004 in these two Member States.

Table 5.5. Change (%) in apparent labour productivity in the NEEI between 1995 and 2004 in selected Member States

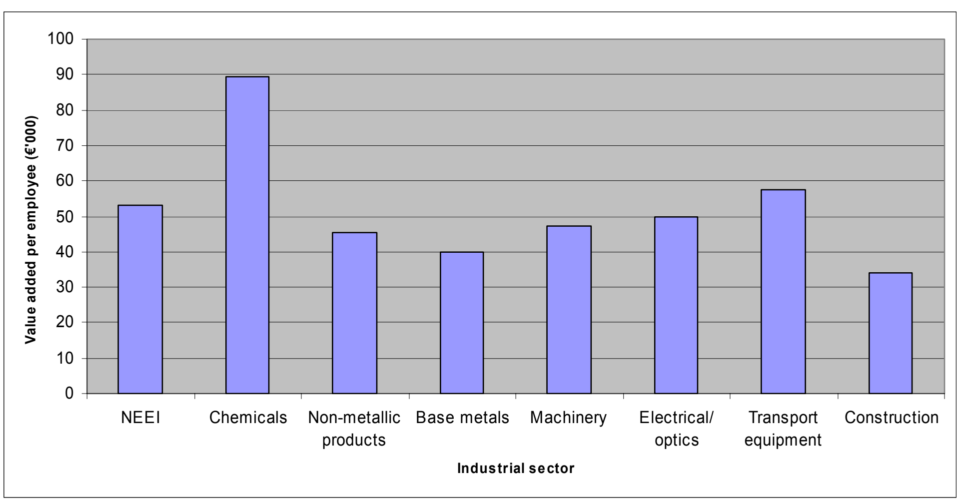
	% change
Belgium	5.7
Denmark	79.6
Spain	42.3
Italy	58.9
Luxembourg	47.3
Austria	14.2
Finland	43.7
Sweden	49.3

Note: There were insufficient data from the other Member States to provide equivalent figures.
Data source: Eurostat.

Comparison of apparent labour productivity with other sectors of industry

The apparent labour productivity of the NEEI appears to compare well with a number of other sectors of European industry (see Figure 5.21). While being some way behind the chemicals industry (almost €90 000 per person) and slightly below the figure for transport equipment (€57 400), it was above the other sectors used in the comparison. In view of the great variability between individual Member States shown in Figure 5.19 and between the different sectors in different countries shown in Table 5.3, the data should be treated with some caution.

Figure 5.21. Comparison of average apparent labour productivity in the NEEI and in other industries in 2003 (Eurostat)



5.8. Wage-adjusted labour productivity

Wage-adjusted labour productivity is the ratio of value added per employee expressed as a percentage of personnel costs[78]. A figure of 100 would indicate that the average value added was the same as the personnel costs, while figures above 100 indicate value added greater than the personnel costs.

The figure for the NEEI as a whole within the EU in 2004 was 188% indicating that the value added was almost twice the personnel costs (see Table 5.6). The highest individual value in 2004 was for metal mining at 227%, which is significantly above the equivalent figures for 2000 and 2001. This probably reflects the recent rapid increase in world metal prices. The figures available on stone quarrying and for sand and clay suggest that labour productivity is falling, while the opposite is the case for salt mining.

It is difficult to identify any particular trends at Member State level (see Figure 5.22), except that many of the countries with the highest values were new Member States (Hungary (242%), Cyprus (236%) and the Czech Republic (235%)), while the lowest values were recorded by Germany (154%) and France (159%).

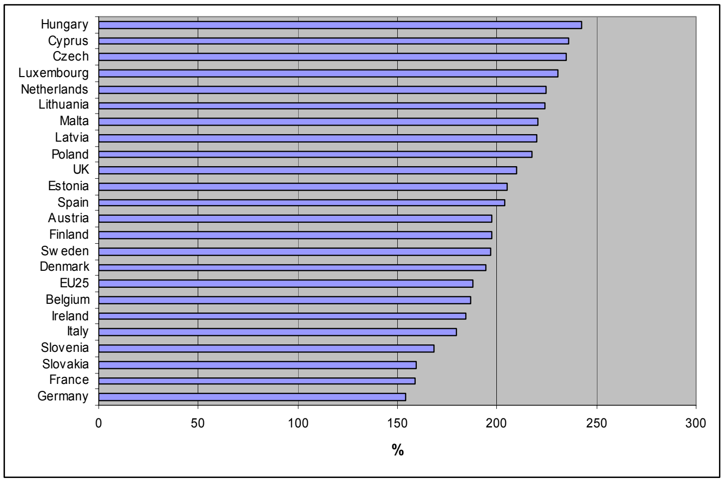
Table 5.6. Gross value added per unit personnel cost (wage-adjusted labour productivity)

	(%)					
	1999	**2000**	**2001**	**2002**	**2003**	**2004**
NEEI	186	185	183	:	170*	188
Metal mining	:	171	160	:	:	227
Stone quarrying	:	177	172	:	168	:
Sand and clay	:	200	199	191:	184	:
Chemicals and fertiliser minerals	:	:	109	96:	:	119
Salt	:	157	160	160:	177	185
Other mining and quarrying	:	173	167	175:	173	183

Data source: Eurostat. *Data recorded as unreliable or uncertain by Eurostat. : Data withheld as confidential.

78 Wage-adjusted labour productivity = value added/personnel costs*100(%).

Figure 5.22. Gross value added per unit personnel cost (wage-adjusted labour productivity) in the NEEI in individual Member States in 2004[1]

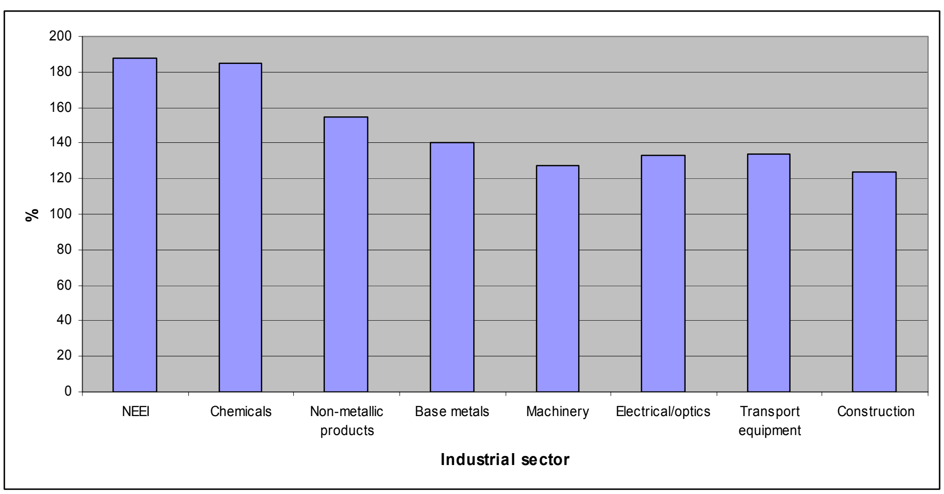


[1] Except Luxembourg, Malta and Slovenia (2003). No data for Greece or Portugal. Data source: Eurostat**.**

<u>Comparison of wage-adjusted labour productivity in the NEEI with other industries</u>

Comparison of wage-adjusted labour productivity for the NEEI with the same indicator for other sectors (see Figure 5.23) shows that the industry is performing well, having the highest figure out of all the industries considered, slightly above the chemicals industry and well above the other sectors.

Figure 5.23. Comparison between gross value added per unit personnel cost (wage-adjusted labour productivity) in the NEEI and other industries (2003*)



* Data for NEEI and base metals: 2004. Data source: Eurostat**.**

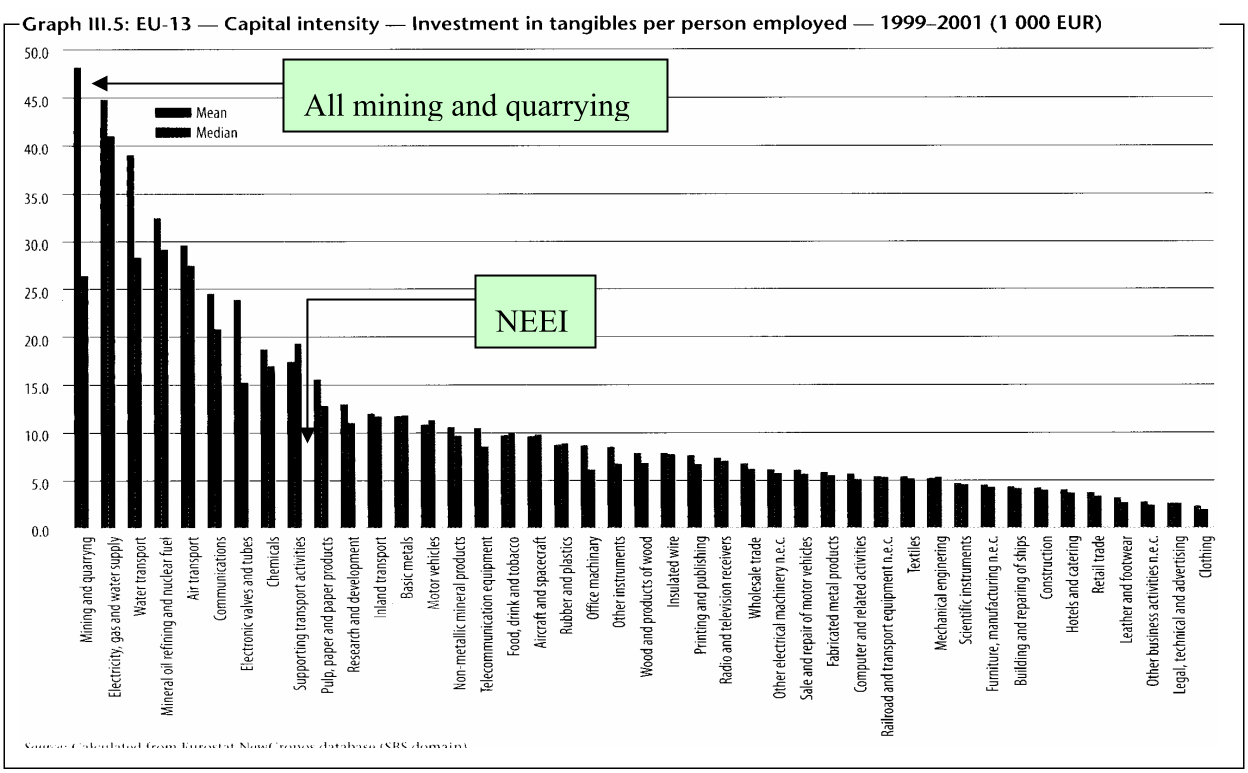
5.9. Capital intensity

"Capital intensity" is defined as the ratio of the total monetary value of capital equipment to the total amount of labour employed. It can be used as a measure of the conditions and behaviour in an industry. High levels of investment can act as a barrier to entry, imply a high degree of risk and shape firms' cost structures and price strategies.

As investment is highly cyclic, sectoral studies undertaken by the Commission tend to assess the relative performance of a wide range of sectors based on average values over three years. One such study published in 2005[79] concluded that "mining and quarrying" was the most capital-intensive industry in the former EU-15 (see Figure 5.24). Unfortunately, as with many such studies, the analysis combined the energy and non-energy extractive sectors.

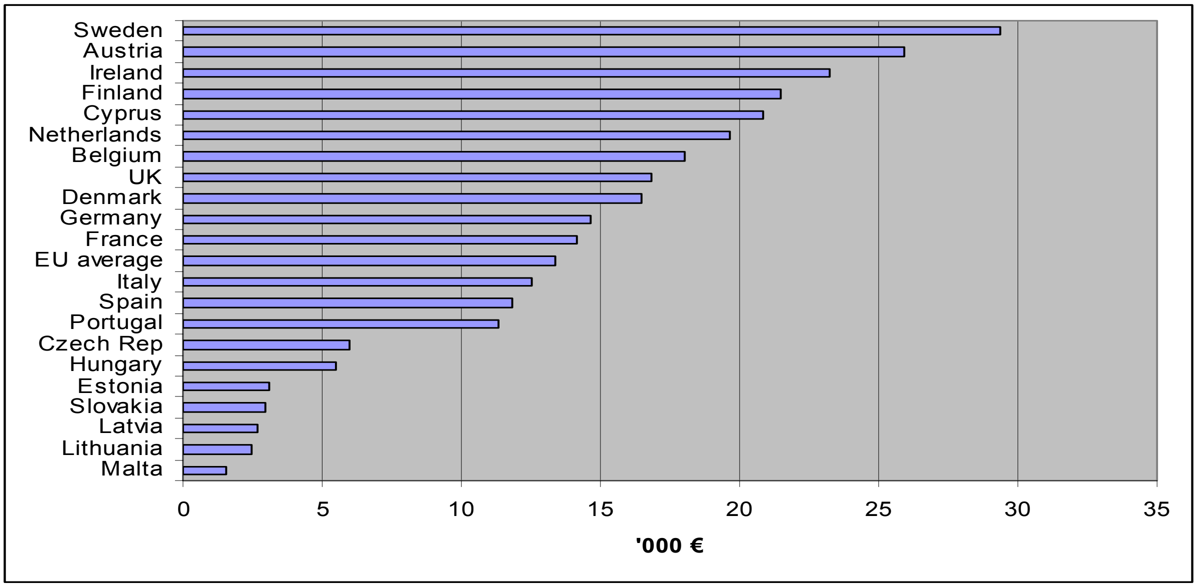
To address this, the raw data were re-analysed to separate the NEEI from the rest of the extractive industries. The result is that while the NEEI is towards the upper end of industries in terms of capital intensity, it is far from being at the top, as indicated on the graph. There is however, wide variability between Member States (see Figure 5.25). While the average for the former EU-15 was €15 400 per person employed, in the new Member States it was only €5 200 per person.

Figure 5.24. Capital intensity of industrial sectors in EU-13 in 1999-2001 indicating the relative position of the NEEI



79 European Commission (2005): EU sectoral competitiveness indicators. Luxembourg.

Figure 5.25. Average annual investment in fixed assets per person employed in the NEEI in EU-25 countries in 1999-2001



Data source: Eurostat.

6. ASSESSMENT OF FACTORS CONSIDERED TO AFFECT THE COMPETITIVENESS OF THE INDUSTRY

6.1. Introduction

A number of issues were raised by stakeholders as being particularly important for the competitiveness and/or sustainability of the non-energy extractive industry. The key topics considered were:

– exploration;
– investment and operating costs;
– the regulatory framework;
– access to resources within the EU;
– the availability of a skilled workforce;
– research and innovation;
– health and safety.

These topics are reviewed one by one in this section, although it should be recognised that they are interdependent. Access to new resources, for example, requires knowledge of their existence (mainly a result of exploration), the confidence of investors to invest in the project and a regulatory and policy framework which is efficient and transparent and encourages investment. Eventual operation of the site requires a skilled workforce operating in appropriately safe conditions. The importance of the interaction between the various issues is pointed out in Section 7.

6.2. Exploration

6.2.1. Introduction

Extraction of mineral resources inevitably leads to their eventual exhaustion at the site concerned. The industry therefore needs to find, and gain access to, new deposits to replace those that are coming to the end of their life. Recent trends in global mine production of most metallic and industrial minerals are upwards, as shown earlier, and this is expected to continue as the world’s population grows and countries such as China and India develop and demand more materials per capita. The ability of Europe's non-energy extractive industry to continue to supply existing markets and to contribute to global growth will depend on additional resources becoming available.

For the industry, there is also pressure at sites that have been operating for some time to identify additional reserves in order to prolong the life of the existing infrastructure, to justify investment in new equipment or to expand[80]. In Europe extension of existing mines, quarries and processing facilities has accounted for many of the additional permitted reserves in recent years.

There are many factors that an exploration or mining company takes into account when making a decision about whether to invest money in mineral exploration and extraction. Table 6.1 provides an interesting ranking of criteria for decision-making, based on a survey of

80 Crowson, P. (2003). See footnote 25 for full reference.

39 international mining companies undertaken for the United Nations. Although the survey was based on operations in countries in the Asia-Pacific region and therefore includes a number of issues which are probably not so relevant to the EU (e.g. risk of armed conflicts), many of the criteria do apply.

Table 6.1. Ranking of investment decision factors at the exploration and mining investment stage

Ranking		
Exploration stage	**Mining stage**	**Decision based on:**
1	n/a	Geological potential for target mineral
n/a[a]	3	Measure of profitability
2	1	Security of tenure
3	2	Ability to repatriate profits
4	9	Consistency and constancy of mineral policies
5	7	Company has management control
6	11	Mineral ownership
7	6	Realistic foreign-exchange regulations
8	4	Stability of exploration/mining terms
9	5	Ability to predetermine tax liability
10	8	Ability to predetermine environmental obligations
11	10	Stability of fiscal regime
12	12	Ability to raise external financing
13	16	Long-term national stability
14	17	Established mineral titles system
15	n/a	Ability to apply geological assessment techniques
16	13	Method and level of tax levies
17	15	Import/export policies
18	18	Majority equity ownership held by company
19	21	Right to transfer ownership
20	20	Internal (armed) conflicts
21	14	Permitted external accounts
22	19	Modern mineral legislation

Source: J. Otto, "A Global Survey of Mineral Company Investment Preferences, Mineral Investment Conditions in Selected Countries of the Asia-Pacific Region", United Nations ST/ESCAP/1197, 1992, pp. 330-342. n/a: not applicable.

In summary, the industry seeks to explore where there is geological potential and to operate wherever a suitable geological resource has been identified and can be worked profitably and securely. As investment in operations is often very large, the industry seeks sufficient security of tenure to cover its investment costs and produce a profit. An additional priority is that the industry requires a consistent legislative and policy framework.

The Frazer Institute based in Canada undertakes annual surveys of mining companies operating globally to assess how mineral endowment and public policy factors such as taxation and regulation affect exploration investment[81]. Their 2005/2006 report highlighted the importance of geological and economic evaluations as prerequisites for exploration, but observed that a region's policy climate is becoming increasingly important in attracting and winning investment. Their survey therefore sought views on the effect of government

[81] Frazer Institute Annual Survey of Mining Companies 2005/2006. http://pdac.ca/pdac/misc/060322-fraser-institute-full%20survey.pdf.

policies, including uncertainty concerning the administration, interpretation and enforcement of existing regulations, environmental regulations, regulatory duplication and inconsistencies, taxation, uncertainty concerning native land claims and protected areas, infrastructure, socioeconomic agreements, political stability, labour issues, geological databases and security.

Companies were asked for their opinions on the investment attractiveness of 64 jurisdictions – four of which are within the EU (Finland, Ireland, Spain and Sweden)[82] – applying the above-mentioned criteria. The overall result, which took all criteria into account, put all four EU Member States in the top half of the list of jurisdictions most attractive to investors. However, while Ireland was the highest placed of the four in 2005/2006 at 16th out of 64, this was a drop from 2nd place the previous year. Spain also fell significantly, from 6th place in 2004/2005 to 28th in 2005/2006, while Sweden fell from 22nd to 32nd place. Finland, however, moved up the rankings from 24th to 17th. It is notable that all four Member States were in the bottom ten in terms of perceived mineral resource potential.

6.2.2. Current extent of geological surveying in the EU and approaches to exploration

One essential prerequisite for most mineral exploration is, therefore, basic geological surveying and mapping. This reconnaissance level of surveys is usually carried out by international organisations or governments (in their geological surveys) rather than by mining or exploration companies. The Leoben University study on mineral planning policies in the EU found that all the Member States have government-funded institutions which coordinate or undertake geological and geophysical surveys, although the level of coverage and detail differs. Representatives of the extractive industry have indicated that in some Member States the maps and other information produced by the national geological survey is very valuable to them. In others the geological maps are too general. The permitting requirements for exploration activities and the extent to which national geographical surveys (or related institutions) provide basic geological information are summarised for each Member State in Table 6.2.

Table 6.2. Summary of approaches to exploration of non-energy minerals in EU Member States[83]

Member State	Requirements
Austria	Exploration permits are required from the Ministry for Economic Affairs and Labour. The Austrian Geological Survey is responsible for geological mapping and is also authorised by law to search for mineral deposits in Austria. Cooperative projects between different administrative bodies and parts of the industry have led to an almost complete geochemical map of Austria. Some central funding (10-20%) is available for exploration for "free for mining" and landowners' raw materials.
Belgium	The locations of reserves of industrial and construction minerals are well known. Further exploration is the responsibility of operators. Permits are not required for exploration, although the consent of the landowner is.

[82] Other jurisdictions included 12 States in Canada, 14 in the USA and 8 in Australia, 9 African countries, 8 Latin American countries, China, India, Russia and Turkey.

[83] Data sources: Leoben University (2004); Land Use Consultants (1995); the Austrian Federal Ministry for Economic Affairs and Labour; The Department of Communications, Marine and Natural Resources, Ireland; UEPG; and EuroGeoSurveys (Slovakia).

Czech Republic	Exploration for non-reserved minerals requires agreement with the landowner. The Czech National Council Act applies to exploration of reserved minerals and requires approval from the Ministry for the Environment. The reliability of data available from the geological survey has improved in recent years. Quarrying companies use specialised exploration companies and are required to give the results to Geofond (Ministry for the Environment).
Denmark	Authorisation is required from the Minister for the Environment or the county councils. The Geological Survey must be informed of the location of drilling and the nature of strata found.
Estonia	An exploration permit is required from the Minister for the Environment for State-owned minerals and the county governor for others. Additional requirements apply in protected areas.
Finland	The Geological Survey of Finland has a remit to search for minerals and to assess occurrences. Concessions for extraction are then put out to tender. No permit is required to explore for non-claimable minerals, whereas claimable minerals are covered by the Mining Act.
France	The whole of France has been mapped. Exploration permits for mined substances are issued by the Ministry for Industry. Exploration for quarried materials is judged on a case-by-case basis, but a permit is not usually required.
Germany	A prospecting permit is required for “free” minerals and for all minerals which fall under the German Mining Act. No permit is required to explore for minerals which fall outside the Mining Act, such as sand, gravel and limestone. The aggregates industry has indicated that the quality of the maps (1:25 000) is very good and provides a sound basis for further exploration. For aggregates, this is usually carried out by the industry itself and not by specialist companies.
Greece	Both the State geological survey and private companies explore for minerals. Private exploration requires a permit.
Hungary	An exploration licence is issued by the mining authority.
Ireland	The government, via the Geological Survey of Ireland, carries out geological mapping and conducts geophysical and geochemical surveys which support the exploration industry. Also, via the Exploration and Mining Division and the Geological Survey of Ireland, the government promotes the exploration sector by carrying out regional compilations of geological, geophysical and geochemical data and making all non-confidential data submitted by exploration companies freely available on the internet. A permit is required for mineral exploration, except for construction minerals for which the agreement of the landowner is required.
Italy	The State previously played a significant role in the exploration of category 1 minerals, either through its own programmes or by providing assistance to others. Permits are required to explore for category 1 minerals. Control over category 2 minerals has been devolved to regional authorities. A permit is usually required, although not in every region.
Latvia	An exploration permit is required from the State Geological Survey for minerals of State importance. It is granted following competitions organised by the Ministry for Environmental Protection and Regional Development. For other minerals, permits are required, except where landowners extract common minerals such as clay, sand and gravel for non-commercial purposes.

Lithuania	The Geological Survey of Lithuania is responsible for collecting geological information and making it available. It also issues permits for exploration activities. The Geological Survey can ask the exploration company to undertake additional survey work, in which case the extra cost is refunded.
Luxembourg	The National Geological Survey has completed a national map. Permits are not required for borehole investigation but can be for trial excavations, although they are not usually required.
Netherlands	The Dutch Geological Survey (now TNO-NITG) has extensive maps which are regularly updated. Applications to explore for surface minerals are judged on a case-by-case basis, but are often not necessary. The State subsidises a large part of the budget for the survey. Aggregates companies tend to undertake their own geological studies on demand, either by themselves or via a sub-contractor.
Poland	Exploration concessions are granted by the Minister for the Environment for chemical and metallic minerals and by the relevant regional authority (Voivod) for other basic minerals - except for exploration of common minerals over an area of less than 2 hectares, in which case the local authority (Starosta) grants the concession.
Portugal	INETI is undertaking a geological survey of the country, which includes an inventory of mineral resources and a mineral resources database. An exploration licence granted by the Minister for Economic Affairs is required.
Slovakia	Exploration for non-reserved minerals requires agreement with the landowner. Exploration for reserved minerals requires approval from the Ministry for the Environment. Exploration companies are required to give the results to Geofond (Ministry for the Environment). Some exploration activities were/are funded by the State, but State funding is not usual.
Slovenia	The Geological Survey of Slovenia carries out exploration activities. Permits are required for exploration, which follow a two-stage application process – a preliminary exploration permit, which indicates the approval of the communities in the proposed area, and an exploration permit.
Spain	The State (Geological Survey of Spain), and the autonomous regional governments carry out their own exploration for a range of higher value minerals. Permits are required for exploration and investigation for concession minerals (sections B, C and D) but not for non-concession minerals (section A). Permits are obtained from the Mining Departments of the autonomous regional governments. The aggregates sector has indicated that the basic geological studies provided by the "Magna Plan" are good, even though on a scale of 1:50 000. Specialist exploration companies are often used. However, aggregate companies often buy existing sites or developed areas with reserves rather than investigate new areas.
Sweden	Prior to 1993 exploration was undertaken by the State and by private companies. The records and drill cores are now held and made available by the Geological Survey of Sweden which is also responsible for geological mapping. Permits are usually required to explore for concession minerals and are obtained from the Mining Inspectorate, but are not required for non-concession minerals.
United Kingdom	A comprehensive programme of exploration and mapping has been carried out by the British Geological Survey. Small-scale operations are deemed to have planning permission, subject to time and place restrictions. Many companies use the maps and related information produced by the BGS as a first step to identify broad areas for potential searches. The marine aggregates industry uses specialist exploration companies working to specifications determined by the aggregates company.

However, even where there is good coverage by the maps produced by the geological surveys, detailed exploration work still needs to be carried out by the industry, because only it can determine whether a deposit will be commercially viable. This work is usually undertaken by the extractive industry itself or by specialist exploration companies, although some national geological surveys also undertake detailed mineral assessments. Exploration usually seeks to target a particular mineral, often in the vicinity of known resources, where the likelihood of being successful is usually higher. Companies usually maintain their own archives of previously explored areas.

Representatives of the Industrial Minerals Association have stressed the importance of precise chemical and/or physical characteristics in industrial minerals for particular applications and the significance of the cost of transporting the mineral to the end-user. This creates additional constraints on the geographical range and choice of search areas for these minerals. The approach to greenfield exploration seen with metallic minerals, such as geological modelling, is not generally taken, except for commodities such as heavy mineral sand deposits containing titanium, zircon and associated minerals. It is more usual for companies to conduct searches around known deposits or, as indicated by one contributor, to assess selected prospects and small-scale producers in a target area and consider their development potential by evaluating the quality, potential size and processability of the deposit. If certain basic criteria are met, acquisition will be considered, which is followed by investment in delimiting the ore body and process development in response to market requirements. The sector therefore relies heavily on in-house information with geological maps generated by central geological surveys as complementary or background support on a consultancy basis.

Aggregate companies also make use of geological survey data, but to different extents in different Member States (see Table 6.2). Perhaps not surprisingly, the better the quality of the available information the more it is used by companies. The approach often taken in France is summarised in Box 6.1.

Box 6.1. Approach to exploring for aggregates in France (source: UNPG)

- Geological maps (scale 1:50 000), notes and survey databanks are in the public domain and available for purchase. The first step is to consult these data to know the nature of the mineral (e.g. Jurassic limestone, granite, etc.). Unfortunately, they are too vague to determine whether or not exploitable resources are present (which is influenced by the thickness of the topsoil and sub-layers). These data are therefore used to select prospecting zones.
- Reconnaissance on the ground is undertaken by geologists. This might include examining the faces of old quarries, sampling rock and, if necessary, using surveys and petrographic tests. Use is also made of aerial photographs to study topography and spatial land use.
- Planning documents are consulted to identify factors likely to prohibit extraction, such as land-use plans of the local area, water management schemes, regional quarry plans and environmental protection zones. If this consultation proves positive, the next step is to identify the owners of the sub-surface area in order to obtain their agreement to allow access to the land. Apart from marine aggregates, for which it is necessary to obtain a permit for prospecting at sea, prospecting for aggregates in France is not usually subject to administrative procedures. The sub-surface layers are private property, and the only constraint to carrying out detailed exploration of potential areas is the need to obtain the agreement of the owners to gain access to the ground.
- The work is carried out and financially supported by the company. In large companies prospecting is led by their geological department. However, certain operations, such as mechanical geophysical surveys or tests on the characteristics of the rock, may be sub-contracted to specialist external companies.
- The longest phase of the process (several years) and the most difficult to control is obtaining the agreement of the owners. This phase requires good regional knowledge and mobilises many people on a full-time basis (several dozen in large companies). Subsequent authorisation to extract the mineral requires a new agreement with the owner and will require additional work in order to prepare the impact study.

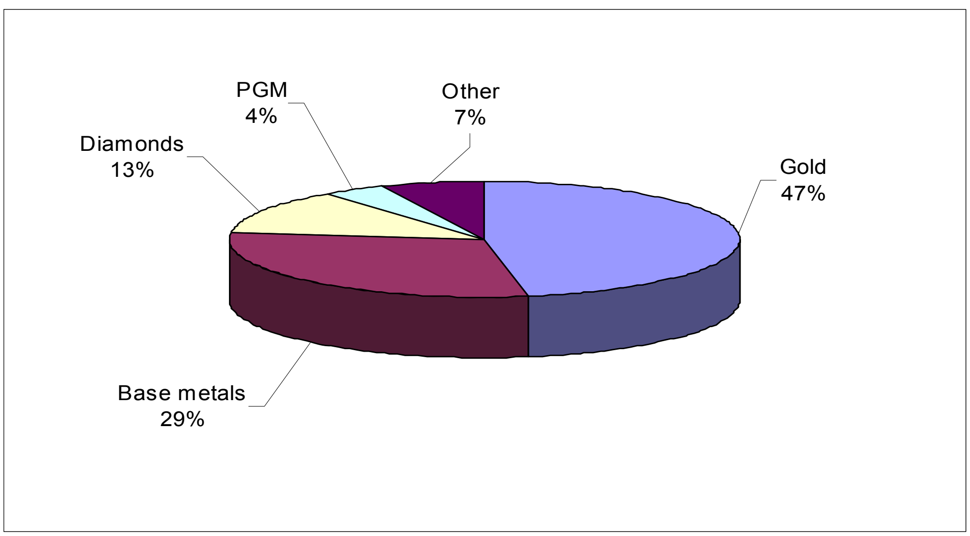
Exploration techniques are continually being developed in response to the need to find increasingly inaccessible deposits. For metals in particular, exploration has typically moved from prospecting of surface outcrops to detection of relatively shallow deposits, using geochemical and geophysical techniques, and use of predictive models of ore genesis and distribution. As new exploration techniques are developed, previously explored areas may be successfully re-examined.

However, identification of a geological deposit does not mean it is commercially viable to mine nor that a permit will be granted to the operator by the permitting authority. In more remote areas, in particular, insufficient local water supplies, the cost of transport and infrastructure development can make a site uneconomic to develop.

6.2.3. Trends in exploration activity

Globally, the majority of exploration activity involves searching for metallic minerals, particularly gold and base metals (see Figure 6.1). The overall level of exploration activity is therefore often related to world metal prices. Low metal prices in the late 1990s and early 2000s resulted in a slump in global exploration[84]. Expenditure dropped from a high of over US$5 billion in 1997 to under US$2 billion in 2002. Canada, which spends the most on exploration (see Figure 6.2), recorded a drop from over US$900 million to about US$500 million over the same period. Since then, high global metal prices have reversed the trend, and in 2005 the global expenditure was estimated to have returned to about US$5 billion[85].

Figure 6.1. Global exploration for minerals by type, 2005



Source: Dimmell, P. M. (2005).

Expenditure in Europe (included within "other countries" in Figure 6.2) is low compared with the major mining countries such as Canada and Australia. Investment in exploration in Finland in 2004 totalled approximately €40 million, with about 30 domestic and international exploration and mining companies operating. In Sweden €31 million was invested in

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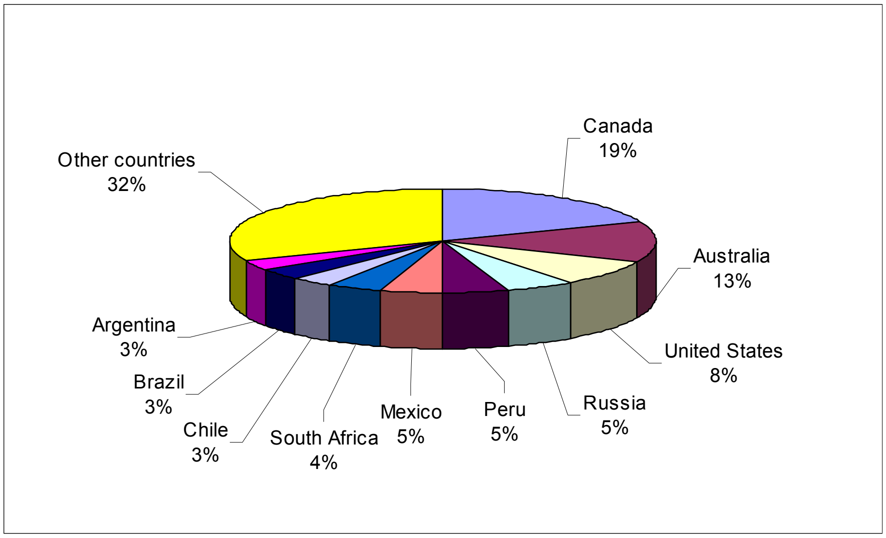
84 Mercer (2003). Paper to 4th Fennoscandian Exploration and Mining Conference, 2003.

85 Dimmell, P. M. (2005). "Global trends in mining exploration." In proceedings of the 5th Fennoscandian Exploration and Mining Conference, 2003.

exploration in 2005 by 65 different companies (both foreign and national)[86]. The view has been expressed that the bedrock and ore potential of the Fennoscandian Shield is comparable with the similar shield areas of Canada and Australia and is still under-explored. Many industrial mineral companies spend up to 3% of their sales turnover on exploration, acquiring data on new deposits or improving their beneficiation processes[87].

Figure 6.2. Global exploration for minerals by country in 2005



Source: Dimmell, P.M. (2005).

The extractive industry's Strategic Research Agenda[88] suggested that it is plausible that most of Europe's major surface metallic mineral deposits have been discovered, at least for the traditional commodities. Improvements in exploration technology are therefore of paramount importance for new discoveries of deeply buried resources and estimation of their economic potential. It has been suggested that robust three-dimensional models of the top 5 000 metres of the earth's crust within mineral belts need to be developed. Apart from gaining access to new resources, deep mining would minimise waste production and the environmental impact of extraction, which in turn would increase public acceptance of the extractive industry.

6.2.4. Approaches to encourage exploration

The high levels of expenditure on exploration in Canada (see above) are thought to have been achieved because of close cooperation between the government, securities regulators and the industry. Initiatives such as establishment of a joint securities regulator/industry task force to introduce higher standards of corporate reporting, combined with enforcement of the "qualified person" concept and the introduction in 2000 of the Investment Tax Credit for Exploration (ITCE) which enhanced the tax benefits of flow through shares are thought to have increased investment in exploration.

A few Member States offer financial assistance to private companies. More generally, the industry is assisted in the form of provision of geological maps produced with State funding.

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86 Source: EuroGeoSurveys.

87 Industrial Minerals Association – direct communication.

88 http://www.etpsmr.org/contents/downloadable-documents/Public%20Download%20Area/SRA_03.2006.pdf.

In Finland a government-owned investment company administered by the Ministry for Trade and Industry engages in equity capital investment and invests in venture capital funds, private equity funds and directly in selected target companies. Its funding is based on proceeds accrued from the privatisation of State-owned companies. Its role is also to acquire data on new areas and prospects to encourage further evaluation by the private sector. All discoveries and prospects are put out to global tender to the private sector by the Ministry for Trade and Industry as the government has no direct role in mining.

A mining fund (the Fennoscandian Mining Fund) has also been established to bridge the funding gap between early-stage exploration activity, which is funded by private entrepreneurs and exploration companies, and to provide sources of equity-oriented development capital which are required to finance prospective developments.

In the past the UK government had a policy to encourage mineral exploration and development[89] and provided private-sector finance for exploration for non-ferrous metals, fluorspar, barium minerals and potash in the form of grants awarded by the Department of Trade and Industry (DTI) under the Mineral Exploration and Investment Grants Act 1972 (MEIGA). The DTI also funded the British Geological Survey from 1973 until 1997 to provide baseline information on prospective areas for metallic minerals in Great Britain (known as the Mineral Reconnaissance Programme (MRP)). It was designed to stimulate private-sector exploration and to encourage development of Britain's indigenous mineral resources. This involved geological, geochemical, geophysical and metallogenic studies on a wide range of mineral deposits in many areas of Britain. The investigations ranged from "grass roots" reconnaissance surveys to diamond drilling of geochemical or geophysical anomalies.

The main emphasis was initially on exploration for base metals but, in response to changes in market conditions, through much of the 1980s efforts concentrated on "strategic" metals, such as platinum, palladium, chromium, manganese, vanadium, titanium, cobalt and nickel. From the late 1980s onwards, in response to changing exploration interests worldwide, the main focus of the programme was gold. Towards the end of the programme, a small number of projects concerned with gemstones and industrial minerals were also completed.

The MRP was regarded as having been very successful in stimulating exploration in Britain. More than half the projects carried out attracted significant commercial follow-up and many new prospects were discovered. Since 1998 BGS has undertaken minerals-related activities on behalf of the DTI under the Minerals Programme. In this programme the BGS provides information and advice to government and industry.

Germany had a scheme for encouraging exploration for raw materials in Germany and third countries between 1970 and 1990. Over €500 million are thought to have been spent[90].

Concern has been expressed by some representatives of the industry that government subsidies or tax reductions (depending on the country) which were formerly granted to facilitate exploration for new deposits or for better use and recovery of existing deposits have been removed and that this is discouraging exploration within the EU at the time when it is most important. On the other hand, the availability of government financial assistance is

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89 http://www.bgs.ac.uk/mineralsuk/exploration/potential/home.html.

90 Steinhage, M. – direct communication.

probably a secondary consideration in terms of investment interest compared with factors such as the mineral potential (particularly at times of high metal prices) and the regulatory regime.

6.3. Costs

6.3.1. Investment costs for new mines and quarries

The cost of acquiring a mineral operation varies significantly. Typical costs for an aggregates quarry can vary from around €2 million for a small quarry with an output of 0.25-0.5 million tonnes per year to between €7 million and €25 million for a large quarry producing more than 1 million tonnes per year. A super quarry can cost in excess of €45 million[91].

Metal mines can require considerably more investment reflecting the generally larger scale of operations, processing requirements to concentrate the ores and in many cases the need to operate underground. A zinc mine was commissioned in the EU at a total cost of US$134 million, while the capital cost of another was US$150 million, with capital and development costs of US$50.6 million in 2000 and US$35.2 million forecast for 2001[92].

6.3.2. Operating costs

6.3.2.1. Introduction

Operating costs can be difficult to obtain as companies usually treat such matters as confidential. However, some information is publicly available, while a number of companies provided data anonymously via their trade federations. In addition, the Commission purchased economic data from www.minecost.com, a company that collects and sells cost information on particular metal mines across the world. This analysis focused on the www.minecost.com data on copper and zinc mines only, as they are both relatively important in terms of EU production and demonstrate most of the issues relevant to this analysis.

This section looks first at the overall operating costs within the industry before looking more specifically at energy and transport costs. Labour costs were considered in detail in Section 5, but are touched on here.

6.3.2.2. Overall operating costs

Cash cost curves are a useful means of identifying the relative competitiveness of a mine, as they show the cost per unit weight of producing the mineral. Figure 6.3 provides cost curves for 112 copper mines operating globally, indicating the relative position of the five European copper mines included in the www.minecost.com database. Figure 6.4 provides a similar assessment of 66 zinc mines showing the position of seven EU mines. The data take account of revenue generated by sales of other metals obtained as by-products of extraction and processing of the main metal.

The two cost curves differ significantly. The seven EU zinc mines included in the assessment are widely dispersed across the chart with some having relatively low production costs and

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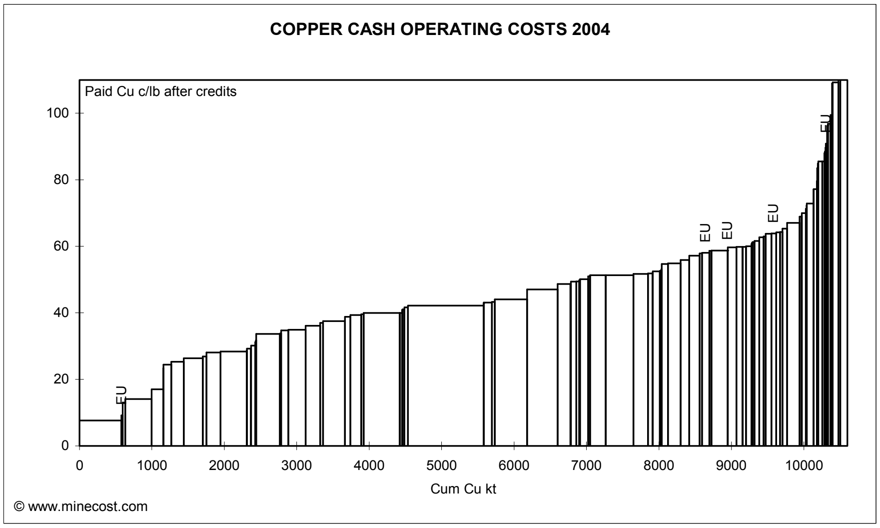
91 Lafarge data, cited from JP Morgan, Global Equity Research (Building Materials Sector), August 2005.
92 Minecost.com.

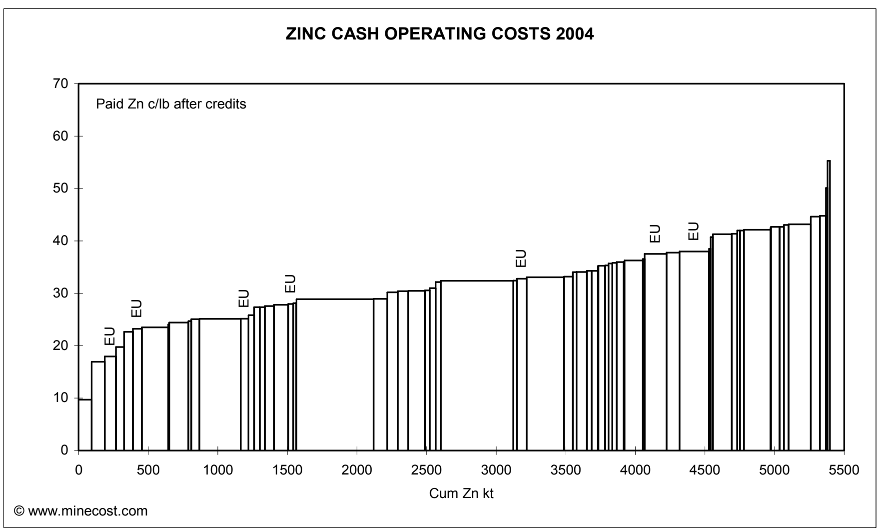
others high. Four of the five copper mines are at the top end of the graph. In other words, they have high production costs relative to many other mines globally.

Figure 6.3. Cash operating costs for global copper mines after credits in 2004



Data source: minecost.com.

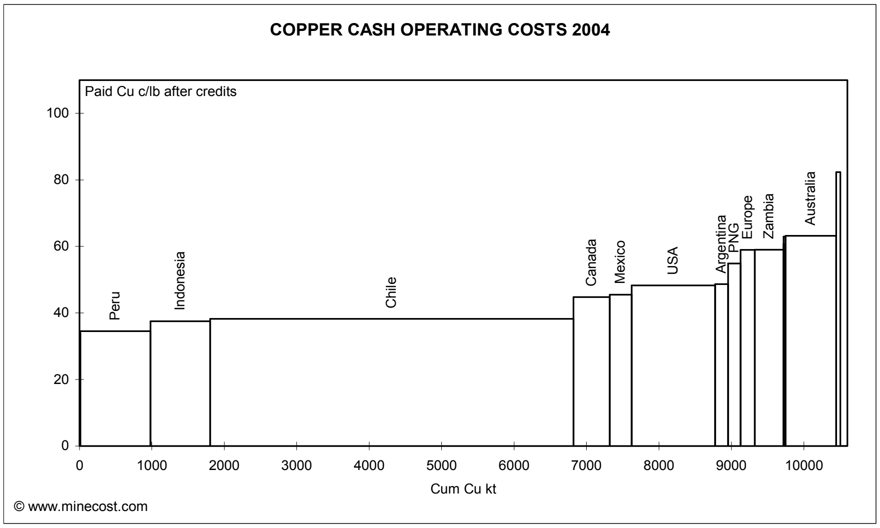
Figure 6.4. Cash operating costs for global zinc mines after credits in 2004, indicating EU sites included in the database



Data source: minecost.com.

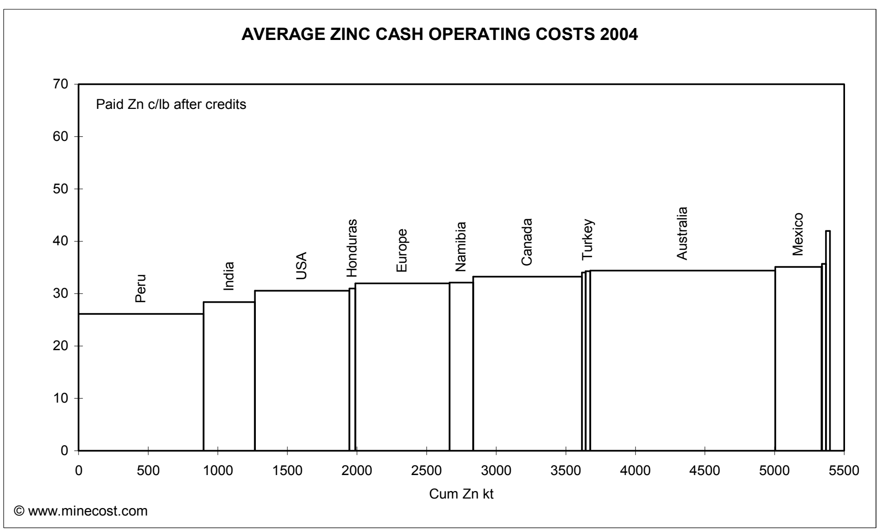
Reanalysis of the data to illustrate the average cost by country (or region) puts the EU towards the upper end of the copper cost curve (see Figure 6.5) but in the middle for zinc (see Figure 6.6). The dominance of Chile as the world's leading producer of copper, followed some way behind by Peru, Indonesia, the USA and Australia, can clearly be seen.

Figure 6.5. Comparison between cash operating costs taking account of credits for sales of other metals in copper mines in Europe and elsewhere (2004)



Data provided by www.minecost.com, but analysis and graphs by DG Enterprise and Industry.

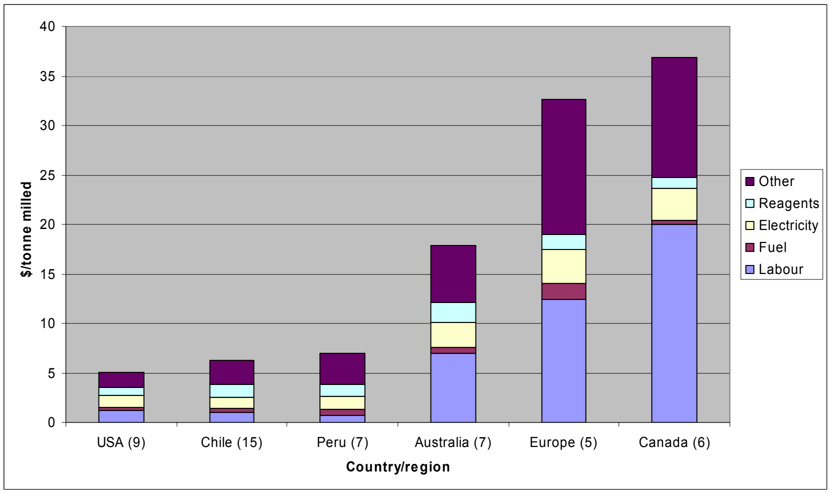
Figure 6.6. Comparison between cash operating costs taking account of credits for sales of other metals in zinc mines in Europe and elsewhere (2004)



Data provided by www.minecost.com, but analysis and graphs by DG Enterprise and Industry.

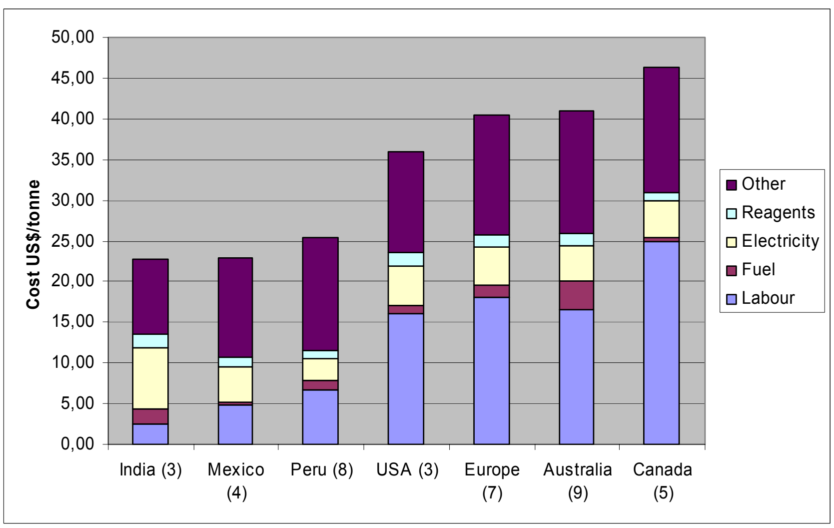
The database contains separate figures for the labour, fuel, electricity and reagents costs of on-site mining and milling at each mine. This allowed comparison of on-site costs in different parts of the world. Because of the amount of data involved, the analysis was limited to the EU sites in the database and the larger sites in countries which are significant producers of either copper or zinc. In all, 49 of the 112 recorded copper mines and 36 of the 66 zinc mines were considered, with the data averaged for each country. The results for copper are presented in Figures 6.7 and for zinc in Figure 6.8.

Figure 6.7. Average mining and milling costs per tonne of copper ore milled in selected mines in Europe and elsewhere (2004)



Data provided by minecost.com, but analysis and graphs by DG Enterprise and Industry. The figures in brackets indicate the number of sites in each country which are included in the analysis.

Figure 6.8. Average mining and milling costs per tonne of zinc ore milled in selected mines in Europe and elsewhere (2004)



Data provided by minecost.com, but analysis and graphs by DG Enterprise and Industry. The figures in brackets indicate the number of sites in each country which are included in the analysis.

The data illustrate, in particular, the much lower average cost of labour in India, Mexico, Peru and Chile compared with Europe, Australia, Canada and the USA[93]. It is also clear that labour costs dominate the cost structure in the more developed countries.

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93 The very low costs (per tonne of ore milled) indicated in Figure 5.23 for copper production in the USA are thought to reflect the dominance of reworking of spoil tips at the sites included in the assessment. As the costs are expressed in US$ per tonne of ore milled, the very large volumes of spoil milled and relatively limited mining involved skew the results.

6.3.3. Energy costs

The main energy requirements for mining and quarrying are to power ventilation systems, water pumps, crushing and grinding machinery and for heating to dry some minerals. The main sources of energy are electricity and fuel oil, but also smaller amounts of petrol, coal and gas. Diesel fuel is mainly used for haulage and transport. A report on the extractive industry in the USA suggests that across a range of construction, industrial and metallic minerals the extraction operation itself accounts on average for 19% of on-site energy consumption (almost half of which is used to pump water out of voids). Beneficiation and processing of ores accounts for 39%, but the largest category is materials handling which swallows up 42% of the energy consumed[94].

Energy requirements differ considerably, depending on the type of mineral being extracted, whether it is underground or on the surface and the extent to which it is processed. Underground mining requires significantly more energy than surface operations because of the need for ventilation, pumps and the longer haulage distances involved. Estimates of the cost of energy as a proportion of total operating costs for the three sub-sectors are presented in Table 6.3. These show that for industrial and metallic minerals energy costs can account for between 10% and 20% of total operating costs, depending on the mineral and the nature of the operation. According to Eurostat figures[95], purchase of energy accounted for 6% of total operating expenditure on average in 2003.

Table 6.3. Comparison of the relative costs of energy (electricity and fuel) as a proportion of overall operating costs

Sub-sector	Estimated energy costs in the EU as a proportion of overall site operating costs
Construction minerals (aggregates)	3%
Industrial minerals	11%-19%
Metallic minerals (copper and zinc)	15%-17%

Data source: UEPG and IMA with metallic data derived from minecost.com data.

Extraction companies that also manufacture products such as cement, lime or magnesia have significantly higher energy costs. It is estimated that 40% of the cost of manufacturing cement[96] and 45% in the case of lime production[97] is related to energy.

One of the main concerns expressed by the industry is that the cost of energy has increased significantly in recent years. The figure for industrial minerals presented in Table 6.3 relates to the situation in 2006. Comparable figures for 2000 have been estimated to range from 7% to 13%[98]. This suggests that over the six years the sector has faced a relative increase in energy costs of around 50%. Alongside other factors, such increases can significantly affect the competitiveness of a company. In its 2005 results Imerys, a major producer of kaolin,

94 US Department of Energy. "Energy and Environmental Profile of the US Mining Industry."

95 Eurostat. Statistics in Focus, Industry, trade and services. The non-energy mining and quarrying industry in the EU.

96 Cembureau – direct communication.

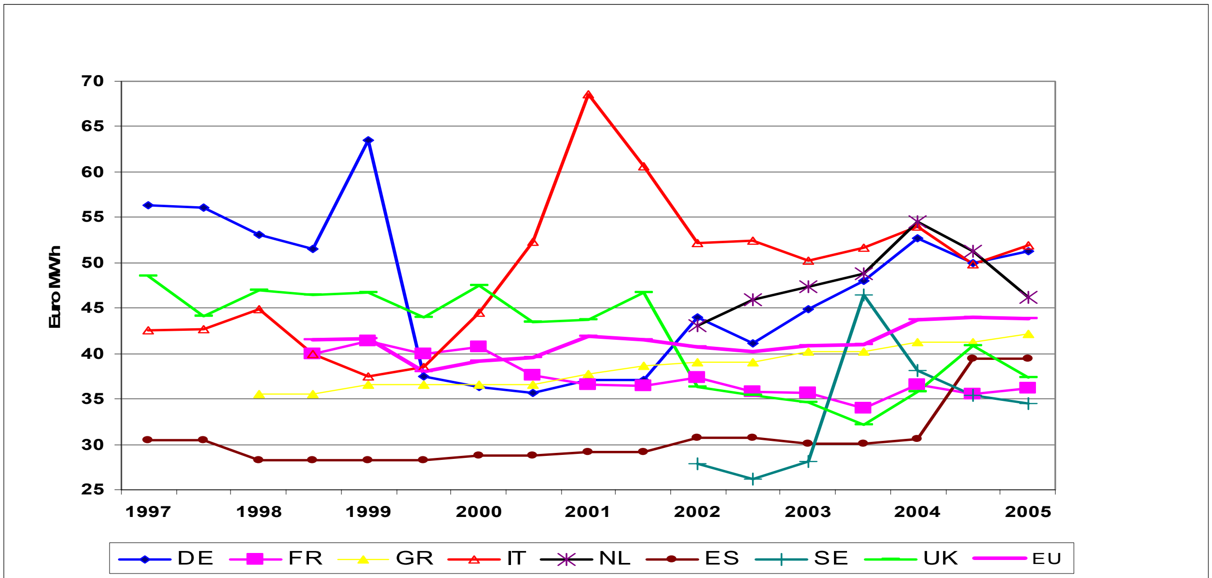
97 DG Enterprise and Industry data.

98 IMA – direct communication.

reported that its energy costs in the UK had increased by 42% compared with 2004. It has announced that it will cease production of paper-coating grades of kaolin and close its hydrous kaolin operations in the UK by the end of 2007, with the loss of 800 jobs, while increasing its kaolin production capacity for coating grades in Brazil. Energy costs were cited as the main reason[99]. A metal mining company which operates both in Europe and in several other regions of the world has indicated that its electricity costs in Europe have increased significantly compared with its non-European operations[100].

Within the EU Member States, electricity prices vary significantly and have fluctuated in recent years, as illustrated in Figure 6.9. The reasons for the increases and variability between Member States include changes in world energy prices (for oil and gas) caused by the fast growing demand from countries like China, the incomplete liberalisation of the EU energy market and national taxes in some Member States.

Figure 6.9. Electricity prices for very large industrial users (up to 50MW) in selected EU Member States



Source: Eurostat and UK DTI, taken from SEC (2006) 1069.

It has also been suggested that the EU's emission trading scheme (ETS)[101] may have led to price increases on the EU electricity market to the advantage of the energy suppliers (distributional effect). The parallel analysis of the competitiveness of the European metals industry[102] reported that, according to recent studies, the EU ETS contributes as much as 5% to 25% to the current electricity price level[103].

The ETS also applies directly to some of the vertically integrated companies operating in the sector. It applies to installations producing cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day and lime production in rotary and other types of kiln

99 Taken from Industrial Minerals, August 2006.

100 Details have been withheld at the request of the provider.

101 Directive 2003/87/EC of 25 October 2003.

102 Commission Staff Working Document SEC (2006) 1069: "Analysis of economic indicators of the EU metals industry: the impact of raw materials and energy supply on competitiveness".

103 Study by the Energy Research Centre of the Netherlands (ECN): "CO_2 price dynamics, the implications of EU emissions trading for the price of electricity", September 2005.

with a production capacity exceeding 50 tonnes per day[104]. Most cement and lime producers in the EU are therefore thought to fall within the scheme. Magnesia production is exactly the same process as lime production, except that magnesite (magnesium carbonate), rather than limestone (calcium carbonate) is calcined. It is for Member States to decide whether magnesia production is included in their national allocation plans. Most Member States which produce magnesia have not included the sector within the scheme, but some have. Operators in a country which is subject to the ETS are therefore at a potential disadvantage compared with competitors in other countries (in the EU and elsewhere) which are not.

These issues were the first to be considered by the newly established High-Level Group on Competitiveness, Energy and the Environment. This Group has been instrumental in focusing the EU policy agenda and providing advice endorsed by businesses and NGOs. The Group's recommendations have been considered by the Commission in its Action Plan on Energy Efficiency and its January 2007 Climate Change and Energy Package. The three pillars of the Energy Package call for a true internal energy market, acceleration of the shift towards a low-carbon energy economy and increased energy efficiency.

The industry has also expressed concern that Member States are applying different tax regimes for diesel used by the extractive industry, which is thought to put some producers at a competitive disadvantage.

6.3.4. Transport costs

Transport can have a considerable influence on the price of a mineral and, therefore, on the competitiveness of individual companies and the industry as a whole. This is particularly the case for bulky lower value minerals such as aggregates for which the cost approximately doubles if they are transported more than 50 km[105]. Freight and logistics costs can account for 50% to 70% of the cost of deliveries of industrial minerals to the customer[106].

In Austria about 50% of the total mass transported by road is building materials, accounting for about 25% of the tonne-kilometres moved[107]. Similarly, almost 350 million tonnes of minerals were transported on British roads in 2003, accounting for 21% of all goods transported. Of this, approximately 50% travelled less than 25 km. And if metallic minerals are excluded from the calculation, over 90% of minerals travelled less than 100 km (see Figure 6.10). Metallic minerals travelled further on average, with 20% of the total tonnage (4 million tonnes) being transported further than 100 km.

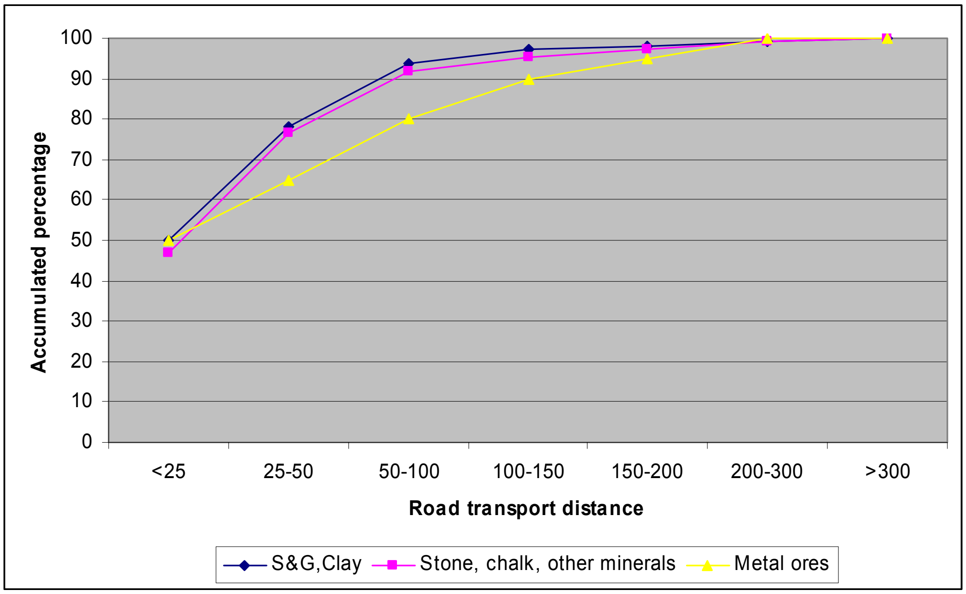
104 The scheme also applies to other furnaces with a production capacity exceeding 50 tonnes per day.

105 Leoben University report – see footnote 26.

106 O'Driscoll, M. (2004). "The economic importance of industrial minerals." IMA proceedings. See footnote 47.

107 Prof. Wagner – direct communication.

Figure 6.10. Length of haul of minerals on roads in Great Britain in 2003[108]



Data source: UK Department of Transport.

Modes of transport

Of the available forms of transport, road is the most expensive per tonne of material moved (see Table 6.4). As well as generally being cheaper, other modes of transport, such as rail and water, also reduce the number of vehicles on the roads, which in some Member States is considered to be one of the main causes of complaints and opposition to the industry. However, other forms of transport require additional infrastructure, for example wharfs for loading and unloading on and off ships. In the Netherlands, most concrete plants are located in harbours or on canals, so the material can be unloaded directly from barges into storage bunkers.

In the UK it is estimated that over 25% of industrial minerals are transported by rail or ship, which is a much higher proportion than for aggregates. However, a number of economic and practical disincentives have been identified which prevent even higher proportions being transported this way[109].

Table 6.4. Estimated cost ($c/ton-mile) of transporting aggregates using different forms of transport

Lorry	6-12 cents/ton-mile
Rail	3-6 cents/ton-mile
Barge	1-2 cents/ton-mile
Container ship	0.1-0.5 cents/ton-mile

Source: JP Morgan (2005). Global Equity Research.

108 Department of Transport (2004). "Transport of goods by road in Great Britain 2003. Annual report of the continuing survey of road goods transport."

109 Bloodworth, A.J. et.al. (2004). "Industrial minerals: issues for planning." Report commissioned by the British Geological Survey, CR/04/076N.

6.4. Regulatory framework

6.4.1. Introduction

As indicated in the introductory section, the non-energy extractive industry is regulated at both European and national level. Almost all the European legislation affecting the industry is horizontal and was not developed with the specific requirements of the extractive industry as a key objective.

This section considers in greater detail the EU provisions thought to affect the industry most directly, particularly those potentially affecting its ability to gain access to land and its operating costs. As the industry and representatives of some Member State identified the Habitats Directive and its requirement to designate areas of land as sites of Community importance and form a network of protected areas (Natura 2000) as having the greatest potential effect on the industry, this is considered in greatest detail below. This section draws to a large extent on contributions received by members of the Raw Materials Supply Group, in particular from NEEI representatives.

6.4.2. Legislation affecting access to land

The Birds and Habitats Directives (Natura 2000)

Many representatives of Member States and the industry have indicated that the Birds[110] and Habitats Directives[111], which together provide the basis for the Natura 2000 network of protected conservation sites, is having, or will have, a significant impact on the extractive industry's operations in Europe. The topic was covered briefly by Leoben University's study on mineral planning policies in the EU, although it was beyond the scope of that project to quantify the situation. As the issue has been raised so many times in different fora, it was looked at in some detail in order to provide a more quantifiable basis for future discussion[112].

The European minerals industry federations were asked to canvass their members to obtain examples of situations where designation of land as a site of Community importance (SCI) had resulted in an existing permit having to be modified or revoked. They were also asked if any permit applications had been turned down because the area of land was within or close to such a designated site. The results of this quick survey are summarised in Box 6.1. The European geological surveys were also consulted via EuroGeoSurveys for their views on mineral resources in Europe which might be of strategic importance to Europe in the longer term and may be located predominantly under protected areas, but at present there is no general direct evidence to support this. The initial analysis (see Box 6.1) suggests that the vast majority of existing mineral operations are unaffected by Natura 2000, although a number of companies have had to spend money to demonstrate to their competent authorities that they are not a threat to the protected areas, while some proposals to extend existing sites or for new permits have been turned down. For those companies already affected, this is a problem. The bigger issue for the industry as a whole could be in the future as it seeks to replace exhausted sites.

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110 Council Directive 79/409/EEC of 25 April 1979 on the conservation of wild birds.

111 Council Directive 92/43/EEC of 22 July 1992 on the conservation of natural habitats and of wild fauna and flora.

112 This analysis was restricted to Sites of Community Interest under the Habitats Directive.

Box 6.1. Summary of responses from the non-energy extractive industry and national geological surveys to the request for information on the current impact of Natura 2000 on permits for minerals extraction

Austria – A few aggregates companies are affected, although it is not clear if these are existing sites or proposals. Guidance has been produced explaining the requirements for activities affecting such sites.

Czech Republic - Current mining operations have not been affected by Natura 2000. However, a significant number of gravel and rock resources are within or adjacent to Natura 2000 sites and any future applications for a permit are expected to be rejected.

Finland - There are no exact figures on how the situation has already influenced exploration or mining, but companies will not risk money on exploration if the chances of starting mining are small.

France – A few proposals for extensions to existing sites and one renewal of a permit have been delayed, while in one case the area sought was reduced. The key concerns appear to be the time and costs involved in addressing the situation.

Germany – In one region 80 cases are said to be affected, although the nature of the difficulties has not been stated, and the outcome has yet to be decided. Another region indicated that eight potential sites had been excluded from the Regional Plan because of Natura 2000 designations. Problems were also recorded with a gypsum quarry. At another site, initial difficulties to extend the permit area had been resolved, although this had required much time and money.

Greece – While no existing permits were found to have been affected, there is concern that large areas of the Greek mountain chains (e.g. Olympus-Pindos in central/western Greece and Rhodope in north-eastern Greece) contain important mineral deposits but have been designated as Natura 2000 sites. A number of permit applications have been rejected.

Ireland – No active industrial extraction site has reported any negative impact as a consequence of Natura 2000.

Lithuania - New permits are not being granted on land notified as a Natura 2000 site. However, extraction can continue where a permit already exists. No permits have been revoked or suspended as a result of an area being notified as a Natura 2000 site.

Portugal - There are no legal constraints on exploration or extraction activities in protected Natura 2000 areas if the activity takes place in previously defined areas. However, the existence of Natura 2000 areas makes mining activities on such land impossible, because the national institution that manages the network considers that the environmental values are incompatible with mining. Mining activity in these areas is therefore limited because of the investment risks.

Slovakia – The national list of Natura 2000 sites is still being produced. No conflicts with extraction have been noted.

Spain – The industry is of the view that site selection was hurried and lacked a consistent approach across the autonomous regions. It has been suggested that the boundaries of some notified sites were set to stop future industrial development, including mineral extraction, but this has not been substantiated.

UK - Constraints have been placed on the extraction of ball clay resources which are overlain by wet heathland in Dorset. Current operations adjacent to designated areas are increasingly being constrained, possibly reducing the life of the existing pits. There are Natura 2000 sites within the China clay pits at St Austell in Cornwall. These are very small and will have an impact on only one backfilling operation. A small number of other examples of sites adjacent to designated areas were given, but in each case any difficulties had been resolved.

One international company which had carried out a quick survey of its members concluded that none of its quarries had been directly affected. There were examples of boundaries of designated areas being very close to the limit of the mineral concession (in France and Sweden).

The aim of the Habitats Directive is "to contribute towards ensuring biodiversity through the conservation of natural habitats and of wild fauna and flora…." by taking measures "designed to maintain or restore, at a favourable conservation status[113], natural habitats and species of wild fauna and flora of Community interest". Each Member State is required to contribute to the creation of Natura 2000 in proportion to the presence on its territory of the natural habitat types and habitats of species listed in Annexes I and II to the Directive.

The Directive's key provisions are in Article 6 which requires Member States to establish necessary conservation measures which correspond to the ecological needs of the habitats. Member States must take appropriate steps to avoid deterioration of the natural habitats and the habitats of species or to prevent significant disturbance of the species for which the areas are designated. Any plan or project[114] not directly connected with or necessary for management of the site but which is likely to have a significant effect upon it must be subjected to an "appropriate assessment" of its implications for the site in view of the site's conservation objectives. The competent authority cannot approve a plan or project until it has ascertained that it would not adversely affect the integrity of the site.

From the perspective of this analysis, there are two main issues: (i) the basis for the selection of Natura 2000 sites and (ii) the extent to which mining and quarrying activities are prevented within, or in the vicinity of, such sites. These are considered briefly below.

<u>Site selection</u>

There are two stages to designating sites. Stage 1 requires Member States to forward a list of *proposed sites of Community importance* (pSCIs), selected on the basis of the criteria set out in Annex III to the Directive and relevant scientific information. Stage 2 involves the Commission establishing, in agreement with each Member State, a list of sites of Community importance (SCIs), drawn from the national lists, identifying sites hosting priority natural habitat types or species. Once an area is on the agreed list, Member States then have up to six years to designate it as a special area of conservation (SAC).

The European Court has ruled that, when selecting and delimiting the boundaries of sites, Member States may not take the economic, social and cultural requirements or regional and local characteristics into account[115]. In addition, the discretion left to Member States in drawing up lists of sites is limited and subject to compliance with the criteria laid down in the Directive. The choice of sites has to be based on scientific criteria only; the list has to be complete, and the sites proposed have to provide geographical cover which is homogeneous and representative of the entire territory of the Member State, with a view to ensuring the coherence and balance of the Natura 2000 network[116].

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113 The species concerned is maintaining itself on a long-term basis as a viable component of its natural habitats, its natural range is neither being reduced nor is likely to be reduced for the foreseeable future and there is a sufficiently large habitat to maintain its population on a long-term basis (Article 1(h)(i)).

114 "Project" is not defined in the Directive, but the Commission's guidance points by way of analogy to the EIA Directive which provides that "project" means "the execution of construction works or of other installations or schemes … other interventions in the natural surroundings and landscape, including those involving the extraction of mineral resources".

115 C-371/98, First Corporate Shipping Ltd, November 2000.

116 ECJ cases against Ireland (C-67/99), Germany (C-71/99) and France (C-220/99).

The lists have been revised in recent years with the effect, in most cases, of reducing the area covered in each Member State from that initially proposed. Lists have not yet been finalised in some of the new Member States. The extent of terrestrial SCIs in each Member State in June 2006 is presented in Table 6.6.

Table 6.6. Number, area and % of national territory covered by terrestrial SCIs in each Member State (December 2006)

Member State	Number of SCIs	Area of terrestrial sites (km^2)	% of national land area
Austria	16 595	88 859 413	10.6
Belgium	278	3 040	10.0
Cyprus	367	661	11.5
Czech Republic	86 438	7 244	9.2
Denmark	254	3 177	7.4
Estonia	509	7 172	15.9
Finland	1 715	43 092	12.7
France	1 305	43 340	7.9
Germany	568	31 885	8.9
Greece	239	21 643	16.4
Hungary	467	13 929	15.0
Ireland	413	7 175	10.2
Italy	2 286	42 735	14.2
Latvia	331	7 095	11.0
Lithuania	267	6 493	10.0
Luxembourg	47	383	14.8
Malta	27	40	12.6
Netherlands	141	3 485	8.4
Poland	192	13 124	4.2
Portugal	94	16 013	17.4
Spain	1 380	113 921	22.6
Slovakia	382	5 739	11.8
Slovenia	259	6 359	31.4
Sweden	3 981	56 708	13.7
UK	613	15 978	6.5
EU-25 Total	20 862	482 638	12.2

Data source: http://ec.europa.eu/environment/nature/nature_conservation/useful_info/barometer/pdf/sci.pdf.
Note: The table excludes marine sites, some of which may extend onto land.

Almost half a million square kilometres of land within the EU has been designated as Natura 2000 sites, equivalent to 12.2% of the total land area. One notable point is that the proportion of national territory covered varies considerably between Member States. A report on implementation of the Directive published by DG Environment in 2004[117] states that many of the national lists predominantly reflect the distribution of nationally designated conservation areas that already existed in those countries (e.g. Austria, Finland, Netherlands and the UK), although in other cases a considerable number of new sites had also been proposed. Beyond that, buffer and transition zones designed to increase the coherence and connectivity between sites have also added to the recorded area.

117 Report from the Commission on implementation of the Directive (COM(2003) 845 final).

For the purposes of this analysis, the crucial issue for the extractive industry is not the absolute area of land which has been designated nor the proportion of a Member State's territory involved. The important issue is the extent to which designated areas coincide or overlap with important mineral resources, particularly of minerals which are not found elsewhere within the EU, and the extent to which the Directive really results in prohibition or restriction of mining activities.

Protection of designated areas

Once an SCI has been accepted by the Commission, Member States are required to take appropriate steps to avoid deterioration of the habitats and/or disturbance of the species for which the area was selected[118]. Any plan or project likely to have a significant effect must be subjected to an "appropriate assessment" of its implications for the site.

If an appropriate assessment of a proposal for a mine or quarry concludes that the activity is unlikely to affect the integrity of the site, the project can proceed (usually subject to conditions and following wider approval under the relevant mine licensing procedure applicable in the Member State). The survey of the industry revealed that there are examples of mining and quarrying continuing within Natura 2000 sites. If the appropriate assessment indicates that the activity will affect the integrity of a site, but the Member State considers that the project must be carried out for "imperative reasons of overriding public interest, including those of a social or economic nature", and in the absence of alternative solutions, the Member State can allow the activity to go ahead as long as all compensatory measures necessary to protect the overall coherence of Natura 2000 are taken[119]. Where the site hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.

The Directives therefore do not create an absolute exclusion to activities such as mineral extraction. The Commission has produced a number of guidance documents[120] on the application of Article 6 and also a few Member States are producing guidance for their minerals industries on how to approach the problem. Since a case-by-case examination of the possible negative impacts has to be made in the frame of the appropriate assessment, the competent authorities will need convincing arguments from the industry for the competent authorities to consider the extraction of the resource to be of overriding public interest.

To understand the strategic important of resources within protected areas requires a more detailed analysis than is currently available of the overall distribution of minerals in the EU and the overlap between different types of mineral and the protected areas. This would allow a more objective assessment of the relative scarcity of minerals that are particularly important to the EU economy and whether alternative sources exist in less constrained areas.

118 An SCI must be designated as an SAC "as soon as possible and within six years at the most".

119 However, the point has been made that the term "the absence of alternative solutions" is more relevant to infrastructure projects, since it is usually impossible to prove that there are no alternatives to mineral extraction in a given area, as there is always the option of obtaining the minerals from another region, another Member State or even from outside the EU.

120 http://ec.europa.eu/environment/nature/nature_conservation/eu_nature_legislation/specific_articles/art6/index_en.htm

A number of European geological surveys completed a questionnaire on the extent of modern mapping on their territory and whether they held GIS data indicating the extent of overlap of important mineral resources with SCIs. The results of the survey are presented in Annex 2 and indicate that some Member States have relevant GIS-based information (e.g. Italy, the Netherlands and the UK). Others are developing such a system (e.g. Cyprus, the Czech Republic, France, Poland and Sweden), while others are not (e.g. Denmark, Germany, Greece, Latvia, Portugal and Spain).

Environmental impact assessment (EIA) and strategic environmental assessment (SEA)

The EIA and SEA Directives serve generally similar purposes (assessment of the environmental effects), but cover two different processes. The aim of the **EIA Directive (Directive 85/337/EEC, as amended by Directive 97/11/EC)** is to ensure that the environmental effects of proposed public and private projects which are likely to have significant effects on the environment are assessed before the project is allowed to proceed. The **SEA Directive (2001/42/EC),** on the other hand, requires an environmental assessment of certain plans and programmes which are likely to have significant effects on the environment, which are subject to preparation and/or adoption by an authority at national, regional or local level or which are prepared by an authority for adoption, through a legislative procedure by Parliament or government, and which are required by legislative, regulatory or administrative provisions. In the context of this study, the SEA Directive is most likely to be applicable where a national, regional or local authority is preparing a land-use plan which is either specifically designed to deal with mineral extraction (e.g. a "minerals plan"), or where mineral extraction is one of the land uses considered in the plan. It is up to the authority developing the relevant plans or programmes to undertake the assessment.

The EIA Directive, by contrast, is aimed at organisations which propose to undertake a relevant project (e.g. either a private company or an authority)[121] and is therefore potentially more directly applicable to mineral extraction enterprises. The Directive lists a number of projects which are subject to an assessment in all cases (Annex 1) and other types of project for which the Member State must determine, either by case-by-case examination or by setting thresholds, whether the project should be subject to an assessment (Annex 2).

Annex I (paragraph 19) includes:

– "Quarries and open-cast mining where the surface of the site exceeds 25 hectares, or peat extraction, where the surface of the site exceeds 150 hectares".

Annex II (paragraph 2) lists:

– "(a) Quarries, open-cast mining and peat extraction (projects not included in Annex I);

– (b) Underground mining;

– (c) Extraction of minerals by marine or fluvial dredging".

[121] There is potential for overlap, as identified in a report for the Commission "The relationship between the EIA and SEA Directives" http://ec.europa.eu/environment/eia/pdf/final_report_08.pdf.

Annex III to the Directive sets out criteria that should be considered when determining whether a project listed in Annex II requires EIA, and Annex IV lists the information required from the developer. This includes a description of the project covering its physical characteristics and land-use requirements, the characteristics of the production process proposed and an estimate of the type and quantity of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from the proposed project. It also requires information on the likely effects on the environment and a description of measures aimed to mitigate adverse effects on the environment. An outline of the main alternatives studied by the developer and the main reasons for the choice is also required.

Some representatives of the industry have indicated that the cost and administrative burden is too much for small companies, although no specific details were made available. The report on minerals planning undertaken by Leoben University also indicated that the thresholds applied to the screening of Annex II proposals differ in individual Member States, which could, it is claimed, favour some operators in Member States with higher thresholds.

6.4.3. Legislation affecting operating costs

Management of waste from the extractive industries (Directive 2006/21/EC)

The proposal for a Directive on the management of waste from the extractive industries (the "Mine Waste Directive") was one of the priority measures (together with amendment of the Seveso II Directive and preparation of a reference document on best available techniques) recommended in the Communication "Safe operation of mining activities: a follow-up to recent mining accidents"[122]. The Communication was adopted in response to tailings dam failures at two metal mining facilities at Aznalcóllar in Spain in 1998 and Baia Mare in Romania in 2000. The Directive was published in the Official Journal on 11 April 2006 and will come into force on 1 May 2008[123].

Its aim is to provide measures, procedures and guidance to prevent or reduce as far as possible any adverse effects on the environment and any resultant risks to human health brought about as a result of the management of waste from the extractive industries. It deals, in particular, with management of spoil heaps (also known as tips) and tailings ponds (or lagoons), combined with a more limited set of requirements for management of extractive waste which is inert or put back into the extraction void.

The Directive will require all operators to prepare a waste management plan which sets out the quantity and type of extractive waste to be produced and to explain how they propose to manage it. Operators of sites producing hazardous and non-hazardous non-inert waste as well as inert waste managed in a Category A facility (i.e. the waste facilities which pose the greatest risk to the environment or human health in case of failure or malfunction) will be required to obtain a permit from the competent authority which will set out the requirements for operation, closure and after-management of the facility. Operators of Category A facilities will also be required to prepare a major-accident prevention policy and put into effect a safety management system implementing it. The competent authority will be required to draw up an

[122] COM(2000) 664.

[123] A number of operators have indicated that some Member States are already applying the general requirements of the Directive and the BAT guidance to new sites.

external emergency plan specifying the measures to be taken off-site in the event of an accident.

Some of the more detailed aspects are still being developed with the aid of the comitology procedure, such as waste characterisation, sampling methods, the classification of Category A facilities and preparation of guidance on the use of financial guarantees. The response of the industry to the Directive has generally been positive, although some operators have commented on the additional administrative burden of categorising their waste arisings and producing a waste management plan. For operators of Category A facilities, preparation of a major-accident prevention policy and the potential cost of a financial guarantee (where required) are considered to be additional burdens. As the Directive has yet to come into force and many of the provisions reflect existing best practice in the industry, it is difficult to assess in any detail the effects on the competitiveness of the sector. However, it is recognised that the Directive provides legal clarity and a specific legal framework adapted to the specificities of the extractive industries; in this way it is therefore expected that it will have a positive effect.

Seveso II

Directive 96/82/EC on the control of major-accident hazards involving dangerous substances (Seveso II), as amended by **Directive 2003/105/EC**, aims to prevent major accidents which involve dangerous substances and to limit their consequences for man and the environment. The 2003 amending Directive introduced exclusions for the exploration, extraction and processing of minerals in mines, in quarries or by means of boreholes, with the exception of chemical and thermal processing operations and storage related to those operations which involve dangerous substances, as defined in an Annex to the Directive. It also excluded offshore exploration and extraction of minerals. However, it removed from the previous list of exclusions, disposal facilities for operational tailings containing dangerous substances, as defined in the Annex to the Directive, in particular when used in connection with the chemical and physical processing of minerals.

Operators of existing mining waste facilities which fell within the scope of the Directive as a result of the amendments were required to notify the competent authority of various details, including the quantity and physical form of the dangerous substances involved, the activity proposed and the immediate environment of the establishment, within three months after the date from which the Directive applies. For new establishments, the Directive refers to "a reasonable period of time prior to the start of construction or operation" (Article 6). Operators of existing facilities are then required to produce a safety report within three years of the date when the Directive came into force. This report must demonstrate that:

– a major-accident prevention policy and a safety management system for implementing it have been put into effect;

– major-accident hazards have been identified and the necessary measures have been taken to prevent such accidents and to limit their consequences;

– adequate safety and reliability have been incorporated into the design, construction, operation and maintenance of any installation, etc.;

– internal emergency plans have been drawn up, and information has been supplied to enable an external emergency plan to be drawn up in order to take the necessary measures in the event of a major accident.

These requirements are the same as for the Category A facilities defined in the Mine Waste Directive (see above). As a result, mine waste facilities which fall within the scope of Seveso II are not subject to the similar requirements required under Article 6 of the Mine Waste Directive.

Member States were required to bring the laws, regulations and administrative provisions necessary to comply with this Directive into force before 1 July 2005. According to DG Environment[124], none of the 8 000 or so facilities recorded in its database as being covered by the Directive as of June 2006 is associated with the extractive industry.

Integrated pollution prevention and control (IPPC) Directive (Directive 96/61/EC)

The purpose of the IPPC Directive is to achieve integrated prevention and control of pollution arising from a range of industrial activities listed in Annex I to the Directive. Competent authorities are required to ensure that applicable installations are operated in such a way that:

– all appropriate preventive measures are taken against pollution, in particular by application of best available techniques (BAT);

– no significant pollution is caused;

– waste production is avoided, or where waste is produced it is recovered, or where that is not economically or technically possible the waste is disposed of while avoiding or reducing any impact on the environment;

– energy is used efficiently;

– the necessary measures are taken to avoid accidents and limit their consequences;

– the necessary measures are taken upon definitive cessation of activities to avoid any pollution risk and return the site to a satisfactory state.

Annex I does not mention activities directly related to the extraction of non-energy minerals, but it does cover the activities of some downstream industries which are vertically integrated with mining and quarrying. These include installations for the production of cement clinker and lime[125] and for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain[126].

Although the sector is not listed in the IPPC Directive, according to Euromines some Member States have taken the unilateral decision to apply it to some mining installations, e.g. Austria, Spain, the Netherlands and Slovakia. Slovakia has developed its own BREF note for

[124] Direct communication.

[125] Rotary kilns with a production capacity exceeding 500 tonnes per day of cement clinker or 50 tonnes of lime or other types of furnace with a production capacity exceeding 50 tonnes per day.

[126] With a production capacity exceeding 75 tonnes per day and/or with a kiln capacity exceeding 4 m^3 and with a setting density per kiln exceeding 300 kg/m^3.

magnesite production. According to a report by the Commission on implementation of the Directive, this is not unique[127]. It could reflect the fact that some countries were operating integrated licensing procedures before the IPPC Directive came into force.

6.5. Planning for minerals supply

While Europe's population demands raw materials for new roads, schools, hospitals and other infrastructure, there is often widespread opposition from local communities to any proposals from the extractive industry to work a new area of land or to extend an existing operation. Much of the EU is constrained by landscape and biodiversity protection areas, high-quality agricultural land, forests and other land uses which are considered by society to be of high value. The industry has often expressed concern that it is becoming increasingly difficult to gain access to new resources, either because some national and local governments do not recognise the importance of minerals and therefore give relatively little weight to the need for minerals compared with other issues or because large tracts of land are designated under EU, national or local legislation as protected areas, from which the industry is excluded.

However, minerals are vital for the continued development of Europe. Demand is usually driven by downstream industries and, for construction materials in particular, by public authorities (see, for example, Section 3.2.1). Unless resources are replaced as they become exhausted, the EU will either be faced with an increasing shortage of materials available to meet demand or will become increasingly dependent on imports. Importing minerals that can be extracted economically within the EU not only affects important jobs within the industry in the EU but also has implications for the competitiveness of larger downstream sectors, as was seen in Section 2. If the imports are sourced from regions whose low price is a function of poor environmental and health and safety standards, there is also a strong argument for saying that the EU is unnecessarily exporting its environmental and other responsibilities.

As one component of this analysis, the University of Leoben was commissioned to undertake a review of the minerals planning policies and supply practices in each of the EU Member States. Its review sought to describe:

– EU legislation which has an impact on national minerals planning policies and practices;

– national systems of ownership of mineral resources;

– existing national legislation, policies and administrative procedures for securing supplies of minerals;

– key features of national and regional land-use planning systems which have an effect on the extractive industry.

The final report was published in November 2004[128]. Many of the report's findings have been summarised earlier in this report. It also made six recommendations which are repeated *verbatim* below.

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127 Report by the Commission on the implementation of Directive 96/61/EC concerning integrated pollution prevention and control (COM(2005) 540 final).

128 See footnote 26.

Issue No 1: The limited knowledge of the importance of the non-energy extractive industry in Europe.

The study has shown that the official statistics concerning the non-energy extractive industries are incomplete. The most serious shortcomings are in the important areas of industrial minerals and construction minerals and in particular aggregates. The problem is caused by the structure of this sector which in many Member States comprises a substantial number of medium, small and very small enterprises. These are not covered by the national statistics and consequently also not by Eurostat. The second difficulty arises from the fact that many enterprises in this sector are vertically integrated and that it is difficult to clearly identify which part of the business is minerals extraction and which is processing and value added. As a result of the incomplete statistical data the economic and strategic importance of the sector is not fully appreciated.

Leoben recommendation:

It is recommended that a study group is established to address this issue and to come forward with a proposal on how more complete and reliable data on the economic importance of the sector can be collected on an ongoing basis. The following data should be collected:

- *Production*
- *Employees*
- *Revenue generated*
- *Land used for mineral extraction*
- *Land returned for other uses.*

Issue No 2: The lack of appreciation of the strategic importance [of] non-energy minerals and in particular construction minerals (aggregates) for the development of Europe.

The study has shown that about 3 billion tonnes of aggregates are produced and used in Europe annually. These aggregates are required by the construction industry for building and infrastructure development. In addition the industrial minerals sector is of global significance. The minerals legislation of most Member States does not recognise the growing importance of these sectors of industry. This is particularly noticeable in the areas of land use planning and access to mineral deposits.

Leoben recommendation:

It is recommended that at the European and national level more attention is given to the growing importance of industrial minerals and construction minerals (aggregates), including at the political and legislative level. Issues of particular importance are access to mineral deposits in areas of high industrial activity.

Issue No 3: In most Member States non-energy minerals are allocated a low priority by the governments of the day.

The study has shown that only a small number of Member States have clearly defined national minerals policies although all Member States subscribe to the concept of sustainable development. The low level of importance attached to non-energy minerals is seen as a disadvantage in land-use planning. Land-use planning is a matter of deciding between different options of land use, and deciding on priorities. As a result, access to mineral deposits is becoming increasingly difficult with the effect that many mineral deposits are no *longer accessible. This, however, impacts on the sustainability of the minerals supply from local mineral resources. This could develop into a long-term supply problem, particularly in the case of aggregates which are consumed in such large quantities and cannot be imported readily from most parts of Europe.*

Leoben recommendation:

It is recommended that Member States examine how the sustainable supply with non-energy minerals and in particular with construction minerals can be secured in the light of increasing demands.

Issue No 4: In most Member States access to mineral deposits is becoming more difficult.

Under issue No 3 reference was made to land-use planning which is considered to be the key to sustainable minerals supply. The study has identified that one of the problems in connection with land-use planning is lack of information on mineral deposits within land-use data bases. As a result minerals are often not being considered in land-use planning.

Leoben recommendation:

It is recommended that Geological Surveys become more actively involved in land-use planning and as a matter of priority provide information on mineral deposits for land-use data bases.

It is also recommended that land-use planning is done at two levels, namely the strategic long-term level looking at the national level at time frames of several generations and at the operational level, where all details have to be considered.

It is further recommended that minerals extraction areas are identified in land-use planning systems and protected against other potential uses.

Issue No 5: The time required for authorisation of mineral extraction tends to be very long and the outcome is often uncertain.

The study has shown that the authorisation process can take several years. This has resulted in situations where the proposed extraction period is the same duration as the authorisation process. Furthermore the cost of the authorisation process is such that it is no longer affordable for small operators. The main causes for this development are the large number of authorities involved in the process, the complexity of the environmental assessment procedure and the increasing involvement of the public.

Leoben recommendation:

It is recommended that attention is given to how the authorisation process can be made more transparent and stream-lined. Attention should be given to the concept of "one stop - one shop" which is being applied successfully in Canada and based on the principle of parallel processing and intense cooperation between the authorities.

Issue No 6: The increasing environmental pressures on the non-energy extractive industries.

In recent years numerous EU Directives on environmental matters have been issued. These have had a significant effect on the extractive industries both in terms of access to mineral deposits as well as in terms of complexity and cost of the authorisation process.

Leoben recommendation:

It is recommended that in addition to the environmental initiatives at the EU level initiatives which address the sustainable supply of Europe with natural resources and in particular mineral resources are also being considered.

These are the conclusions and recommendations of an independent consultant and were not influenced in any way by the Commission. It appears from presentations made by representatives of the extractive industry since publication of the Leoben report that there is general support for the recommendations. A number of the observations, particularly those concerning the difficulty of obtaining accurate data on the industry, were also experienced during production of this report.

The most important recommendations from the Leoben study relate to the need for a more efficient approach to forward planning for minerals supply in some Member States. Both the Leoben study and this one identified the very different practices in individual Member States reflecting firstly that the matter is a national competence, but also the very different nature of the industry and its markets in different Member States. A number of examples of good practice were identified. Most involve production of minerals plans at either national or local level which provide a clear guide to the minerals industry, decision-makers and the public about the locations where mineral extraction may take place, but also where it is unlikely to be allowed. This provides greater certainty for the industry when it makes proposals and also has the potential to transfer the “political” discussion about demand and the need for additional sites to strategic planning level rather than in response to individual applications. This also allows more objective consideration of issues such as the need for a particular mineral or the relative importance of identified constraints, such as forest or conservation areas (whether designated under EU, national or local legislation). However, this top-down approach is not considered appropriate in all cases. The Netherlands, for example, developed such a system in the 1970s and 1980s, but changed its policy in 2002-2003. Top-down planning of mineral extraction sites was not considered successful due to local resistance to such projects, which consequently made local and regional governments reluctant to allow new mineral developments, especially projects in the south-east of the country which were needed to supply the west. Companies are now expected to develop bottom-up projects working together with local parties. Both the companies and the government believe this to be a more successful approach. This may indeed be a way of providing a better clarification in relation to environmental pressures sometimes exercised by the extractive industries.

Whatever the approach, knowledge of the distribution and quality of mineral resources within the EU (as discussed above) and their strategic importance would provide a basis for objective consideration of the issues. The Leoben study did not review the current extent of mapping in each Member State. However, as a contribution to this study, EuroGeoSurveys sent a questionnaire to national geological surveys on the extent of modern geological mapping in each Member State. The response (see Annex 2) indicates that there is comprehensive coverage in some Member States, and less in others. As issues dealing with land use are matters for individual Member States, a useful first step would be to address the issue of national demand and supply in each country (as already happens in many Member States). There would appear to be benefits in a more regional or Europe-wide approach. The study on construction raw materials policy and supply practices in north-western Europe coordinated by the Dutch Ministry for Transport, Public Works and Water Management is a good example of how a regional assessment can provide a better basis for understanding patterns of demand and supply and thereby identify where shortfalls are likely to occur.

There are also likely to be benefits if plans (or separate policy statements) provide criteria against which applications for permits are assessed. Where possible and practicable, known mineral deposits should be protected from unnecessary sterilisation by other forms of development. In the UK, for example, areas are often identified on plans as mineral consultation areas, within which there is a presumption that mineral extraction should be considered before other forms of development which might exclude the future possibility of extracting underlying minerals. By contrast, in the Netherlands, while planners are required to consider protection of resources, sealing large areas of land from other developments is not considered acceptable. Protection of resources is considered to be more relevant when dealing with unique resources which are available in only a very limited number of areas.

The Leoben study also recommended use of landbanks as a means of making forward provision for minerals[129]. A landbank, as used in the UK, is the sum of the tonnage of mineral reserves with a valid permit. The minimum length of the landbank reflects the time needed to obtain a permit and bring a site into full production. In the UK this is taken as seven years for aggregates. Therefore a landbank of less than seven years is an indication that additional resources may need to be permitted. The policy in the UK is that where a landbank is more than twice the minimum – 14 years – the permitting authority should grant a new permit only where it is shown that demand could not be met from the existing permitted reserves, for example for reasons of quality and/or distance to market. In such cases, the industry is encouraged to agree voluntarily to revocation of existing permits at sites that are unlikely to be worked again to provide a more accurate figure for the available permitted reserves.

Where there is a distinct and separate market for a specific type or quality of aggregate, for example high-specification aggregate, a separate landbank calculation may be justified. Good practice guidance for minerals published by the UK suggests that landbanks are not appropriate for high-value internationally traded commodities because of the competition from overseas sources on the open global market.

The World Bank Group[130] has also expressed the need for an effective minerals policy framework when developing guidelines for multinational companies to mine in developing countries. As many of the issues are just as relevant to the EU, its recommendations are set out in Box 6.2 below.

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129 This recommendation was included in the general text, rather than as a main recommendation.

130 John Strongman (2005). Presentation to the Intergovernmental Forum on Mining, Metals and Minerals, Geneva, 7-9 November 2005.

Box 6.2 Recommendations made by the World Bank Group in relation to the need for and content of a minerals policy

Minerals policies should clearly :
- state the respective roles of the government and the private sector;
- outline the key elements of regulatory policy;
- identify key government institutions and their functions;
- link mining policy to other key national policies, especially fiscal, environmental, social and regional development policies.

Particular elements include:

<u>Economic aspects</u>
- procedures for licensing and closure;
- fiscal regime – including duties and royalties;
- procedures for revenue collection and management;
- arrangements for the provision of infrastructure;
- arrangements for benefit-sharing at local and regional level, including the participation of local communities;
- linkage to local and regional economic development;
- agreements regarding local sourcing of supplies and services;
- procedures for supporting small and medium-sized business development;
- procedures for collecting, reporting, monitoring and verifying economic data.

<u>Environmental aspects</u>
- collection of baseline data;
- establishment of water and air quality compliance criteria;
- procedures for reporting, monitoring and verifying environmental data;
- procedures for hazardous materials handling and storage;
- requirements for biodiversity and natural habitat conservation;
- requirements for local rehabilitation and restoration;
- procedures for protection of forests and cultural sites;
- procedures for integrated land-use planning;
- procedures for collecting, reporting, monitoring and verifying economic data.

<u>Social aspects</u>
- identification of those affected by the project;
- procedures for protecting their rights;
- procedures to address the special needs of indigenous people;
- procedures for prior, informed consultation;
- procedures for resettlement and compensation/income restoration;
- measures to protect and enhance local culture;
- measures to reduce risks and improve benefits to the most vulnerable groups;
- measures to build community institutional capabilities;
- arrangements for mine site security;
- procedures for collecting, reporting, monitoring and verifying social data.

<u>Administrative aspects</u>
- mining ministry – sets policy and initiates legislation;
- geological survey – oversees resource base data;
- mining department – administers the mining law and regulations and oversees the relationship between the mining companies and local communities;
- mining cadastre – registry of mining claims;
- environment ministry – sets policies and initiates legislation;
- environmental protection authority – environmental monitoring and enforcement;
- local government authority – provides services to the local community; supports partnerships between the mine and the local community.

6.6. Availability of a skilled workforce

The NEEI employs a large number of highly skilled specialists as well as providing many semi-skilled and unskilled jobs. This includes not only mining engineers, metallurgists and minerals specialists, but also relevant disciplines such as geology, planning and environmental science. There has been increasing concern in recent years that the number of students graduating in subjects that are relevant to the sector is falling as is the number of graduates then taking up posts in the industry. At the same time the average age of the workforce is increasing, with a significant percentage likely to retire over the next five to ten years.

An assessment of graduates from EU universities with mining-related degrees was undertaken as part of this analysis. Data for 10 universities were collated covering the period 1996-2001 (see Table 6.7). This gave a mixed picture, with a general slow downward trend, within which there is some variation. While numbers appear to have fallen at some universities, at others they have increased. The small number graduating from some universities in certain years is noticeable and has led to concerns about the viability of some of the existing courses. A number of mining universities and courses in Europe and around the world have already shut in recent years.

Table 6.7. Number of graduates from EU universities with mining-related degrees[131]

Year	Leuven	RSM	Leeds	Delft	Helsinki	Clausthal	Camborne	Aachen	Freiberg	Leoben	Total
2001	6	5	6	4	3	10	13	17	32	6	96
2000	7	3	6	3	4	13	13	26	28	13	103
1999	5	11	15	4	3	10	31	20	16	9	105
1998	13	5	16	3	8	15	8	29	21	7	118
1997	8	14	11	5	4	16	16	23	21	10	109
1996	9	8	17	5	6	13	10	24	19	12	111

A much more detailed assessment of the global supply and demand for graduates in mining engineering, geology and metallurgy is being undertaken jointly by four of the largest mining companies in the world - Anglo American, BHP Billiton, Rio Tinto and Xstrata - which together account for approximately 40% of global capitalisation in the minerals industry (excluding Russia and China). The full results have not been published, but Dr Chris Cross of Rio Tinto provided the Commission with a summary of his company's contribution to the study which focused on mining engineering, metallurgy and mineral engineering. Much of the analysis which follows is based on the information he provided.

The aim of the study by the industry was to examine if there is a shortfall in the supply (or quality) of graduates and what can be done to address the issue. It involved a survey of universities and professional bodies in countries where the four companies recruit staff – Australia, Canada, Chile, Europe, South Africa and the USA. In addition to determining the supply of graduates, it also considered the stability of departments and assessed what could be done to address the issues raised.

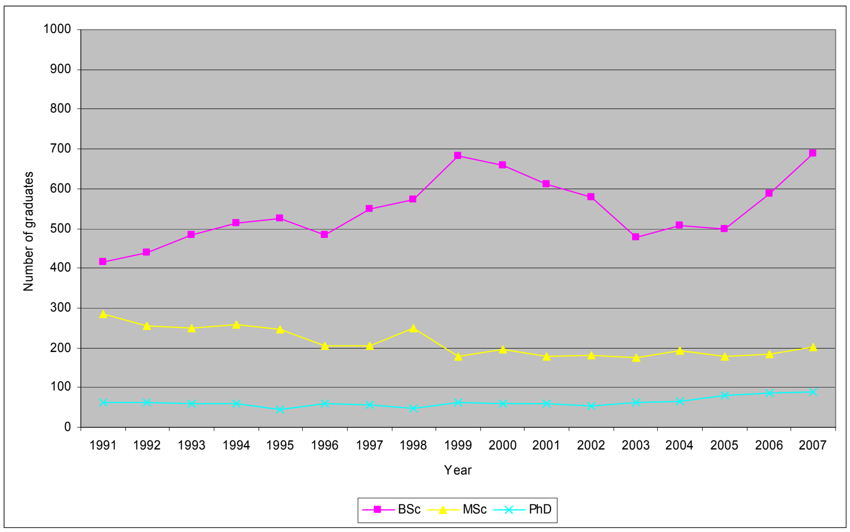
131 Prof. Hans de Ruiter "Mining and mineral engineering education", except data for Aachen and Freiberg provided by Prof. Ulrich Hahn (Deutscher Gesteinsverband e. V.) and Leoben University provided by Prof. Wagner.

Mining engineering

Mining engineering is a vocational degree which specialises in the mining industry and covers topics such as ventilation, rock mechanics, economic geology and mining methods. It is a vital discipline if the industry is to maintain safe and efficient production.

The survey of university departments indicated that in 2004, a total of 500 BSc and 190 MSc mining engineers graduated (see Figure 6.11). However, up to 40% of these graduates are thought to be unlikely to join mining companies directly, suggesting that only about 414 graduates are available to the industry. This is the lowest figure since the early 1990s, which itself was the lowest ebb since 1974.

Figure 6.11. Number of graduates from mining engineering programmes in Australia, South Africa, Chile, Canada, the USA and Europe



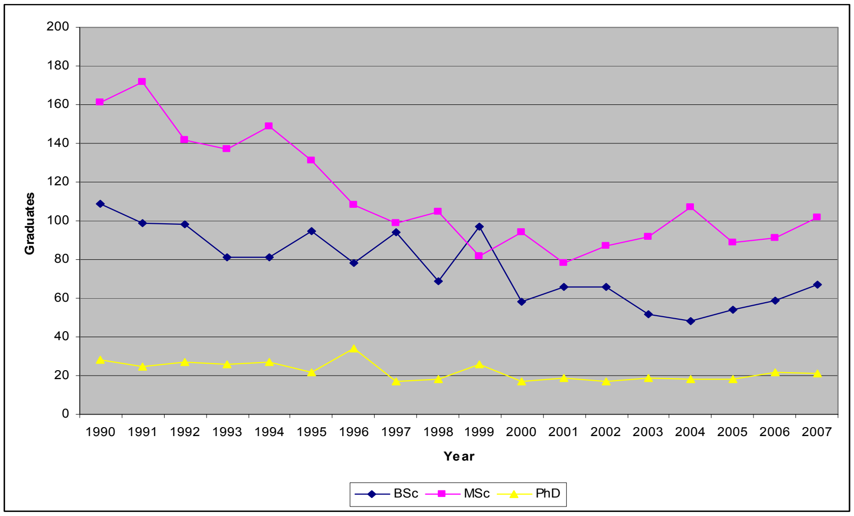
Source: Chris Cross, Rio Tinto – direct communication.

Demand for graduates was difficult to determine accurately because of the small number of companies supplying data, but it was estimated that the current demand is in the range of 500 to 800 graduates per year. There is therefore a shortfall and a low point in the supply cycle for mining engineers, at the same time as demand is increasing globally. In addition, the age structure of engineers already employed is towards the higher age bands and a relatively large number of mining engineers will retire in the short to medium term.

The survey involved 13 mining engineering departments in Europe (out of 23 which were sent survey forms)[132]. The trend in the number of graduates is illustrated in Figure 6.12. Most of the departments in Europe are very small, with the majority having fewer than 10 graduates a year.

[132] The data provided separated the UK from other EU countries. The analysis here combines the two.

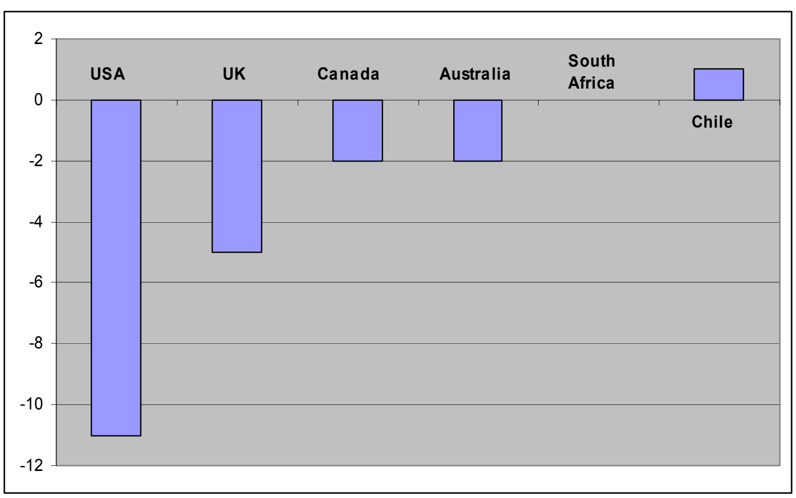
Figure 6.12. Number of graduates from mining engineering programmes in Europe (1990-2007)



Source: Chris Cross – direct communication.

Of 53 university departments identified in the survey as teaching mining engineering, five are closing and 24 average fewer than 10 graduates a year. There are also concerns about the sustainability of at least three other departments. This is set against the wider background that over the last 20 years 20 mining engineering departments have closed in Australia, Canada, the UK and the USA, although one has opened in Chile (see Figure 6.13). It was concluded that the closures were due to a variety of reasons, including lack of students studying mathematics and science at upper secondary school, the closure of courses with a high cost per student and a negative image of the mining industry. Surviving departments tend to be small, with almost half of those surveyed turning out less than 10 graduates per year. Other studies have also suggested that the cyclic "boom and bust" nature of the industry deters potential applicants who are looking for stable careers[133].

Figure 6.13. Change in number of university mining programmes between 1985 and 2004



Source: Knights, P. Taken from Chris Cross – direct communication.

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133 Mining Industry Training and Adjustment Council (2005). "Prospecting the future: Meeting Human Resources Challenges in Canada's Minerals and Metals Sector."

Metallurgy and mineral engineering

Minerals processing and extractive metallurgy programmes are specialised courses which, like mining engineering, are having difficulty remaining viable at many universities. The courses are often absorbed into other departments, such as chemical engineering or materials science.

The industry's survey of universities included information from eight European universities[134] and from universities in the USA, Canada, South Africa, Australia and Chile. Many of the programmes in Europe are post-graduate courses, and there are few at undergraduate level. It should be noted that the EU universities contacted were selected because of existing relationships with the mining companies taking part in the study. The study did not cover eastern European universities, where the supply of graduates is thought to be strong. The Faculty of Mining at the Stanislaw Staszic University of Mining and Metallurgy in Poland, for example, was reported as having six departments with over 2 500 full-time and part-time students.

While specialised minerals processors and metallurgists are more immediately relevant to the industry, the general skills and the high quality of chemical engineering graduates are equally attractive. It was estimated that approximately half the metallurgists and minerals processors employed trained initially as chemical engineers.

Globally, the supply of minerals processing and extractive metallurgy graduates with BSc or MSc level degrees has declined by approximately 25% over the last 10 years, from a high of 291 graduates in 1994 to around 220 graduates per year now. Of these, perhaps 30% will not seek employment in the minerals industry.

It is estimated that the annual demand is approximately 340 graduates per year. Assuming that 50% of these are chemical engineers, approximately 170 pure metallurgists and minerals processors are needed. The demand is therefore higher than the current supply level of perhaps 154 graduates hoping to enter the industry. Fortunately, chemical engineering is a stable subject in which large numbers graduate every year.

The situation in the eight European universities involved in the survey is presented in Figure 6.14. Numbers appear to have fallen dramatically in 2001 and to have picked up slightly since then.

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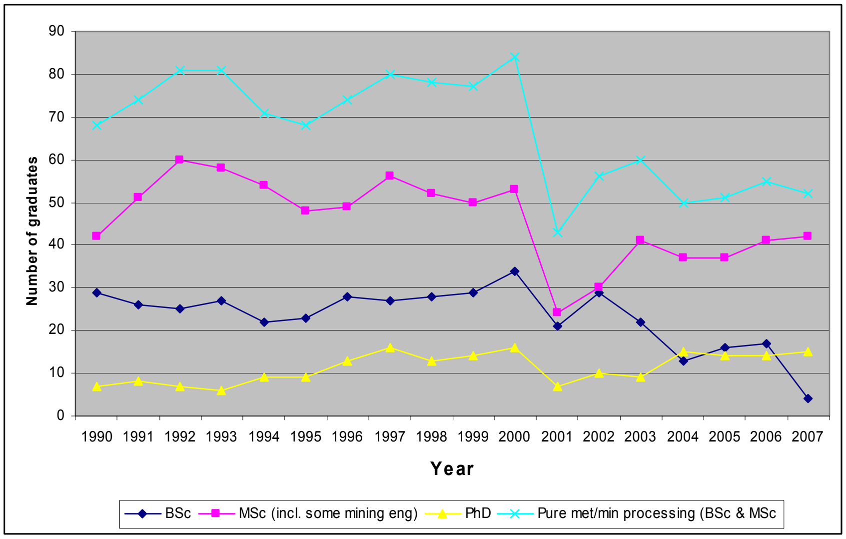
134 Camborne School of Mines, Royal School of Mines, University of Leeds, University of Manchester Institute of Science and Technology, University of Nottingham, Technological University of Delft, RWTH Aachen and the University of Leoben.

Figure 6.14. Number of graduates from metallurgy/minerals processing programmes in the EU which took part in the survey



Source: Chris Cross, Rio Tinto – direct communication

Other issues

Much of the information set out above deals with training for and recruitment into the metal mining sector. The other sub-sectors of the EU industry also rely on a skilled workforce. Lafarge, for example, established its own training institute in Lyon, enrolling 756 trainees in 2004. Imerys has also established a staff training programme using both in-house and external expertise. The extractive industry also has a vocational training organisation CEFICEM.

Attracting students to mining-related degrees and then attracting them actually to work in the industry is one issue. The other is retaining them. As the market for mining professionals is global, and there are competing, and in some cases better paid, sectors, it can be difficult to hold on to trained staff. Also, if a region is experiencing an economic boom, it can be difficult to recruit people to work in the extractive industry when they could find a better paid and less "dirty" job.

A report on the human resources challenges in the minerals and metals industry in Canada, for example, highlighted the differences in average weekly earnings in various sub-sectors of the extractive industry and in smelting and refining. Coal mining was the highest paid sector and non-metallic mining and quarrying the lowest. Metal mining and smelting came in between. Care should be taken when comparing the sectors, as the results do not necessarily reflect like for like employment but could reflect the different skills requirements in each sector. However, it was also observed that the average earnings in the mining industry are higher than in equivalent jobs in the utilities, forestry, manufacturing and construction sectors.

The other area where it is very important to have a sufficiently large and skilled workforce is in the competent authorities (e.g. in land-use planning departments, mining authorities or environmental protection agencies) which are responsible for permitting and monitoring exploration, mining and closure operations.

Addressing the problem

The study by Rio Tinto and the other major companies stressed the importance of collaboration between universities and between universities and the industry. The Federation of European Mineral Programmes (FEMP) and similar schemes, such as the Minerals Tertiary Education Council (MTEC) in Australia and the Minerals Education Trust Fund in South Africa, provide a focus and some funding for collaboration between universities, industry and government to address the issue of declining numbers of mining graduates (see Box 6.3).

Box 6.3 Examples of global initiatives to enhance tertiary education relevant to the extractive industry

The **MTEC** was established in 1999 by the Minerals Council of Australia to build a world-class tertiary learning environment for educating professionals for the Australian mining industry. In 1999 a total of $15 million was allocated over five years, with most of the funds committed to development of course materials and employment of academic staff.

A network of selected universities is cooperating in developing and delivering undergraduate and post-graduate learning in earth sciences, mining engineering and metallurgy.

The **FEMP** was established as the legal organisation behind the European mining course established in 1996, the European mineral engineering course set up in 1998 and the European geotechnical and environment course launched in 2003.

In South Africa the industry funded the **Minerals Education Trust Fund**, which is directed at geosciences, mining and minerals extraction. Its objective is to provide salary support for selected academics to ensure that critical skills are retained in universities. In 2005 over US$1 million was contributed by companies, based on the number of engineering professionals, with the majority of this sum being spent on topping up academic salaries.

More specific suggestions include encouraging students by means of scholarships and regular vacation work and increasing and maintaining the financial stability of relevant faculties by increasing research funding. Replacement with graduates from other suitable disciplines, including, for example, chemical engineering, is already occurring. It has also been suggested that the industry should look for new sources of graduates, for example from eastern and southern Europe, subject to overcoming barriers such as accreditation.

Commission initiatives to address the problem

The Commission recently announced a series of initiatives to address the skills shortages across EU industry. The Communication on industrial policy[135] published in October 2005 identified skills shortages as a key challenge in a wide range of industries. It announced the "Improving Sectoral Skills 2006" initiative, which envisages assessing the nature of the skills problems in particular industries, including identifying the current sectoral skills requirements and gaps and likely future developments.

The Commission is also working on a European qualifications framework to facilitate the transfer and recognition of qualifications held by workers, by linking qualifications systems at the national and sectoral levels and enabling them to relate to each other and with Cedefop[136]

[135] COM(2005) 474 "Implementing the Community Lisbon Programme: A policy framework to strengthen EU manufacturing – towards a more integrated approach to industrial policy."

[136] The European Centre for the Development of Vocational Training.

to produce a sectoral qualifications database, which will contain good practices from industry and authorities. Both these initiatives will include the European mining industry.

6.7. Research and innovation

Introduction

It is widely recognised that if the EU is to compete with low-cost economies it needs to improve its productivity with the aid of research and innovation. This is as true for the NEEI as it is for manufacturing industry. Developments in exploration techniques have helped find new resources, while improvements in extraction and processing have meant that lower quality resources can be economically extracted, while reducing production of waste (see, for example, the significant improvements in the productivity of the natural stone sector described in Section 3.2.3). Automation has made the working environment in mines safer, while improvements in site closure and rehabilitation techniques have enabled sites to be returned to other beneficial uses once extraction ceases, improving the sustainability and public image of the industry.

The sector has repeatedly demonstrated its willingness to engage in networked, pre-competitive research activities which bring together a wide range of European stakeholders, not only from the industry, but also from academia, geological surveys and research institutes. The Fifth Framework Programme (FP5), for example, established the Network of European Sustainable Mining and Processing Industries (NESMI[137]), while under FP6 BioMinE and STREP Bioshale brought together about 40 industrial and research organisations from 15 countries to contribute to competitive, cleaner, safer and more eco-efficient production methods by developing biotechnologies for the non-ferrous metal industry.

More recently, the extractive industry together with a number of related downstream sectors established a European Technology Platform on Sustainable Mineral Resources (ETP-SMR) to address their research needs. It is quite clear that this initiative will need to be fully in line with the EU's competition rules. The Platform aims to provide a focal point for the industry's research efforts and to strengthen its competitiveness by improving cost- and resource-efficiency. The Platform published a Strategic Research Agenda[138] in 2006, which addresses five key focus areas (FA):

FA1. Extraction activities (exploration, extraction, closure and reclamation);

FA2. Resource processing and metallurgy;

FA3. Reuse and recycling;

FA4. Products and materials;

FA5. Minerals economics and societal issues.

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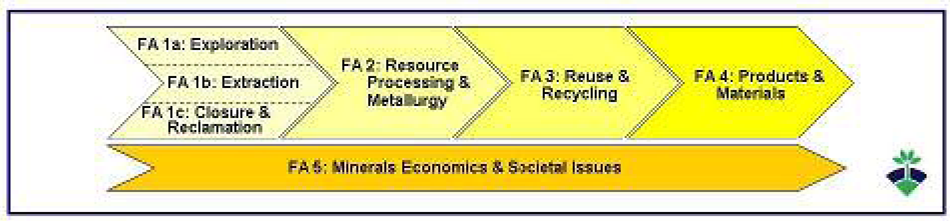
137 www.nesmi.net.

138 Available at: http://www.etpsmr.org/contents/downloadable-documents/Public%20Download%20Area/SRA_03.2006.pdf.

Figure 6.16 Overview of the focus areas (FA) for research by the ETP-SMR



Focus area 1 is of most direct relevance to this report as it deals directly with exploration, extraction and mine closure. Focus area 5 is also directly relevant because it includes the interaction between the industry and local communities together with health and safety, training and education (see below). The other focus areas are important as they relate to the interaction between the extractive industry and downstream sectors, particularly in terms of producing minerals (and other materials or products) that meet the necessary specifications for more modern and efficient applications (i.e. they are relevant to developing policies on the sustainable use of natural resources). Many of the issues raised closely reflect the observations made during this assessment. Those that are particularly relevant to this report are listed below:

New exploration technologies

– Pan-EU predictive resource assessment;

– 4-D mineral belt models;

– Pan-EU GIS/CAD data management and visualisation systems for mineral endowment;

– New exploration tools.

Extraction

– Full resource utilisation;

– Energy-optimised fragmentation and extraction;

– Towards fully automated extraction;

– Sustainable and competitive extraction systems towards zero impact.

Closure and reclamation

– Enhanced use of geotechnology;

– Management tools for prediction, assessment and monitoring;

– Prevention of pollution;

– Optimising land use;

– IT-based tools for assessment and simulation;

– Turning liabilities into assets for the future.

Focus area 2 – "Resource Processing and Metallurgy" addresses the resource processing and metallurgy segment of the metals and minerals industry and focuses on research and development needed to respond to the trends and challenges to support overall improvement in the competitiveness and sustainability of the industry. The work will focus on the following areas:

- towards "Total Resource Utilisation": new strategies and technologies for transformation
- energy efficient fragmentation technologies
- innovation for materials handling and logistics optimisation
- internal processing systems for re-use and recycle
- environmental footprint reduction using new processing systems, techniques, monitoring methods and materials

knowledge building networks

The aim of **focus area 3 – "Reuse and recycling"** – is to ensure that recycling is a natural and integral part of the mining, mineral and metallurgical industry in order to:

- reduce dependence on imported resources,
- address the need for strategic minerals and metals,
- promote sustainable use, production and recycling of resources, and
- renew old and generate new workplaces.

Focus area 4 – "Products and materials. Technology-driven R&D" – is considered vital for the development of breakthrough technologies and products. Establishment of a platform of knowledge on the development of new materials and products would help:

- the European mineral industry to meet the increased global competition for mineral products by developing new or improved products with better functional properties;
- to develop stronger collaboration and products in the industrial "supply chain" which would not only improve the mineral industry's performance, but also benefit related European sectors served by the mineral industry;
- the sustainability of Europe's mineral resources by developing new or improved products that would enhance use of what are currently uneconomic mineral deposits. It would also help to develop new markets and product applications for both *in situ* and reused minerals;
- management of innovation in the European mineral industry, crossing traditional sectoral boarders and disciplines and improve product development capabilities;
- cooperation with other Technology Platforms which involve the end-users of such materials and products.

Focus area 5 – "Minerals Economics and Societal Issues" – deals with cross-cutting issues along the supply chain. Priority areas include:

– minerals economics;

– community relations;

– environmental stewardship;

– health and safety;

– training;

– education.

6.8. Health and safety

Introduction

As indicated in Section 2, two of the three European Directives which are of specific relevance to the extractive industry (as opposed to horizontal legislation) relate to health and safety. More recently, a social dialogue produced agreement on the handling and use of crystalline silica as an alternative to legislation.

Directive 92/91/EEC concerning the minimum requirements for improving the health and safety protection of workers in the mineral-extracting industries through drilling was introduced to protect the safety and health of workers in activities involving drilling which was considered likely to expose workers to particularly high levels of risks. The Directive applies to all industries extracting minerals through drilling by boreholes and/or prospecting with a view to extraction, and/or preparation of extracted materials for sale, but excluding processing of extracted materials. The Directive lays down the employers' obligations regarding general operation of the workplace, protection from fires, explosions and health-endangering atmospheres, escape and rescue facilities, communication, warning and alarm systems, keeping workers informed, health surveillance, consultation of workers and workers' participation. Minimum safety and health requirements are also set out in an annex.

Directive 92/104/EEC on the minimum requirements for improving the safety and health protection of workers in surface and underground mineral-extracting industries extended the provisions of Directive 92/91/EEC beyond activities associated with drilling to include overburden dumps and other tips. For surface workings it covers risks of falls or slips of ground and requires that the height and slope of overburden-stripping and extraction faces must be appropriate to the nature and stability of the ground and the methods of working and that benches and haul roads must be stable enough for the plant used. Faces and tips must not be worked in such a way that instability is created. For underground workings it requires plans of the workings, including roadways and winning areas plus any known features which could influence working and safety. It also covers outlets, transport, support and ground stability, ventilation and additional provisions for underground workings which are considered gassy.

The “**Agreement on Workers’ Health Protection through the Good Handling and Use of Crystalline Silica and Products containing it**” was signed between representatives of European employers and employees from 14 producing and manufacturing industries, including sectors of the non-energy extractive industry (aggregates, cement, industrial minerals and mining). It aims to improve workers’ protection and enhance compliance with EU and Member States’ existing occupational health and safety legislation, notably by minimising occupational exposure to respirable crystalline silica. A Good Practice Guide provides a risk assessment procedure for potential exposure to respirable crystalline silica and technical task sheets to reduce exposure in specific industrial settings. Provisions and recommendations on dust exposure monitoring, training, health surveillance, research and reporting on application complete the Agreement.

Health and safety statistics

Eurostat collects and publishes data on accidents at work and recognised occupational diseases. According to the European statistics on accidents at work (ESAW), mining and quarrying has one of the highest rates, if not the highest, of accidents at work of all economic activities. Within EU-15, the incidence rate of fatal accidents at work in mining and quarrying is five times higher than the average rate of all sectors for which complete European statistics exist (see Table 6.8). Mining of non-energy minerals has an incidence rate of fatal accidents which is about seven times higher than the average. These rates are even higher than in the construction sector which is another infamous risk sector for accidents at work.

For non-fatal accidents which resulted in more than three days of absence from work, the rate within the NEEI is about twice the average and about the same as in the construction industry. Between 1999 and 2003, the incidence rate of non-fatal accidents at work within the NEEI decreased by more (-38%) than the average of all sectors (-18%), although for fatal accidents at work there was no clear decrease in the rate in the NEEI while the average of all sectors decreased by 20%.

Unfortunately, the reporting schemes used for the NEEI in the individual Member States differ from the general schemes for reporting accidents at work and not all groups of workers in NACE categories C or CB are yet covered by the ESAW. The figures reported here refer only to a subset of workers. Nevertheless the lack of coverage reported by the Member States was taken into account by Eurostat when calculating the rates.

Table 6.8. Annual number and incidence rate (per 100 000 workers) of fatal and non-fatal accidents at work in mining and quarrying in general (NACE C) and mining and quarrying of non-energy minerals (NACE CB) in EU-15. For comparison the incidence rates in construction (NACE F) and all sectors are also shown.

	Type	Sector	1999	2000	2001	2002	2003
N							
	Fatal	NACE C	96	87	85	66	74
		NACE CB	65	56	70	53	64
	Non-fatal	NACE C	36 900	34 200	32 000	24 800	23 200
		NACE CB	22 100	21 800	20 300	14 700	13 600
Rate							
	Fatal	NACE CB	35	31	38	28	35
		NACE C	24	24	24	18	23
		NACE F	12	11	11	10	11
		ALL	4.8	4.6	4.2	4.1	3.9
	Non-fatal	NACE CB	11 900	11 900	10 900	7 900	7 400
		NACE C	9 400	9 300	9 000	6 900	7 100
		NACE F	7 800	7 500	7 200	6 900	6 500
		ALL	4 100	4 000	3 800	3 500	3 300

Source: Eurostat, European statistics on accidents at work (ESAW). All sectors refers to NACE categories A, D, E, F, G, H, I, J and K combined.

Recognition of occupational diseases depends on national social security arrangements, which has made it difficult to collect harmonised data. The European occupational diseases statistics (EODS) currently cover 11 of the EU-15 Member States (no data are available for Germany, France, Greece or Ireland) and refer only to cases which were recognised as occupational diseases by the national authorities. In 2003 there were 4 739 cases in NACE C. Of these 1 724 were respiratory diseases, mostly different forms of pneumoconiosis (silicosis, coal worker's pneumoconiosis and asbestosis) and 1 163 were musculoskeletal diseases. Other frequent occupational diseases in NACE C were vibration-induced white finger (940 cases), carpal tunnel syndrome of the wrist (536 cases) and noise-induced hearing loss (254 cases). Many of these diseases result from exposure that occurred decades ago. This means that the diseases occurring today are emerging from an exposed population larger than the current workforce in NACE C. It is therefore difficult to calculate the incidence rates in an unbiased way. Nevertheless mining and quarrying shows the highest incidence rate for many occupational diseases. At the moment the data cannot be broken down to obtain figures just for the NEEI or its sub-sectors.

Reporting procedures in the Member States[139]

Insurance- and non-insurance-based systems

Eurostat receives the ESAW data from the Member States' national registers or other national bodies responsible for collecting data on accidents at work. The ESAW data are occurrence-related and based on administrative sources in the Member States.

Two main reporting systems are used. Insurance-based systems are used in 10 Member States. The reporting procedures are based mainly on notifications of accidents to the insurer (public or private, depending on the case). The reporting procedures of the five other Member States (Denmark, Ireland, the Netherlands, Sweden and the United Kingdom) are based mainly on the legal obligation of the employer to notify accidents to the relevant national authorities.

In insurance-based systems, provision or refunding of care benefits and payment of benefits in cash (daily subsistence allowances, rents where applicable, etc.) resulting from accidents at work are conditional on the report to the public or private insurer. Additionally, in a number of these countries the benefits paid under the accidents at work insurance legislation are higher than in the case of non-occupational accidents. Thus, there is an economic incentive for the employer and the employee to notify an accident at work in insurance-based systems. Due to these various factors, the reporting levels for accidents at work are in general very high in insurance-based systems and are considered by Eurostat to cover almost every case. However, the coverage of the data on accidents at work in these Member States is delimited by the actual coverage of the insurance schemes. For example, groups such as the self-employed are often not covered by an insurance system, while employees in the public sector or specific economic activities such as mining are covered by a specific scheme for which data are not always available.

The five other Member States generally have a system of universal social security "coverage", i.e. national health systems where treatment is free of charge at the point of delivery. In such systems, the benefits provided to the victim of an accident at work do not depend on prior reporting of the accident, except for the specific benefits paid for the most serious accidents (allowances for permanent disability, etc.). Consequently, the economic incentive for notifying accidents at work is not very strong in non-insurance-based systems. Nevertheless, there is a legal obligation for the employer to notify any accident at work for all branches of economic activity and all professional groups. In practice only a part of work accidents are actually reported and the systems based on the employers liability to notify work accidents to the authorities have only a medium reporting level of non-fatal accidents usually ranging from 30 to 50 percent on average for the main branches of economic activity taken together. The rates are corrected according to the international information on the reporting level.

139 Eurostat (2002). European social statistics. Accidents at work and work-related health problems. Data 1994-2000.

Standing Working Party for the Mining and other Extractive Industries

The Advisory Committee on Safety and Health at Work has established a Standing Working Party to deal with questions relating to safety and health at work in the mining and other extractive industries. The specific roles of the Working Party are to provide advice and support to the Committee and to submit draft opinions for adoption by the Committee on future Community initiatives which affect safety and health at work in the mining and other extractive industries.

7. DRAWING TOGETHER THE MAIN ISSUES

7.1. Introduction

The earlier sections of this report sought to quantify the economic characteristics of the non-energy extractive industry in the EU and to illustrate the importance of the sector and its key position in the supply chain. This section of the report seeks to bring out some of the most important findings of the analysis in order to draw attention to the issues most likely to affect the future competitiveness of the non-energy extractive industry.

The analysis has highlighted the diverse nature of the industry, identified the wide range of minerals which are extracted within the EU and demonstrated the industry's importance as a supplier of these raw materials to much larger downstream sectors. Judging from international trade statistics, most of these resources are consumed within the EU. The value chain from extraction of a mineral to a manufactured product can involve an extremely diverse range of interdependent industries, as was illustrated by the example of production of semi-finished aluminium products from bauxite (see Figure 3.7). These semi-finished products are then sold on through the supply chain to sectors such as machinery manufacturers.

The availability and affordability of minerals are therefore important considerations for the competitiveness of much of European industry. The effect of the recent rapid increase in global demand for metals and metal ores, for example, clearly demonstrates the impact of constraining supplies of raw materials - price increases and bottlenecks in supplies - leading in some cases to production shutting down in Europe[140]. This trend is expected to continue in the medium to long term as developing countries seek to improve the living standards of their populations[141].

Of course, not all raw materials supplied to manufacturing industry are, or could be, mined in the EU. Taking metallic minerals as the prime example, as Section 5 demonstrated, although there is still an active metal mining industry in parts of the EU, the EU is heavily dependent on imports for most metallic minerals. This partly reflects the geology of the EU and the absence of some mineral types. It also reflects the fact that metals have been mined in Europe for thousands of years and particularly intensively since the industrial revolution. As a result, many of the largest known surface and shallow sub-surface deposits have been exhausted. However, there is optimism that deeper lying deposits exist but have not been explored sufficiently, partly for lack of cost-effective exploration techniques[142]. In fact the competitiveness of the NEEI can be affected by low social and health and safety standards in 3rd countries. In addition, modern extraction and processing techniques allow smaller and lower grade deposits to be extracted commercially, and globally the average grade of ore which can be economically mined is constantly decreasing[143].

The figures for expenditure on global exploration (see Figure 6.2) provide a good indication of the industry's view on where the largest or commercially interesting deposits are likely to

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140 Commission Staff Working Document SEC (2006) 1069. "Analysis of economic indicators of the EU metals industry: the impact of raw materials and energy supply on competitiveness."

141 Euromines.

142 See, for example, the Strategic Research Agenda of the Technology Platform.

143 Raw Materials Data (direct communication).

be found in the future, i.e. Canada, Australia, the USA and countries such as Argentina, Brazil, Chile, Mexico and Brazil. In Europe most investment in the metal mining sector is currently focused in northern Europe and the new Member States.

This is not a recent phenomenon for the EU. The Commission published a Communication in 1983[144], when the Community comprised only nine countries, advising that even then the Community was depending on imports for 75% of its raw materials supply. The Communication noted that the mining sector had the quality but not the scale of some of its global competitors. At that time the concern was that such import dependence could result in external suppliers not giving high enough priority to supplying European industry in the event of a global crisis. It was also considered that processing industries which lack proper control over their sources of supply are always vulnerable to a "pincer movement" by vertically integrated mining concerns, which can raise the price of their raw material while cutting the price of the processed product.

Euromines[145] has suggested that the situation today is different because the growing markets in Asia are attracting investments from both the end-products industries and from their supplier industries. Lower manpower costs and State policies in developing countries which are oriented towards securing access to metal ore deposits around the world (for example, entering into joint ventures or outright purchases of mines in third countries), could result in a shortage of supply for the downstream industries in Europe. This raises concern about the adequacy of current European policies to guarantee European downstream industries access to raw materials (primary and secondary) in the future.

The European Economic and Social Committee's Opinion on "Risks and problems associated with the supply of raw materials to European industry"[146], published in July 2006, recommended that efficiency improvements during the value-added process and progressively replacing finite resources with renewable ones offer the best opportunities to cut import dependence. It called on Member States to help frame the basic tenets of a European raw materials and energy policy and to shoulder their responsibility for a sustainable raw materials policy in Europe.

For construction minerals, and particularly aggregates, there are many suitable resources across the EU and despite the very large quantities used (around 3 billion tonnes a year), the industry is able to meet demand (at least at present). As transport costs dominate the price of aggregates, most markets are local or regional and there is relatively little international trade, with the notable exception of north-west Europe, in particular Belgium and the Netherlands. However, transport distances appear to be increasing to supply larger towns such as Paris and London as existing local resources are either exhausted or constrained by other land uses.

The EU produces a wide range of industrial minerals and for at least ten types of mineral it is either the largest or second largest producer in the world. Such minerals are traded globally, but most are processed and used in manufacturing within the EU. A number of stakeholders have commented that the strength of the EU's industrial minerals industry is its close working relationship with many of the companies it supplies, both in terms of developing specifications to be used in new applications and by supplying consistently high-quality

[144] "Relations between the European Community and the ACP States in the mining sector." COM(83) 651.
[145] Direct communication.
[146] See footnote 3.

products at competitive prices, aided by relatively high productivity and lower transport costs compared with many non-EU suppliers.

Such interactions are important all along the supply chain. The assessment of the EU metals industry produced in parallel with this analysis[147], for example, reflects that:

"… downstream industries depend on good technical support from the suppliers which would be greatly compromised if metals had to be imported from remote producers in third countries. In addition, the loss of European metal producers would mean less competition which may lead to increases in the prices of metals supplies …" (page 109).

It adds that:

"The economic sustainability of the EU metals industry is therefore not only important in its own right, but could contribute to preventing delocalisation in other manufacturing sectors".

This would also apply to other important sectors of European industry which are highly dependent on supplies of minerals, such as glass and ceramics manufacturers or the construction industry.

7.2. Assessing the competitiveness of the non-energy extractive industry in the EU

The economic indicators used in this report (Section 5) to compare the relative performance of the different sub-sectors of the industry and to make comparisons with selected sectors of manufacturing and the construction industry illustrate that there are larger differences between Member States than between sectors. This is perhaps not surprising as it reflects, in particular, large differences in not only labour costs but also apparent labour productivity between many of the old and new Member States. Overall, however, compared with other sectors, the non-energy extractive industry had amongst the lowest average unit labour costs (see Figure 5.14), slightly above those for the manufacture of non-metallic products and construction, and one of the highest levels of average apparent labour productivity and wage-adjusted labour productivity (Figures 5.19 and 5.21 respectively).

However, in order to understand the sector as a whole, it is necessary to look at the production of, and markets for, individual types of mineral, since otherwise the analysis gives an inaccurate picture of the industry. Metallic minerals demonstrate this point clearly. Aggregating the production or productivity figures for the sub-sector as a whole has the effect of providing a picture of the situation for iron ore production, as it so dominates global and European production of metallic minerals. Annual global production of iron ore is in the region of 1 000 million tonnes, almost seven times the level of production of the second most mined metallic mineral – bauxite (146 million tonnes). Similarly, because of the vast range of markets served by minerals, the many grades of minerals available (with associated price differences) and the effect these downstream industries have on demand, it is important to distinguish between changes in EU production resulting from productivity or competitiveness effects or from changes in downstream demand.

[147] Commission Staff Working Document SEC (2006) 1069. See footnote 16.

7.2.1. Construction minerals

Markets for aggregates tend to be local because of the generally wide availability of minerals suitable for use as aggregate (e.g. sand, gravel, limestone, sandstone and granite) and the relatively high cost of transporting such materials. There is therefore relatively little international trade, either between Member States or with non-EU countries. Production trends for aggregates are closely linked to the economic cycle in individual Member States and the scale of building and renovation programmes. For aggregate producers, the main issues appear to be to have a consistent and level playing field in terms of EU and national policies and regulations and to be able to gain access to new resources to replace those that have been exhausted. The significant differences between labour costs in individual Member States, particularly between some of the old and new Member States, for example, appear to be directly reflected in the price of aggregates in the individual countries which, according to the UEPG, can vary from €4 to €10 per tonne depending on the country of production.

The main exception is the natural stone industry, which accounts for 35% of total global production. It has been facing increasing competition from countries such as China, India and Brazil in recent years, and also from manufacturers of alternative products designed to serve the same purposes such as ceramics, glass and manufactured stone. Initiatives such as OSNET and I-Stone[148] appear to have been successful in improving productivity and reducing waste by taking new innovative approaches to quarrying and technology transfer between the many very small companies in the industry.

Overall, the construction minerals sub-sector could be considered to be competitive at EU level, although some companies will be more competitive than others when serving the same markets. Access to land and new resources appears to be a more important issue for the sector than cost factors.

7.2.2. Industrial minerals

This report looked in particular at the 12 industrial minerals extracted in the greatest quantities within the EU. Of these, the EU is the world's largest producer of feldspar, perlite and salt, and the second largest producer of bentonite, Fuller's earth, kaolin, magnesite, potash and talc. Industrial minerals serve a very wide range of markets; they are unevenly distributed across the EU and can be substituted by other minerals for some applications. The quality of the resource is an important factor for its downstream markets and, hence, price. There are more than 50 grades of industrial limestone, for example, serving different markets and commanding different prices.

Trends in production vary considerably between minerals and in different Member States. At EU level, production of bentonite, feldspar, kaolin, magnesite, perlite, talc and salt all increased over the period 1993-2003, even though production in some Member States fell (e.g. feldspar production in Germany and talc production in Italy both fell). Over the same period, overall EU production of barytes, fluorspar, Fuller's earth and potash decreased. Comparison of the changes in EU production with changes at global level shows that the EU's relative contribution to global supply increased for bentonite, feldspar, kaolin, perlite and talc, but fell for the others, with relative falls for barytes, magnesite and potash of between 30% and 50% (despite EU magnesite production actually increasing).

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148 See Section 3.2.3.

This illustrates the complexity of the sector and the need to examine the specific interactions between companies producing particular minerals and their uses and markets. Taking just two examples, barytes and potash, it is possible to see that demand and sourcing are dictated by the downstream users and do not necessarily directly reflect the relative productivity or competitiveness of the EU extractive industry. Examples for other industrial minerals were summarised in Table 3.4.

One of the main users of barytes is the oil industry which uses it in drilling muds. The level of global oil exploration dictates global demand for barytes, while the location of the drilling activity is likely to influence the source of the barytes used. Any change in the level of oil exploration in or close to the EU is therefore likely to affect demand for barytes sourced in the EU, irrespective of the productivity or competitiveness of a particular mining company operating within the EU.

Similarly, demand for potash depends heavily on use of fertilisers in agriculture as it is the main source of potassium in fertilisers. Demand for fertiliser has fallen in the EU because of changing agricultural practices which seek to make more efficient use of fertilisers. At the same time, as agriculture is becoming more industrialised in many developing countries, demand for fertilisers is increasing there. However, EU potash production fell significantly in the mid-1980s not only because of a change in global demand, but also following the reunification of Germany, since when Russian and Ukrainian buyers have stopped purchasing potash from companies in the former East Germany and instead have been buying from suppliers in Russia and Belarus. By 1993 German production of potash had stabilised at a lower rate and since then it has increased slowly. The overall decline in EU potash production seen in Figure 3.15 was a result of a steady reduction in production in France - from around 1 million tonnes per annum in 1993 to zero by 2003. Production in Russia and Belarus both increased and they are now the second and third highest producers in the world (see Annex 1).

7.2.3. Metallic minerals

Production trends for the 12 metallic minerals considered illustrate that there are still a number of globally important metal mines in the EU, and there is continued interest in exploring for metals, particularly in countries such as Ireland, Finland and Sweden.

Global production of most metals has been heading upwards for many decades, with some, such as platinum group metals and bauxite, showing increases of over 1 700% since 1950. Mercury stands out as a metal for which demand has fallen dramatically since the 1970s, largely due to its substitution by less harmful substances, while production of lead and tin both increased relatively little over the same period.

Both globally and within the EU, iron ore is the most commonly mined metallic mineral. Global production is around 1 billion tonnes a year. The EU production of over 24 million tonnes therefore accounts for about 2.4% of global supply. Bauxite, the primary source of aluminium, is the world's second most mined metallic mineral at 146 million tonnes, of which 2% (about 3.3 million tonnes) is mined in the EU. In terms of the EU's relative contribution to global supply, silver (9.3%) and zinc (8.5%) are the most significant of the 12 metals looked at in detail, although the EU is also an important producer of less common metallic minerals such as selenium (25%) and strontium (28%).

EU mine production increased for chromium, copper, silver, tungsten and zinc between 1993 and 2003 but fell for bauxite, cadmium, iron ore, lead, manganese and mercury. However, in terms of the relative contribution that the EU made to global supply, the only increases were with mercury and tungsten. It should be noted that the mercury mine in Spain which used to account for most of the EU's production closed in 2003. EU production has subsequently fallen to almost zero.

Because of the relatively high price of many metals and the uneven distribution of mines, metals are traded globally, with the prices of many being set by exchanges such as the London Metal Exchange. As the EU is the major consumer of many metals, demand considerably exceeds the EU extractive industry's production capacity. There is therefore a significant trade deficit in metallic minerals at around €10 billion per year.

In addition to import dependence even for the metals that are extracted within the EU, there are many other metallic minerals which are not mined in the EU and for which the EU is highly dependent on imports and recycled materials. While some of these metals are found widely around the world, others are known to exist in economically viable amounts in only a few countries. South Africa, for example, is thought to possess almost 90% of the world's reserves of platinum group metals (used as catalysts), Brazil has over three quarters of the world's niobium (used in special steels and super alloys), while Russia, South Africa and China combined share almost all of the world's reserves of vanadium (used in alloys and as a catalyst). This raises policy issues relating to security of supply.

7.3. Access to land and the sustainability of the industry

Any consideration of the sustainability of the extractive industry needs to recognise that the industry differs from other industrial sectors in a number of fundamental aspects. The most important of these is that **the industry can only operate where suitable minerals have been found**. While a manufacturing company might seek to operate either in locations close to supplies of suitable raw materials – whether from mines and quarries (e.g. cement works adjacent to limestone or chalk resources), ports (e.g. modern steel plants), sources of secondary raw materials (e.g. plaster and plasterboard production close to power stations producing FGD gypsum) or the market/consumer – the extractive industry is confined to locations with known and commercially viable deposits of minerals. The occurrence of minerals is determined by past geological activity, and knowledge of their distribution is very much a function of the level of investment in geological mapping, prospecting and exploration. The industry cannot therefore necessarily seek to operate only in areas where there would be no conflict with other land uses, the general public or areas of conservation, landscape or visual importance. Conversely, the uneven distribution of different minerals both within the EU and globally can also limit or slow down the loss of the sector in Member States with higher labour costs as many low-cost countries will not possess equivalent types of mineral.

The second important consideration is that, as minerals are natural materials, **their characteristics and quality can vary considerably** both within a particular ore body and between similar ore bodies in different parts of the world. The physical and chemical characteristics of a mineral are fundamental to its suitability for particular uses, while its depth, the hardness of the surrounding and overlying rock and the amount of waste rock requiring management can all differ significantly, affecting extraction and processing costs and, therefore, the economic viability of working particular deposits. Other factors which in general terms are common to all sectors of industry, such as the regulatory regime, the technical and managerial quality of the companies, operating costs (e.g. staff, transport and energy) and the degree of automation also have additional implications for the productivity and profitability of a mine or quarry and will therefore influence whether a sector can be competitive in a particular country or region. In Europe advances (thanks to research and development) in extraction and processing, automation and logistics have played an important role in keeping the sector competitive[149].

Because minerals are finite, the industry is required to identify and work new resources to replace those that have become exhausted or are of such a low grade that they are no longer economically viable to extract[150]. However, the need to develop new mines and quarries brings the industry into repeated conflict with other land uses. The industry does have an impact on the environment, and if its activities are not adequately controlled the effects can be very serious. However, the industry has made very large strides in recent years to improve its environmental performance, and there is general acceptance within companies that they have to be responsible and operate to the highest standards. The industry's "footprint" appears to be in the region of only 0.05% to 0.5% of the total land surface across Member States. However, despite developments in recent decades to improve the environmental performance of the industry it continues to face the "not in my back yard" or "NIMBY" syndrome.

The report by Leoben University concluded that most Member States consider the provision of minerals to be a low priority and only a small number have clearly defined national minerals policies. As land-use planning usually involves considering different options for the use of particular parcels of land and coming to a decision on the basis of policy priorities, the low importance often given to non-energy minerals is seen as a clear disadvantage for the sector. In particular, as most decisions about land use are taken at regional or local level within a Member State, the absence of a national policy can result in inconsistent decision-making. The licensing system, which can involve obtaining numerous permits from different government institutions to operate a single site, can also be a slow and expensive process. This deters companies from investing in some areas. The problem is thought to be exacerbated in many cases by lack of information on the occurrence of mineral deposits in land-use databases. This can result in the presence of important mineral resources not being taken into account when decisions are made about other forms of development. This has led to unnecessary sterilisation of resources.

Related to this, the industry has expressed severe concern about its general exclusion from significant areas of land, in particular from areas which are considered by Member States to have high nature conservation value and which have been designated as sites of community importance (SCIs) under the Habitats Directive or special protection areas (SPAs) under the Birds Directive. This may require further analysis in the future. These "sites of Community importance" (SCIs) form the Natura 2000 network. The total terrestrial area (SCIs) designated to date (the lists for some of the new Member States are incomplete) is about half a million square kilometres which is equivalent to about 12% of the land area of the EU. Most of these areas were already designated at national level before they became sites of European importance; however, the level of protection is enhanced. The survey of the industry suggests that, with some exceptions, existing mineral workings have not been significantly affected

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149 Euromines.

150 However, as extraction and processing technology develops, lower grades of minerals can increasingly be economically developed.

(except that some have had to bear the costs of undertaking "appropriate assessments" to demonstrate that their activities would not affect the integrity of adjacent SCIs). The concern for the extractive industry is that applications for permits for new sites or extensions to existing ones within or adjacent to SCIs are being refused, or it is being made clear to the industry that an application would be refused if it were made. However, in some Member States (e.g. Finland) it is recognised that some forms of mineral extraction are not incompatible with nature conservation, and guidelines have been produced for the extractive industry. There is definitely a need for sector-specific guidance in addition to the general guidance documents prepared by the Commission[151].

Unfortunately, without a better knowledge of the mineral resource base of the EU and, in particular, the overlap between the most important deposits and land-use constraints such as conservation areas, it is not possible to make a judgment about the real long-term implications for the extractive industry. If sufficient alternative resources can be identified which are outside such constraint areas, it is questionable whether the Directive really imposes additional problems at EU level - in the short to medium term - in relation to raw materials supply. It will, however, affect individual companies which have already identified resources, for example adjacent to existing operations, which fall within a designated area, particularly where they are unable to identify and gain access to alternative deposits. Where there has been major investment in infrastructure on the assumption that some of these additional reserves would become available over time, there could be more significant long-term financial implications for individual companies, not least because the costs of developing a mine or quarry in a new location can be higher than extending an existing site. The potential alternative is therefore longer transport distances for minerals, where financially viable, with the associated environmental impact.

Natura 2000 is the cornerstone of the EU objective of halting biodiversity loss by 2010[152] and the value of services provided by healthy ecosystems has received increased recognition. Therefore the prospects of the extractive industry should be viewed in this context. However, if a significant proportion of the resource base for particular strategic minerals in the EU is only found within such designated areas, there could be much wider implications for raw materials supply. In this case, it would seem to be justified to reconsider the balance between the need for the mineral and the importance of the conservation area (or other constraint). It should be recognised that not all SCIs are of equal importance to maintaining the natural habitats and species of Community interest at a favourable conservation status, which is the aim of the Habitats Directive. The Habitats Directive contains provisions for allowing projects to be carried out in Natura 2000 sites, where there are "imperative reasons of overriding public interest, including those of a social or economic nature" and where there is an absence of alternative solutions. For sites hosting priority habitat types and species listed in Annex I and Annex II, the considerations are restricted to those relating to human health or safety, to beneficial consequences of primary importance for the environment, or further to an opinion from the Commission, to other imperative reasons of overriding public interest.

[151] http://ec.europa.eu/environment/nature/nature_conservation/eu_nature_legislation/specific_articles/art6/index_en.htm

[152] (COM (2006)216), http://eur-lex.europa.eu/LexUriServ/site/en/com/2006/com2006_0216en01.pdf)

A supportive regulatory framework is important more generally for the industry. Good legislation should enable all companies to operate on a level playing field[153] and to a high standard. Where there are difficulties, companies often consider them to be the result of legislation unnecessarily imposing working restrictions and/or costs on the industry, although this comment should be tempered by the need to protect the environment and human health. The need for proportionality to ensure that the benefits of regulation warrant the costs is therefore paramount. The recently agreed Directive on the management of wastes from the extractive industry is considered by many to strike the correct balance as it recognises and takes account of the specific needs of the extractive industry and provides a framework within which competent authorities and site operators can take account of the particular characteristics of a proposed site.

More generally, the question is whether it is possible to develop a policy framework which would make:

– existing operations more competitive and sustainable;

– extending existing operations more straightforward;

– investments in smaller deposits in the EU viable;

– the administrative burden lighter; and

– access to new resources simpler and more attractive to investors by providing a reliable and cost- and time-efficient permitting procedure which enhances environmental protection and social acceptability.

7.4. Sustainable use of resources

When addressing the sustainability and competitiveness of the extractive industry it is important also to consider the implications of other related EU policies. One of the most important for this sector is the Thematic Strategy on the Sustainable Use of Natural Resources[154].

The Communication on the strategy recognises the importance of raw materials such as minerals for the functioning of the European economy and quality of life. It also recognises that the EU is highly dependent on resources from outside Europe, with the environmental impact of resource use by the EU and other major economies being felt globally. With emerging economies such as China and India using natural resources at an accelerating rate, it estimates that global material use would quadruple within 20 years, if traditional patterns of consumption were maintained. The Communication therefore proposes that for the long-term prosperity of the EU (and globally) it is necessary to develop a long-term strategy which integrates the environmental impact of using natural resources into policy-making.

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153 However, it has to be recognised that even with a level playing field with respect to implementation of legislation, there are "distortions" across the EU in terms of labour costs (EU-15 compared with some of the new Member States), differences in the nature of the minerals present and, equally important, quality issues.

154 COM(2005) 670.

The overall objective of the strategy is to reduce the environmental impact of resource use in a growing economy while at the same time improving resource productivity overall across the EU economy. The strategy therefore focuses on gaining a better understanding of the use of resources within the EU and the consequent environmental effects.

The strategy is particularly relevant to the extractive industry because, depending on how it is developed and implemented, it will influence demand in the medium to long term for raw materials produced both within the EU and elsewhere. The aim would appear to be to reduce demand per capita and to change the types of material used and the way they are produced. This will have long-term effects on the extractive industry, but they are difficult to predict.

The extractive industry in the EU has made significant advances in its environmental performance over the last few decades, not only in terms of reducing the direct environmental effects of extraction operations but also by rehabilitating closed sites to bring them back into beneficial use. In itself, this should be recognised as a significant contribution towards decoupling resource use from environmental impacts which is the key aim of the strategy. However, the industry also plays the important role of working with downstream sectors to develop specifications for minerals in order to produce more efficient and cost-effective products. Advances in refractory materials used in the steel industry, for example, have extended the life of kilns, increasing the efficiency of steel production and reducing the demand for magnesite.

As demand for minerals is largely driven by downstream markets, it would seem logical that policies to influence resource <u>use</u> are targeted at the value chain and the end-user. This should include developing alternative materials and optimising resource use, as recommended by the European Economic and Social Committee. To influence <u>demand</u> for raw materials by limiting the <u>supply</u> of minerals from EU mines and quarries (as opposed to requiring that the extractive industry operates efficiently and with a low environmental impact) is unlikely to decrease demand but will further increase import dependence. More minerals would have to travel further, with the associated environmental effects, while unnecessarily sourcing minerals from regions of the world which operate to lower environmental standards would have an even greater overall effect on the environment, which would be contrary to the aims of the resource strategy. It is therefore clear that if the extractive industry is to continue to supply other EU industries with raw materials in a sustainable way into the future, despite increasing global competition from low-cost economies, it is vital that new resources are identified and opened up, that productivity continues to increase and that the industry works with its stakeholders and, particularly, local communities to develop its "social licence to operate". This means that all companies need to strive to operate to the standards of the best performers. In particular the large extractive companies in the EU can contribute in a positive way through their adherence to the high standards in EU and their commitment to promote these standards at a worldwide level. The industry is well aware of the effect of one poor performer on the image of the whole industry.

7.5. Research needs

The industry recognises these needs in its Strategic Research Agenda which was summarised in Section 6.7. Its aim is "to secure the future supply and sustainable processing of mineral resources for Europe through R&D-based technology leadership to implement best practices, innovative and sustainable production technologies and to continue to increase the competitive position at global level". As some minerals are not geologically present within the EU, the industry has stated its desire to be a trade-marker and exporter of competitive ethical exploration and extraction and has stated that by being the world leader in research and education, the European minerals industry will be in a position to export knowledge and ethics to the rest of the world, and share research and education facilities with overseas students and researchers.

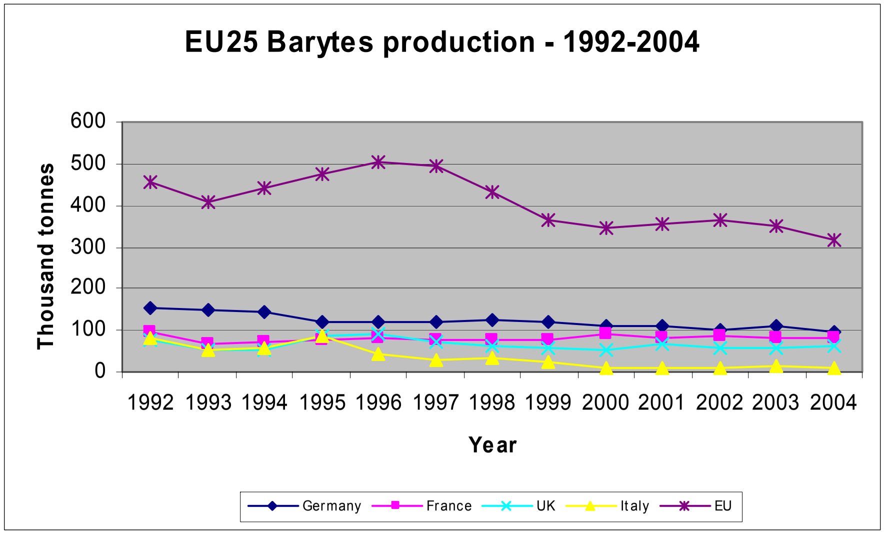
Of the five focus areas identified in the Strategic Research Agenda, focus area 1 has most direct relevance to this report, as its priorities are exploration, extraction, mine closure and reclamation. Key aspects include defining the natural and man-made mineral endowment of the EU, including improving knowledge of the location of the known and potential mineral occurrences in the EU and quantifying their economic value as reserves (proven) or resources (inferred) plus using and sharing the information to manage sustainable use of these resources and avoiding conflicts over land use. However, the other four focus areas address the wider issues of resource use and also appear fully consistent with working towards achieving the objectives of the resource strategy.

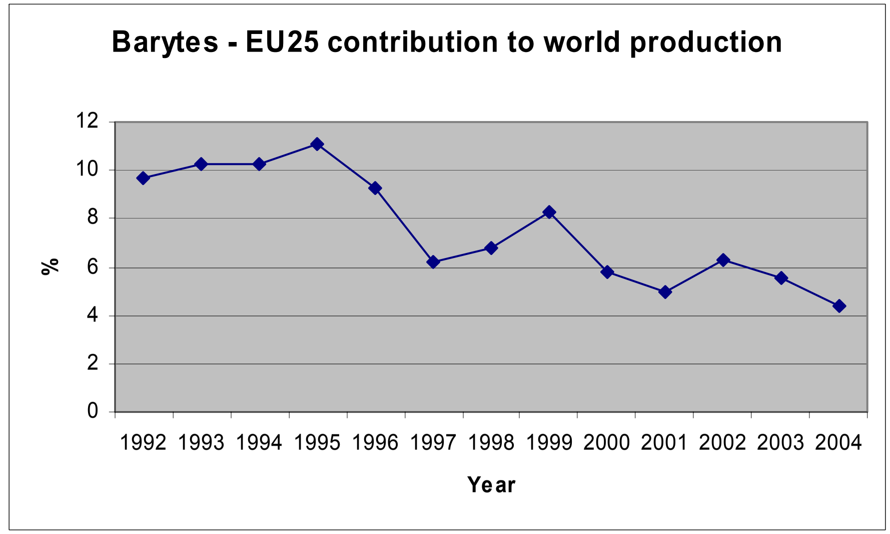
ANNEX 1 - PRODUCTION TRENDS FOR INDIVIDUAL MINERALS

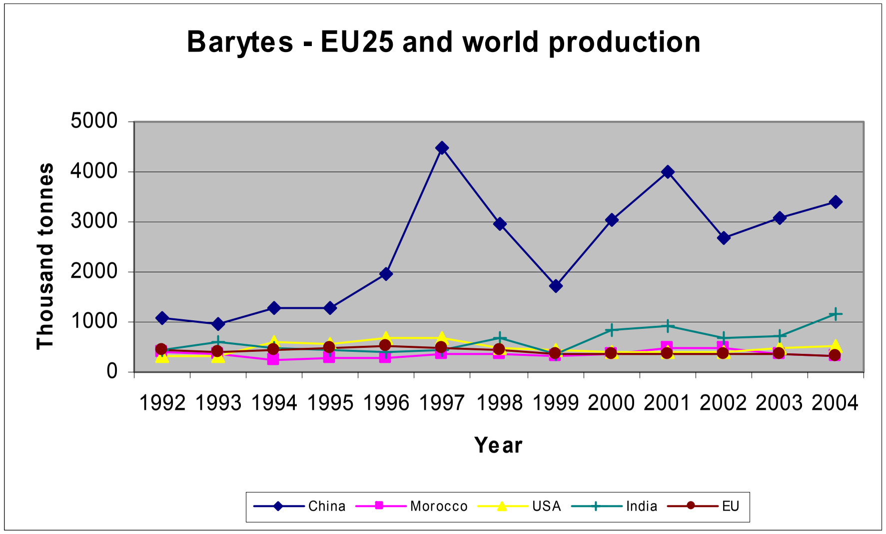
This Annex provides graphs showing trends in annual mine production of the different industrial and metallic minerals listed below, both in the EU and around the world. Most of the data cover the period 1992 to 2004. It also includes graphs indicating the changing contribution which the EU has made to global supply over the same period and, for most of the minerals, the long-term trend (since the early 20th century) in global supply. The data to produce the graphs covering the period 1992-2004 were provided by the British Geological Survey (www.bgs.ac.uk/mineralsuk/home.html), while the data for the long time series data were taken from the United States Geological Survey website:

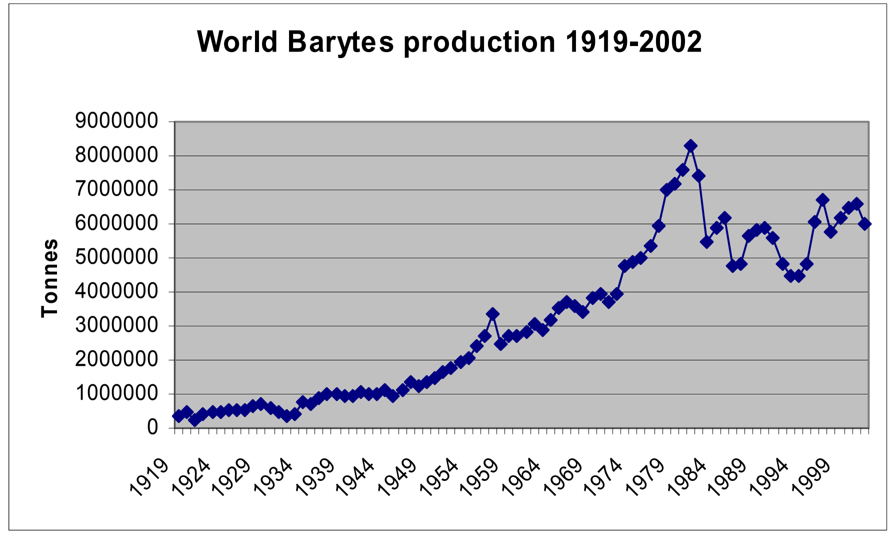
(http://minerals.usgs.gov/ds/2005/140/).

BARYTES

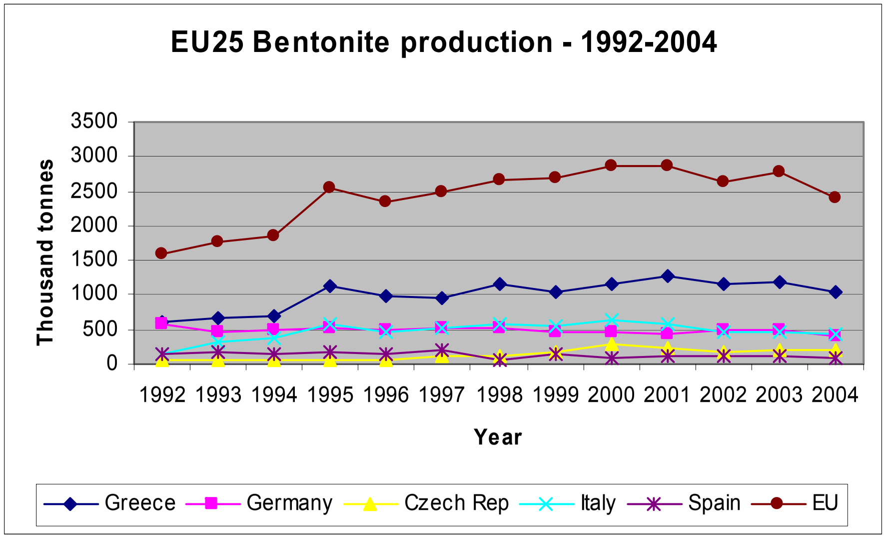

EU25 Barytes production - 1992-2004
Thousand tonnes
600
500
400
300
200
100
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Germany
France
UK
Italy
EU

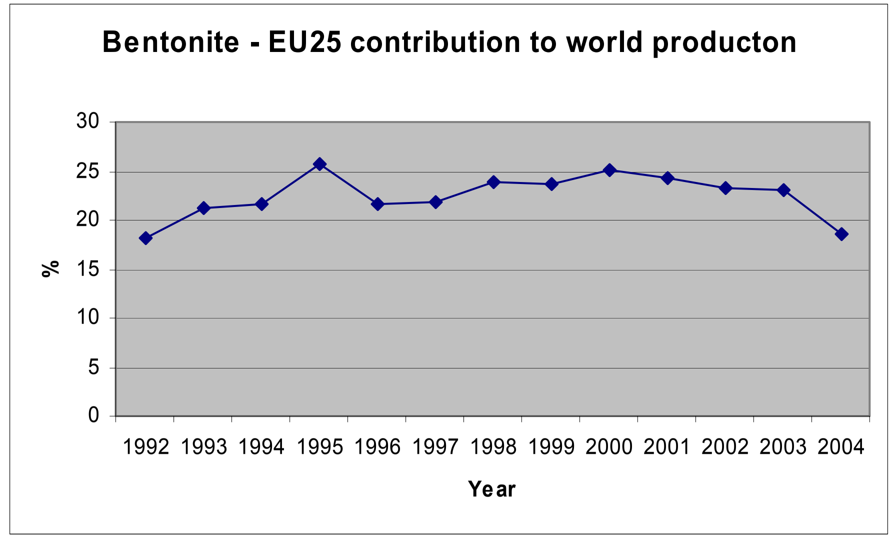

Barytes - EU25 contribution to world production
%
12
10
8
6
4
2
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

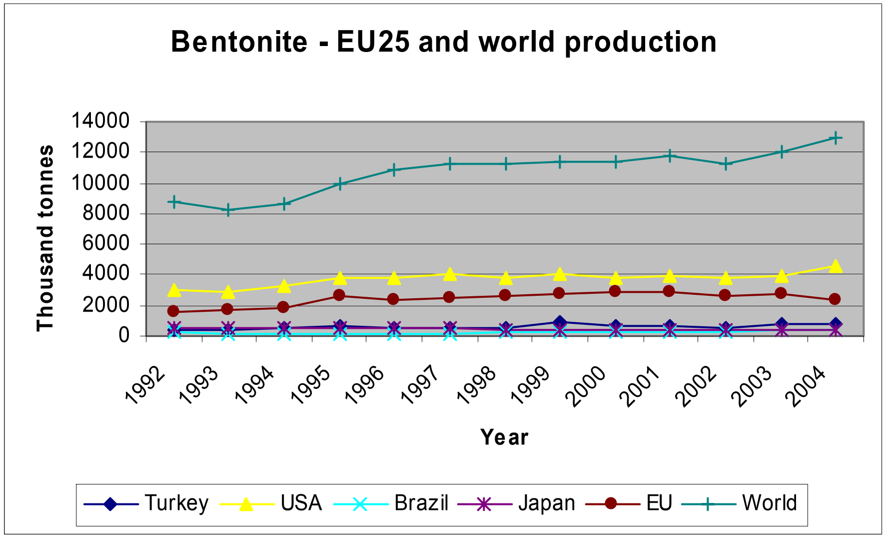

Barytes - EU25 and world production
Thousand tonnes
5000
4000
3000
2000
1000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
China
Morocco
USA
India
EU


World Barytes production 1919-2002
Tonnes
9000000
8000000
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
1919 1924 1929 1934 1939 1944 1949 1954 1959 1964 1969 1974 1979 1984 1989 1994 1999

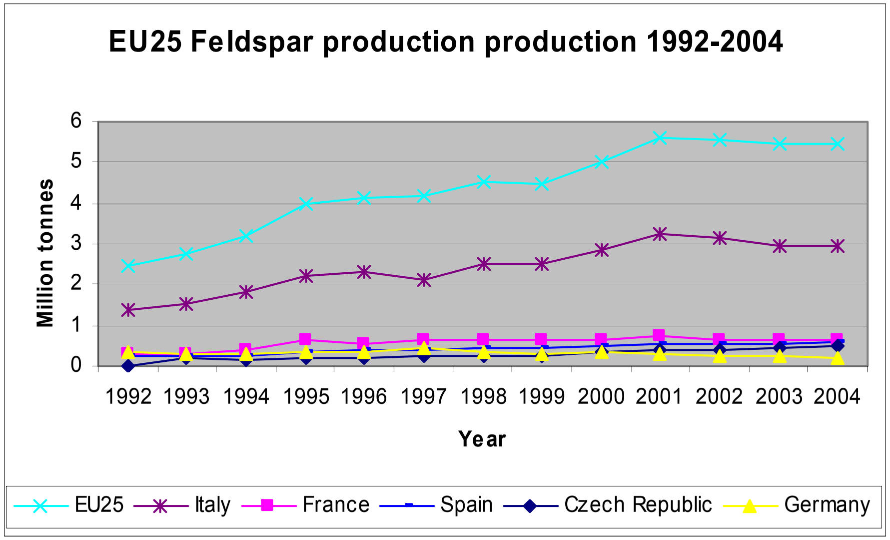
BENTONITE

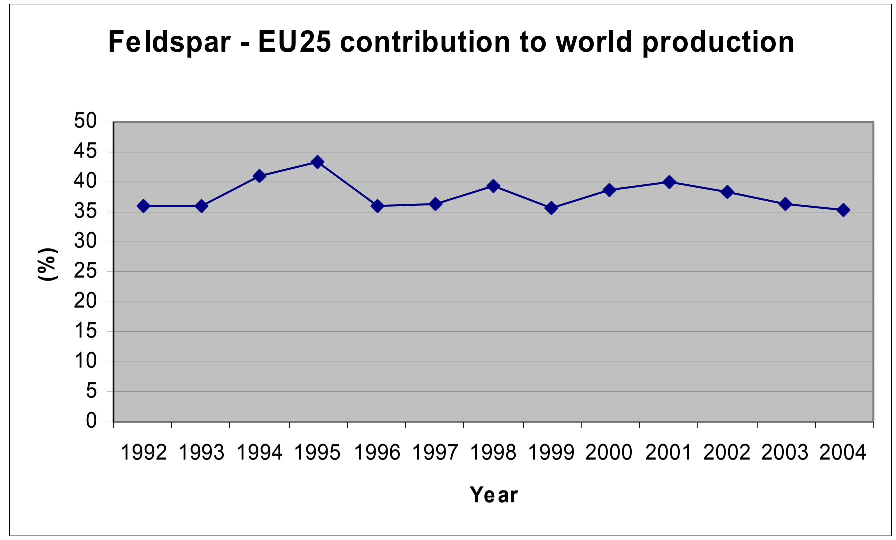

EU25 Bentonite production - 1992-2004
Thousand tonnes
3500
3000
2500
2000
1500
1000
500
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Greece
Germany
Czech Rep
Italy
Spain
EU

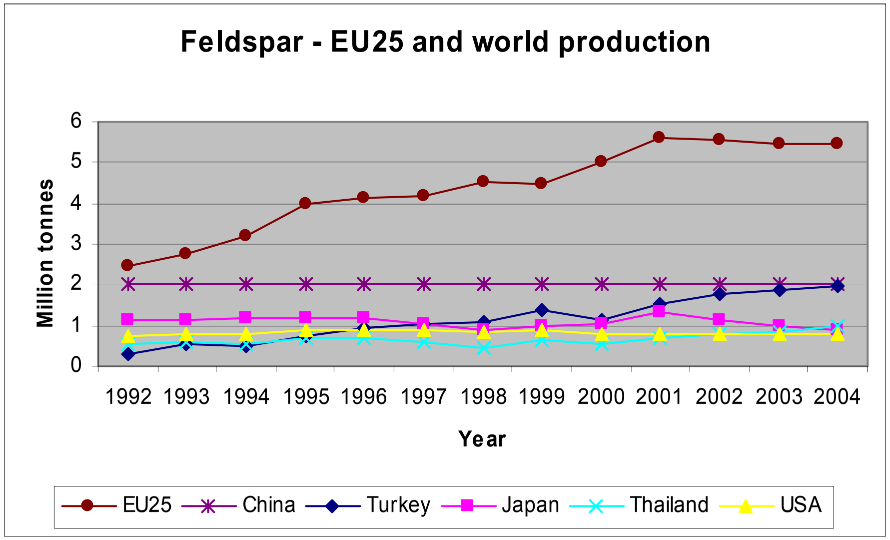

Bentonite - EU25 contribution to world producton
%
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

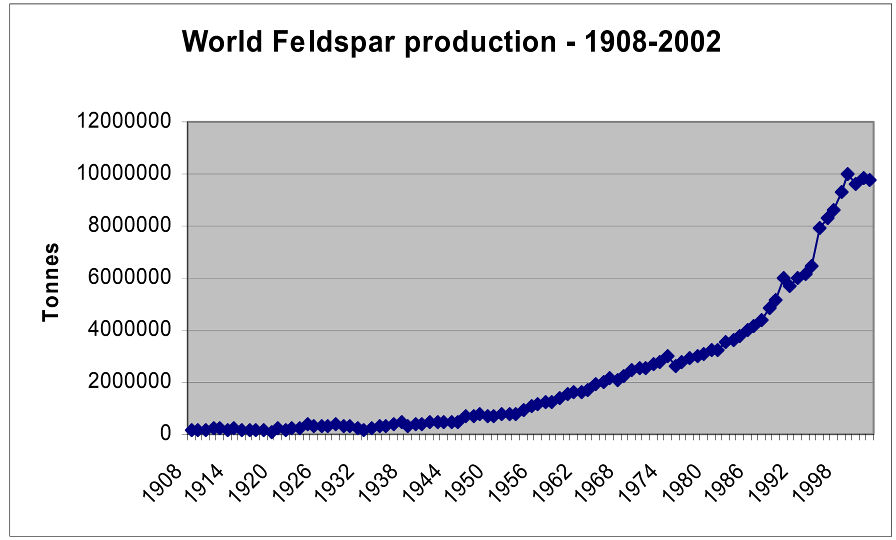

Bentonite - EU25 and world production
Thousand tonnes
14000
12000
10000
8000
6000
4000
2000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year
Turkey
USA
Brazil
Japan
EU
World

FELDSPAR

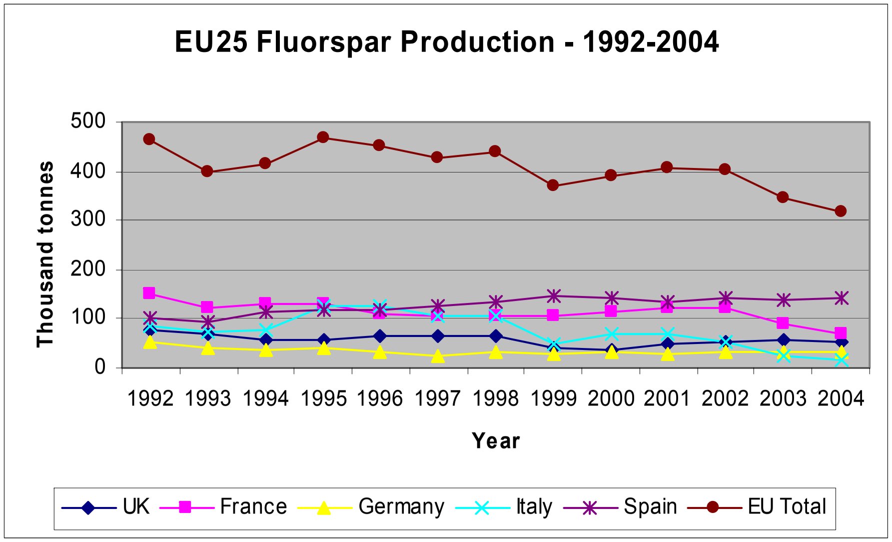

EU25 Feldspar production production 1992-2004
Million tonnes
6
5
4
3
2
1
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
EU25
Italy
France
Spain
Czech Republic
Germany

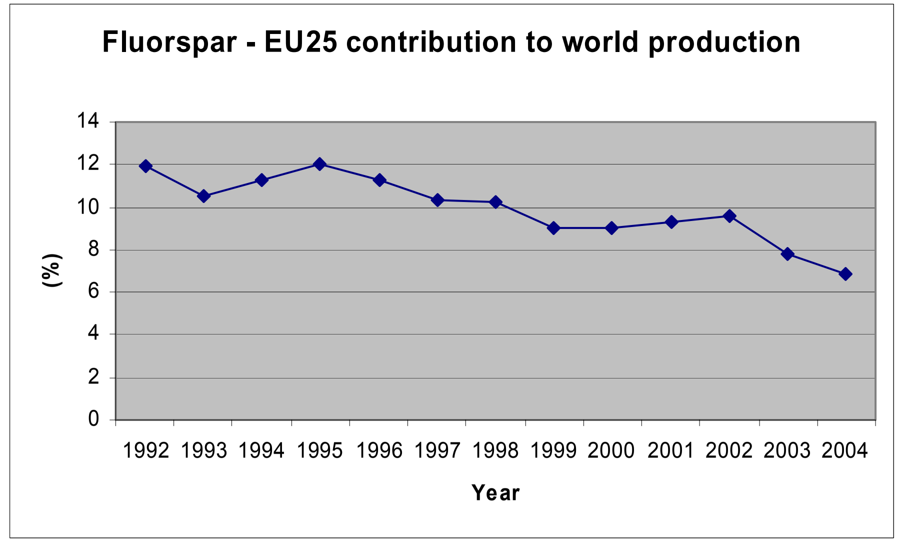

Feldspar - EU25 contribution to world production
(%)
50
45
40
35
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year


Feldspar - EU25 and world production
Million tonnes
6
5
4
3
2
1
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
EU25
China
Turkey
Japan
Thailand
USA


World Feldspar production - 1908-2002
Tonnes
12000000
10000000
8000000
6000000
4000000
2000000
0
1908 1914 1920 1926 1932 1938 1944 1950 1956 1962 1968 1974 1980 1986 1992 1998

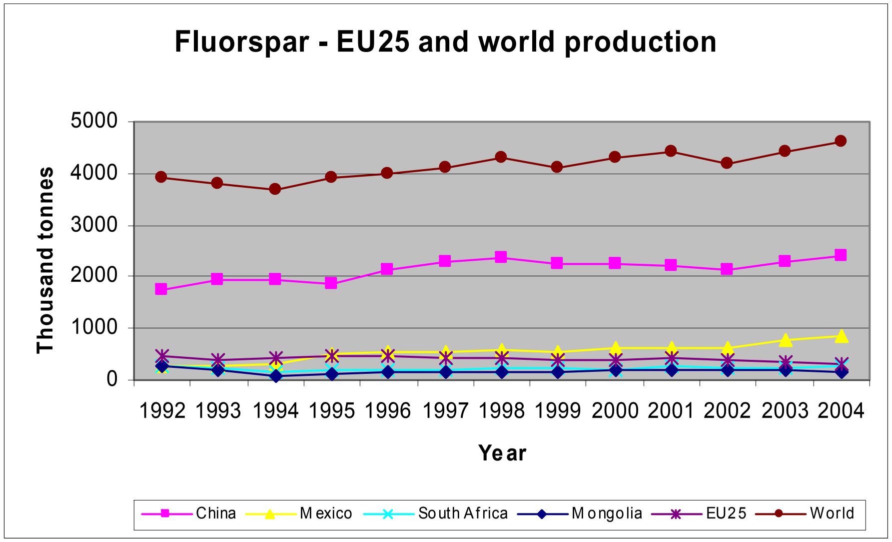
FLUORSPAR

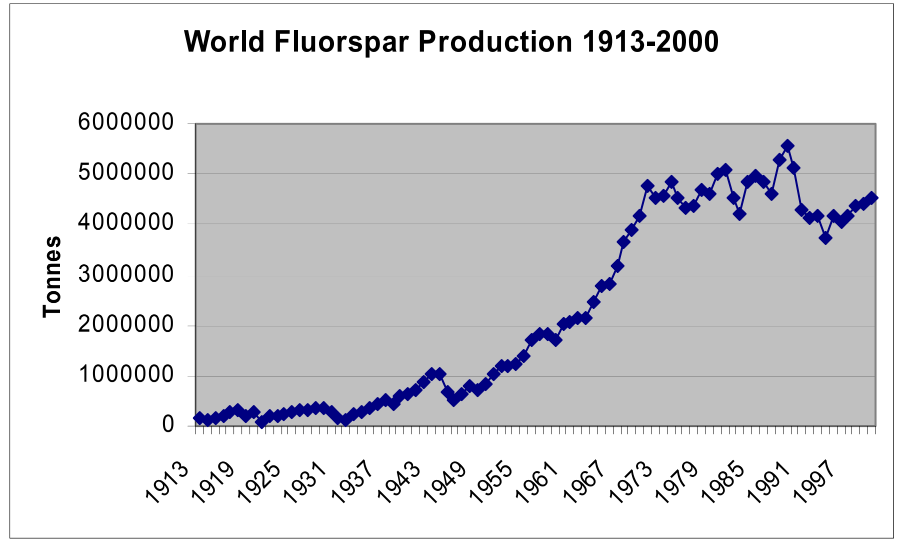




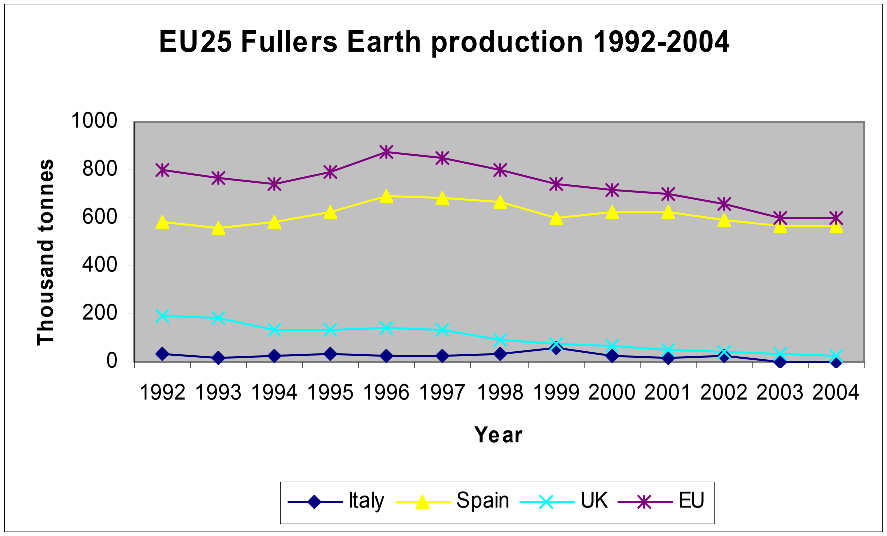
EN

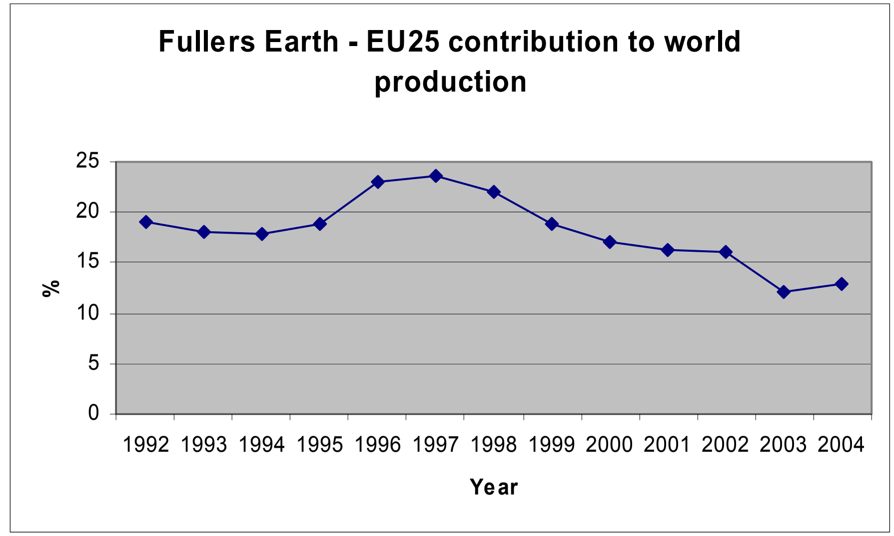
EN

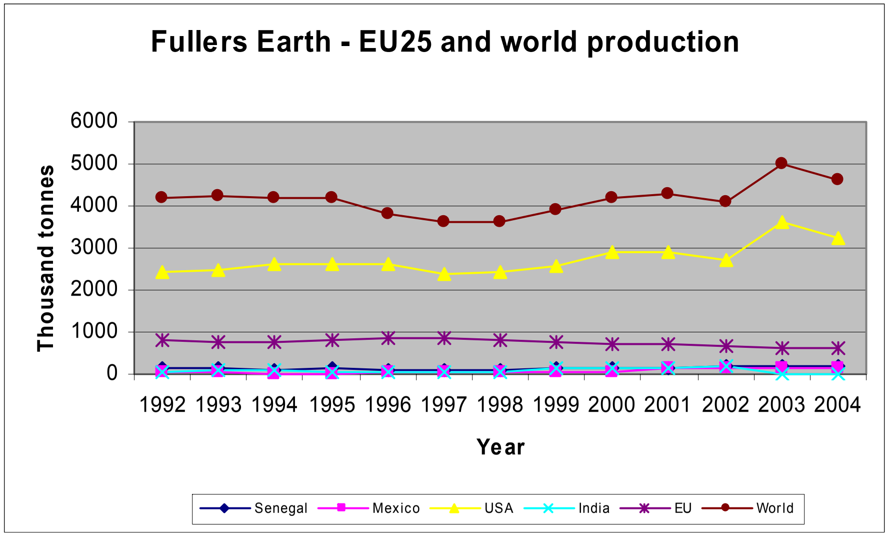

Fluorspar - EU25 and world production
Thousand tonnes
5000
4000
3000
2000
1000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
China
Mexico
South Africa
Mongolia
EU25
World


World Fluorspar Production 1913-2000
Tonnes
6000000
5000000
4000000
3000000
2000000
1000000
0
1913 1919 1925 1931 1937 1943 1949 1955 1961 1967 1973 1979 1985 1991 1997

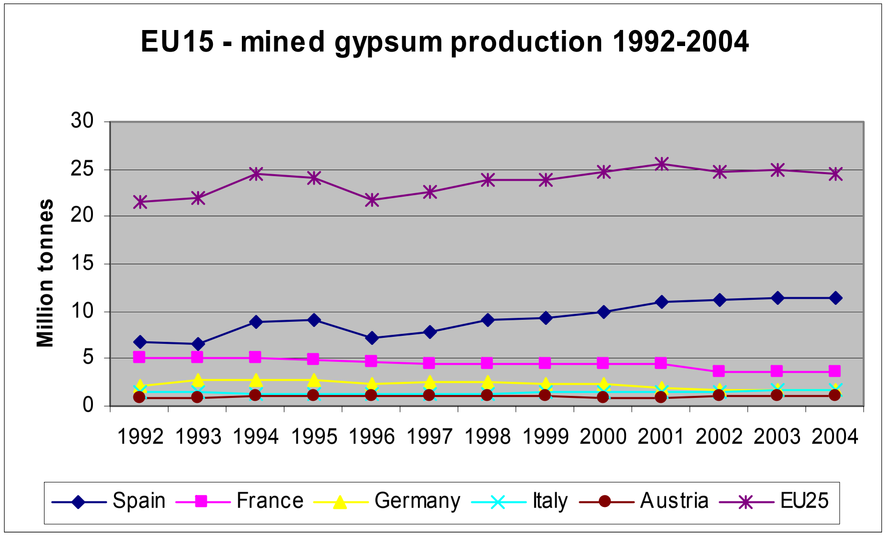
FULLER'S EARTH

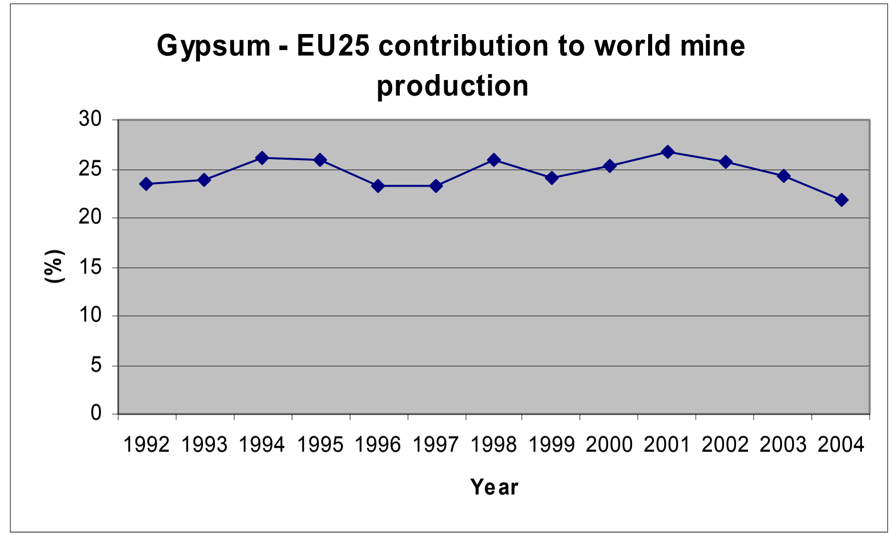


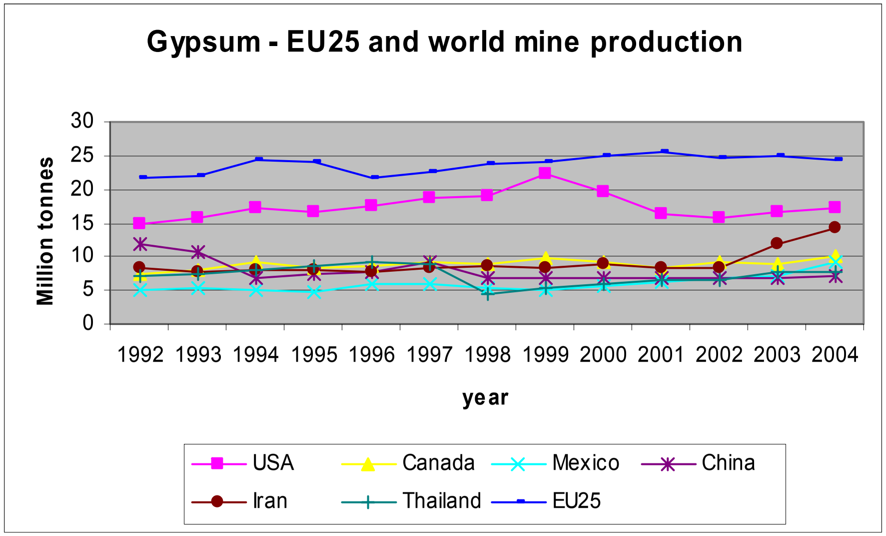


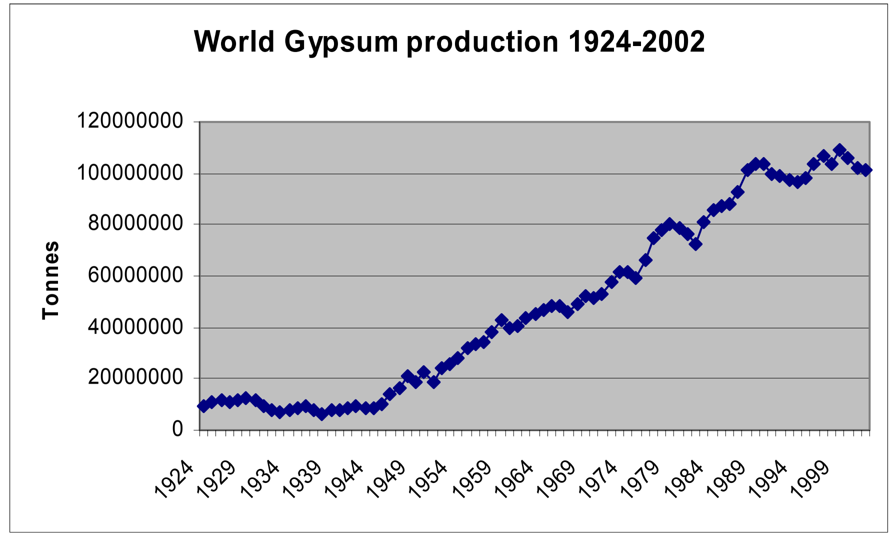

Fullers Earth - EU25 and world production
Thousand tonnes
6000
5000
4000
3000
2000
1000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Senegal
Mexico
USA
India
EU
World

GYPSUM

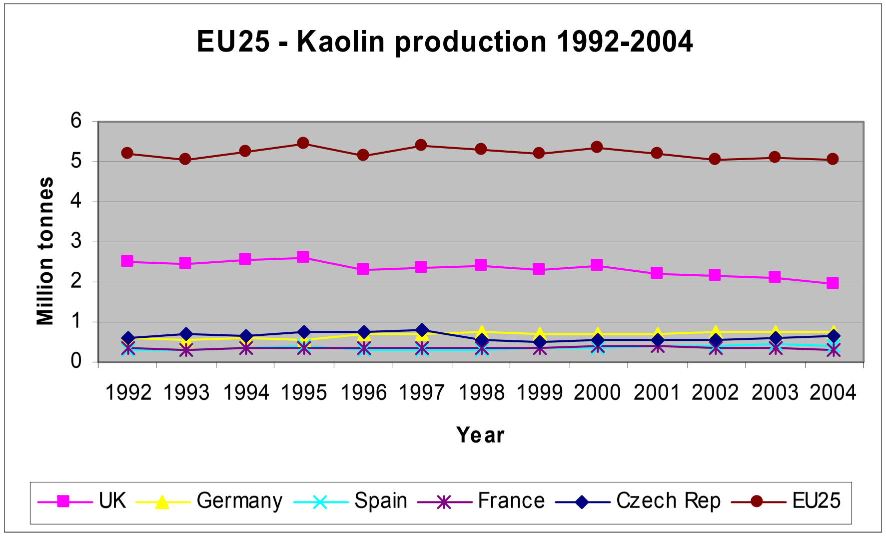

EU15 - mined gypsum production 1992-2004
Million tonnes
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Spain
France
Germany
Italy
Austria
EU25

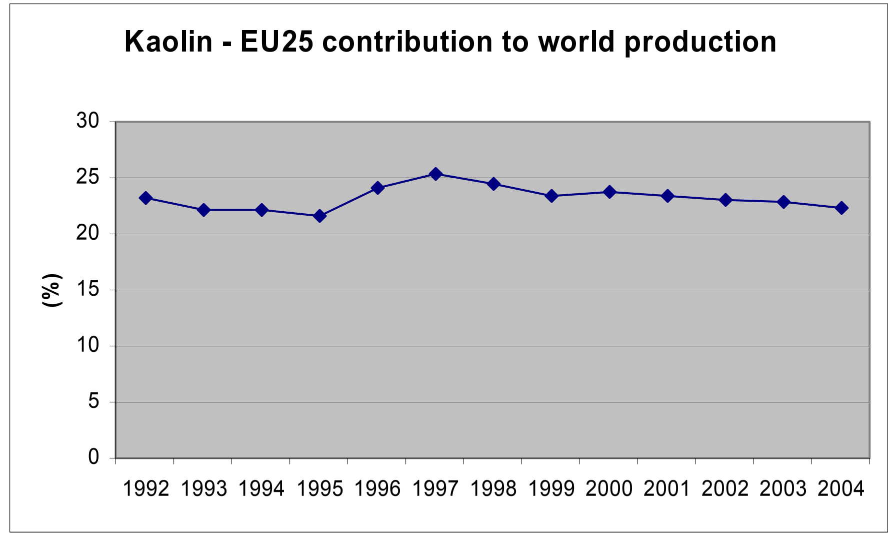

Gypsum - EU25 contribution to world mine production
(%)
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

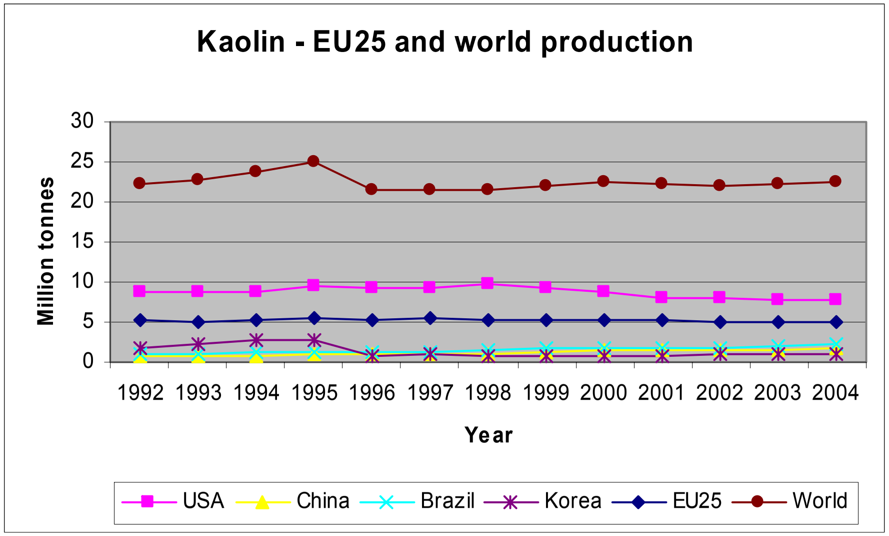

Gypsum - EU25 and world mine production
Million tonnes
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
year
USA
Canada
Mexico
China
Iran
Thailand
EU25


World Gypsum production 1924-2002
Tonnes
120000000
100000000
80000000
60000000
40000000
20000000
0
1924 1929 1934 1939 1944 1949 1954 1959 1964 1969 1974 1979 1984 1989 1994 1999

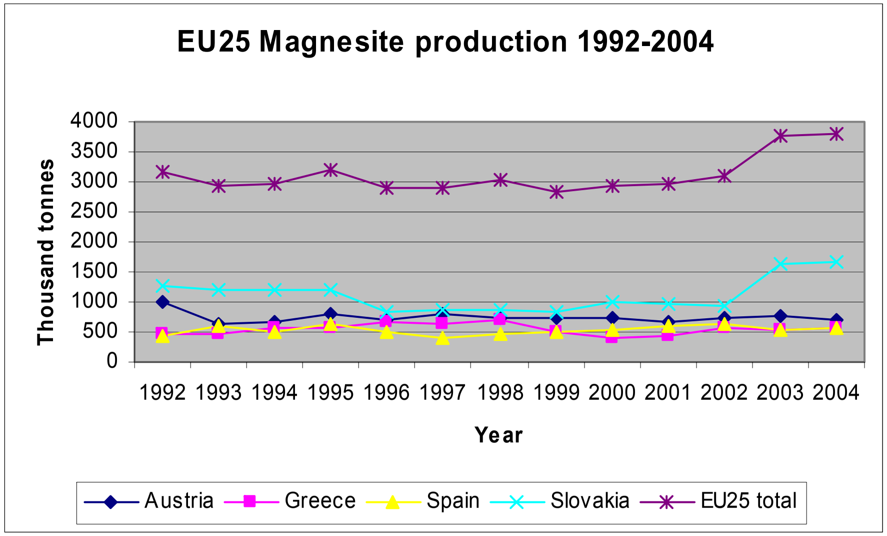
KAOLIN


EU25 - Kaolin production 1992-2004
Million tonnes
0
1
2
3
4
5
6
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
UK
Germany
Spain
France
Czech Rep
EU25

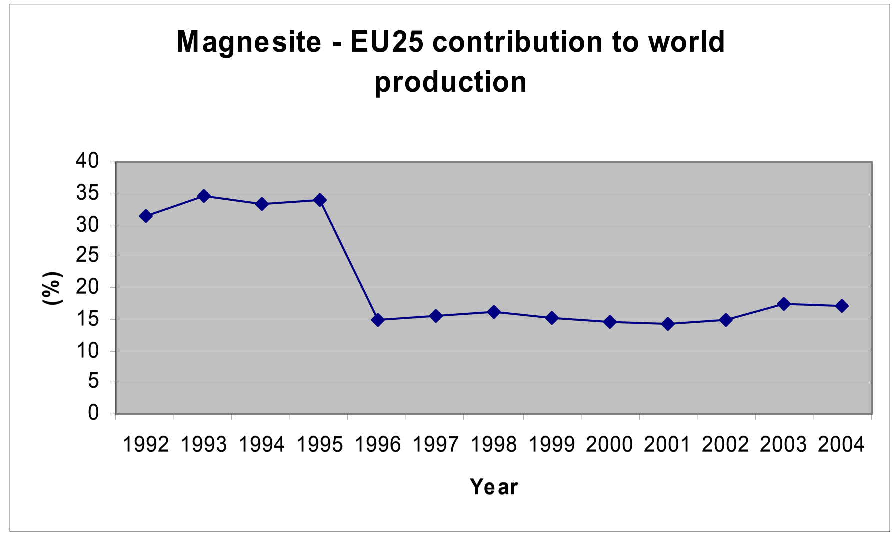

Kaolin - EU25 contribution to world production
(%)
0
5
10
15
20
25
30
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004


Kaolin - EU25 and world production
Million tonnes
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
USA
China
Brazil
Korea
EU25
World

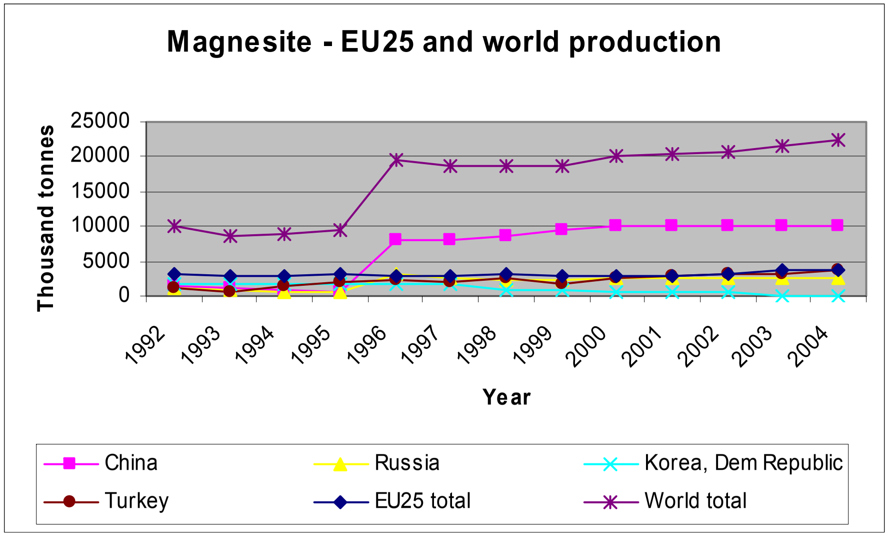
MAGNESITE



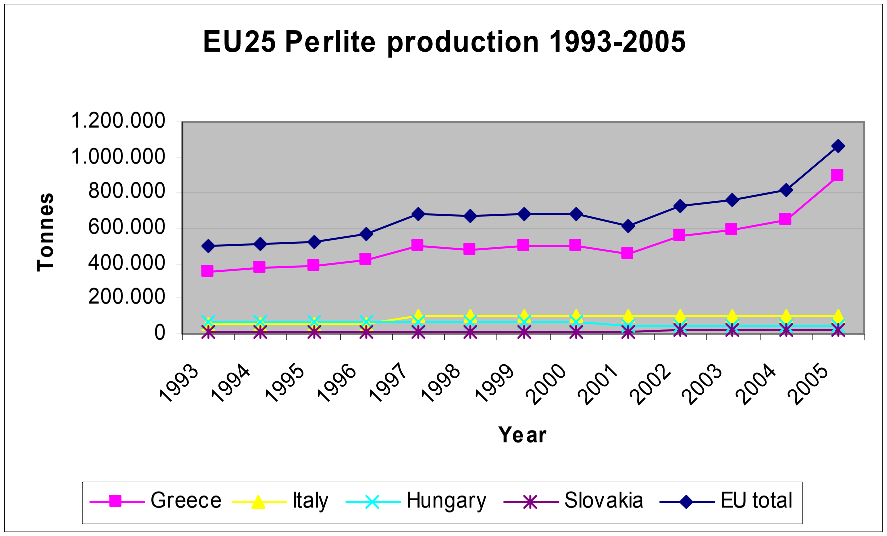
EU25 Magnesite production 1992-2004
Thousand tonnes
4000
3500
3000
2500
2000
1500
1000
500
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Austria
Greece
Spain
Slovakia
EU25 total

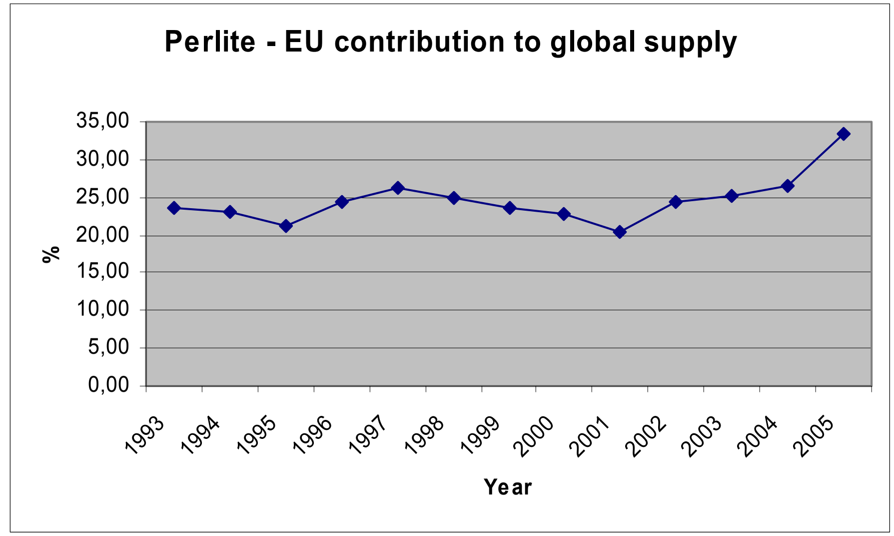


Magnesite - EU25 contribution to world production
(%)
40
35
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year


Magnesite - EU25 and world production
Thousand tonnes
25000
20000
15000
10000
5000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year
China
Russia
Korea, Dem Republic
Turkey
EU25 total
World total

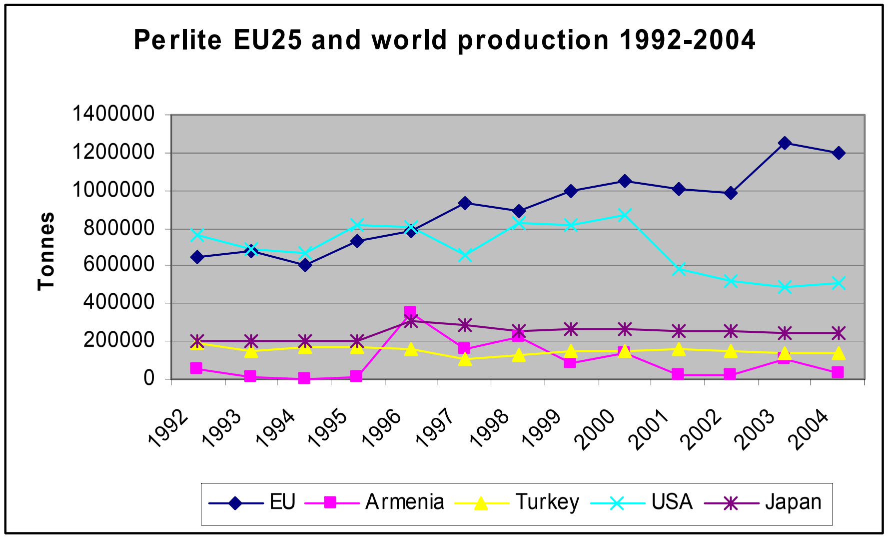
PERLITE



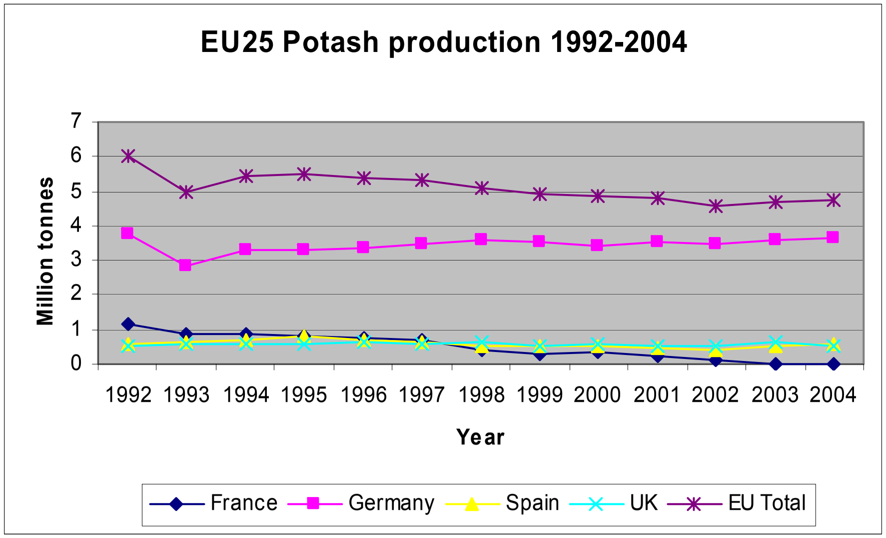


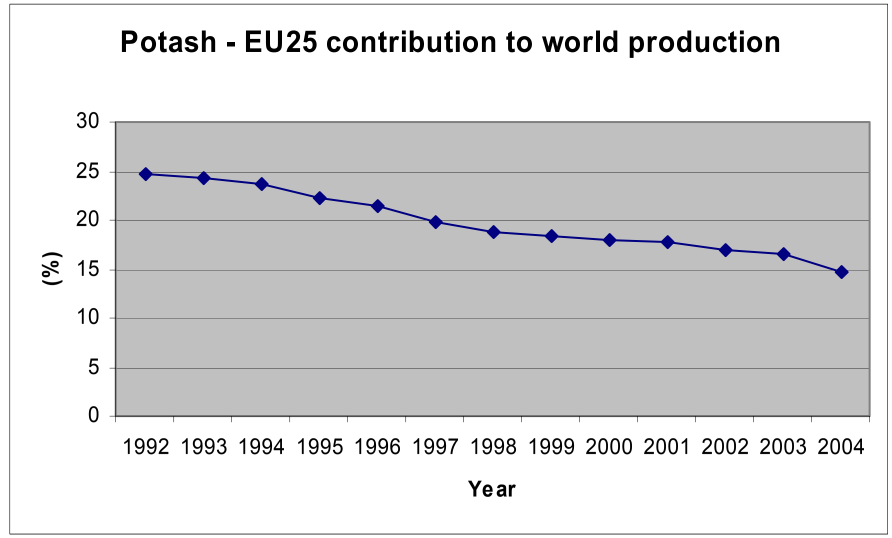
EN

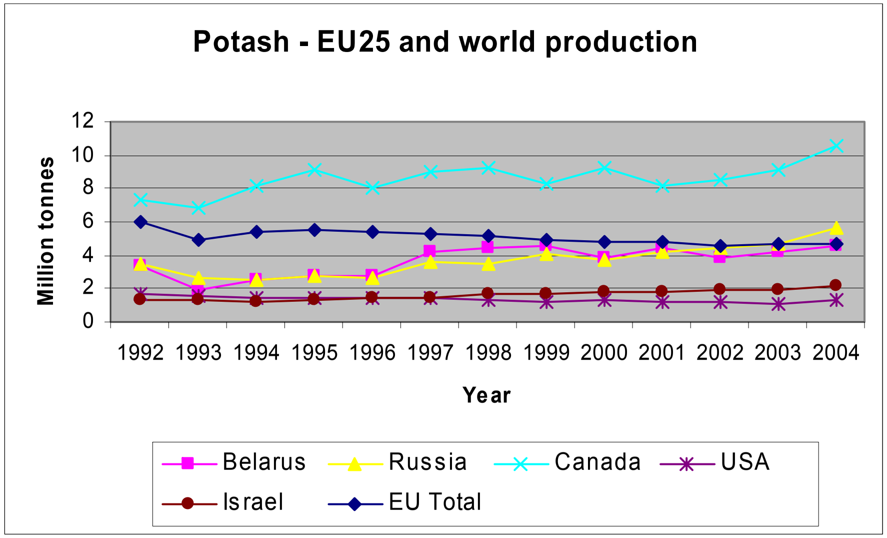
EN

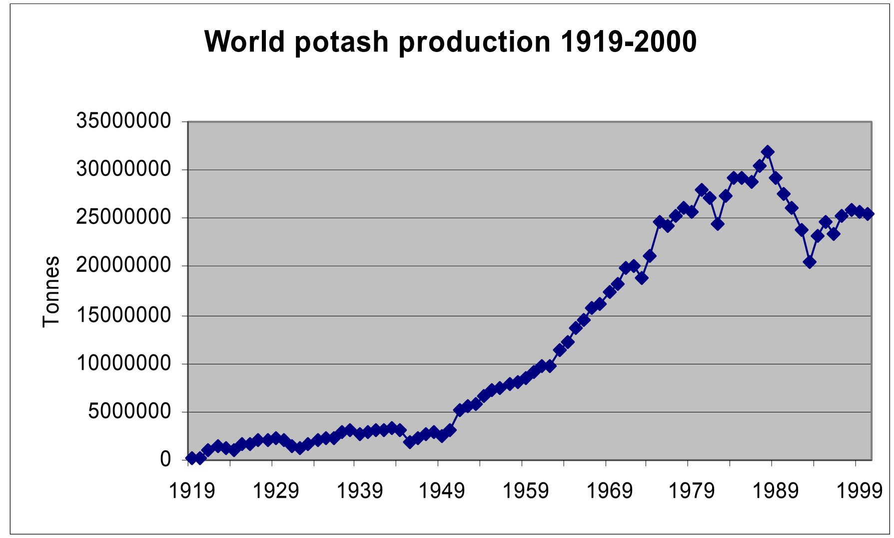

Perlite EU25 and world production 1992-2004
Tonnes
1400000
1200000
1000000
800000
600000
400000
200000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
EU
Armenia
Turkey
USA
Japan

POTASH

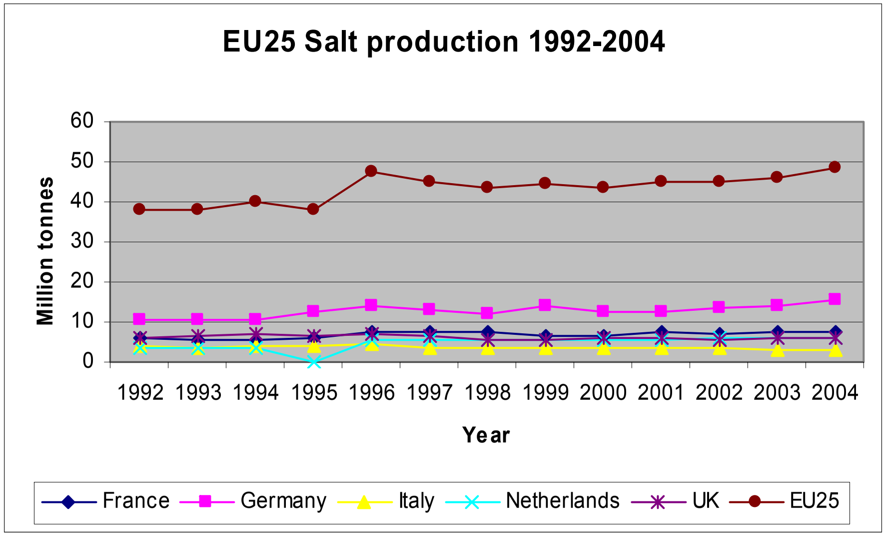

EU25 Potash production 1992-2004
Million tonnes
7
6
5
4
3
2
1
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
France
Germany
Spain
UK
EU Total

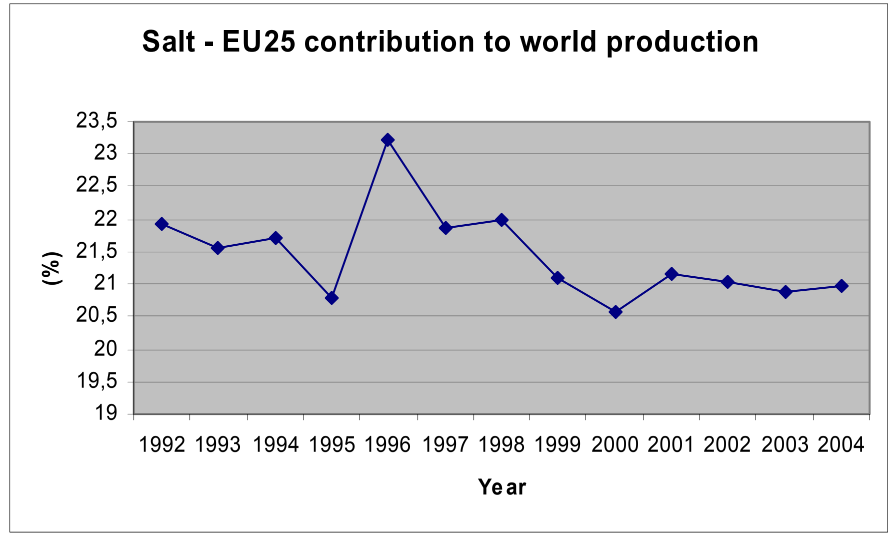

Potash - EU25 contribution to world production
(%)
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

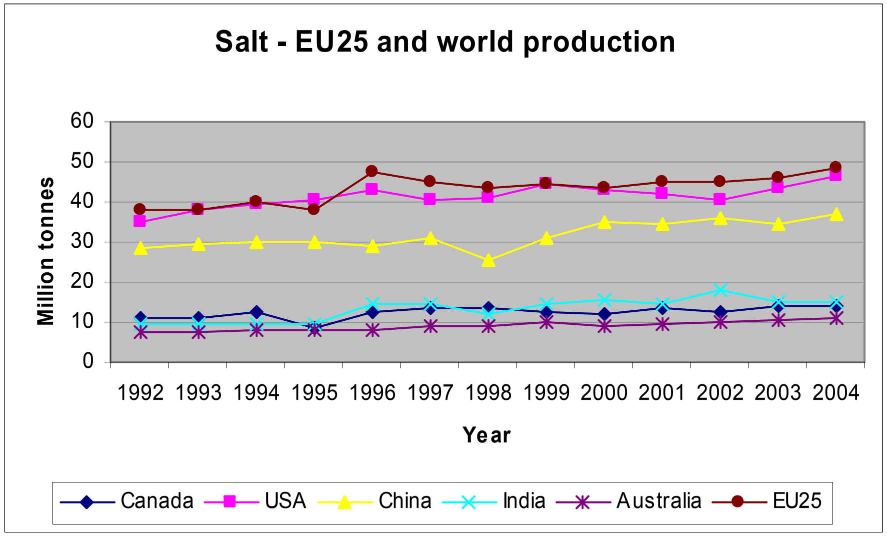

Potash - EU25 and world production
Million tonnes
0
2
4
6
8
10
12
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Belarus
Russia
Canada
USA
Israel
EU Total

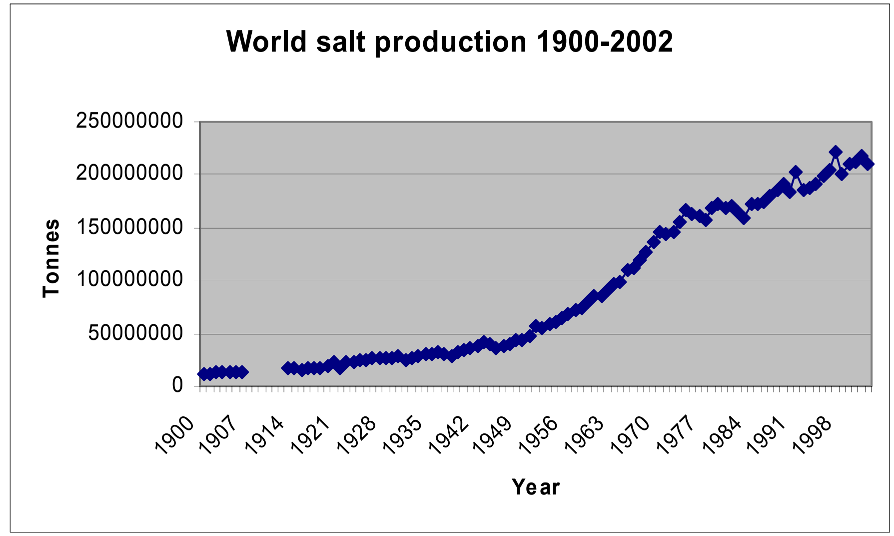

World potash production 1919-2000
Tonnes
0
5000000
10000000
15000000
20000000
25000000
30000000
35000000
1919 1929 1939 1949 1959 1969 1979 1989 1999

SALT

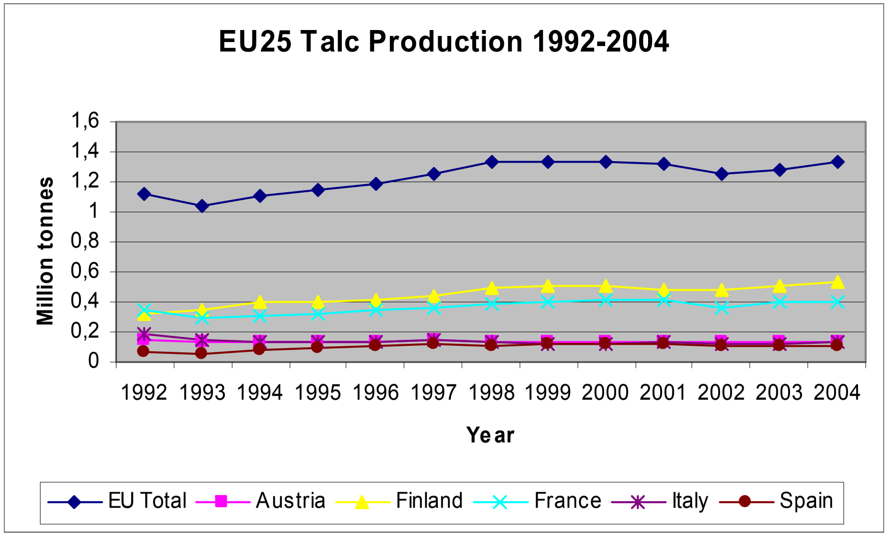

EU25 Salt production 1992-2004
Million tonnes
60
50
40
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
France
Germany
Italy
Netherlands
UK
EU25


Salt - EU25 contribution to world production
(%)
23,5
23
22,5
22
21,5
21
20,5
20
19,5
19
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

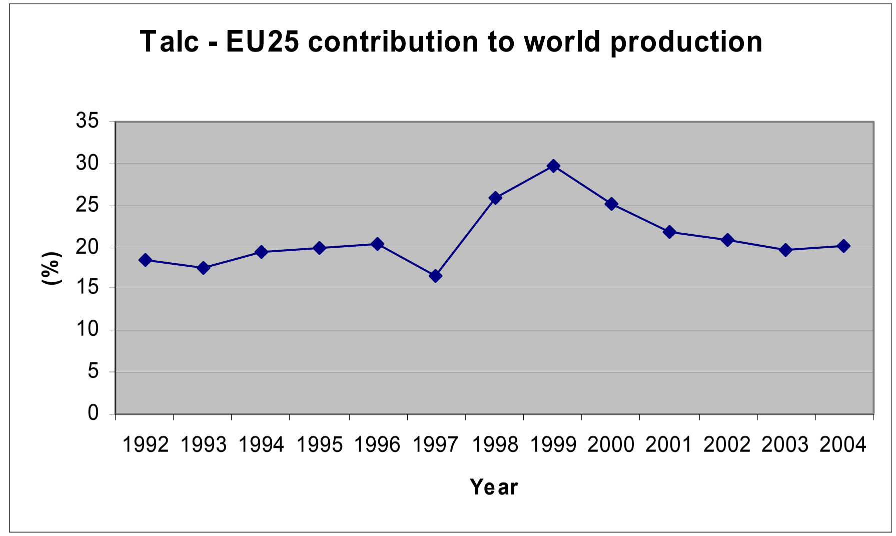

Salt - EU25 and world production
Million tonnes
60
50
40
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Canada
USA
China
India
Australia
EU25


World salt production 1900-2002
Tonnes
250000000
200000000
150000000
100000000
50000000
0
1900 1907 1914 1921 1928 1935 1942 1949 1956 1963 1970 1977 1984 1991 1998
Year

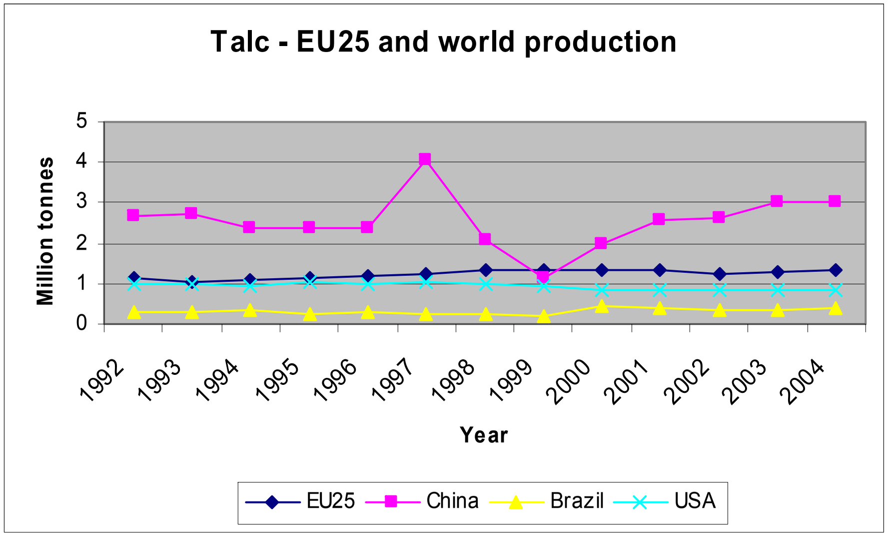
TALC

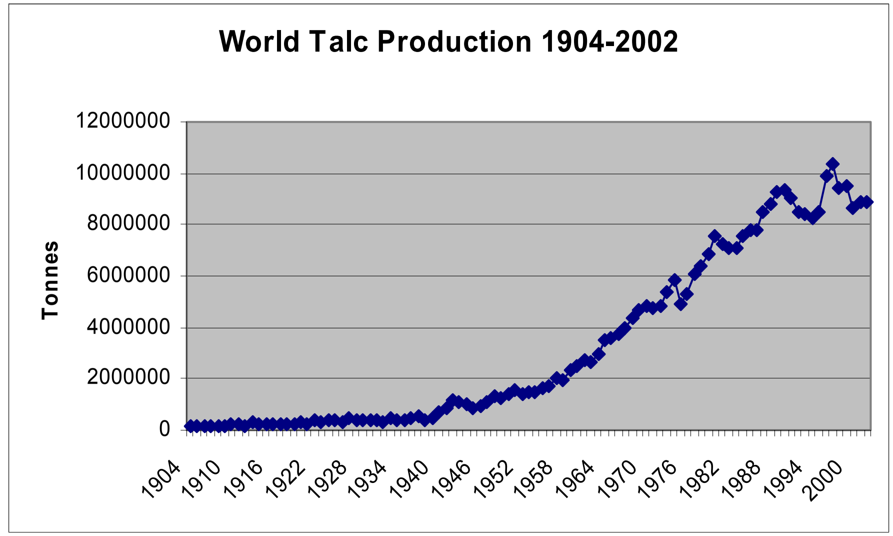


EU25 Talc Production 1992-2004
Million tonnes
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
EU Total
Austria
Finland
France
Italy
Spain

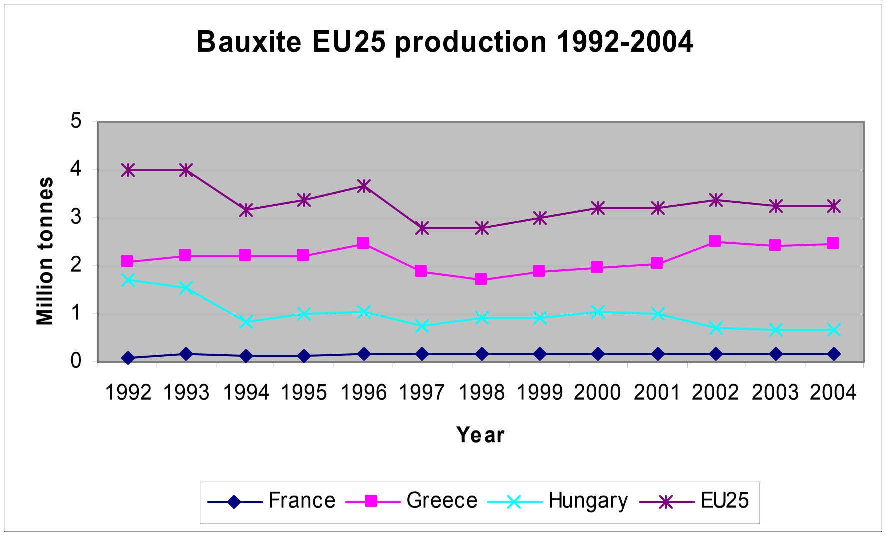


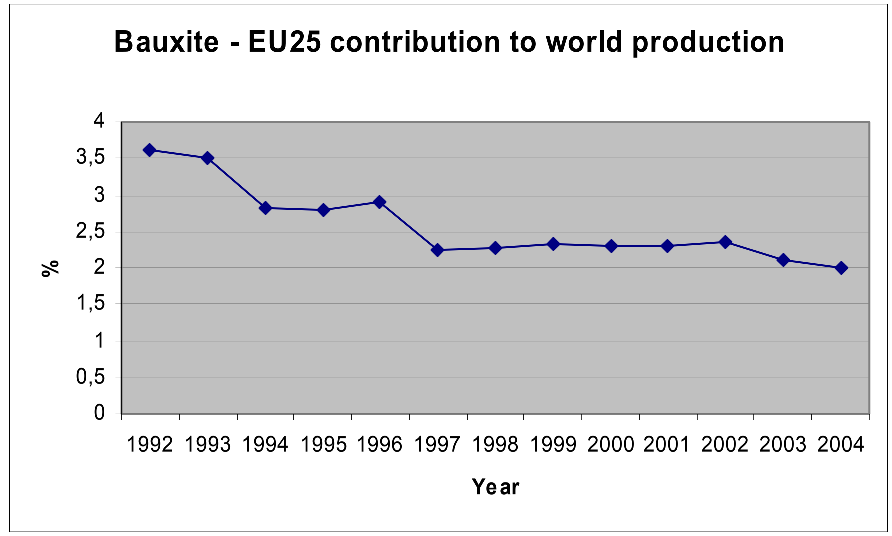
Talc - EU25 contribution to world production
(%)
35
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

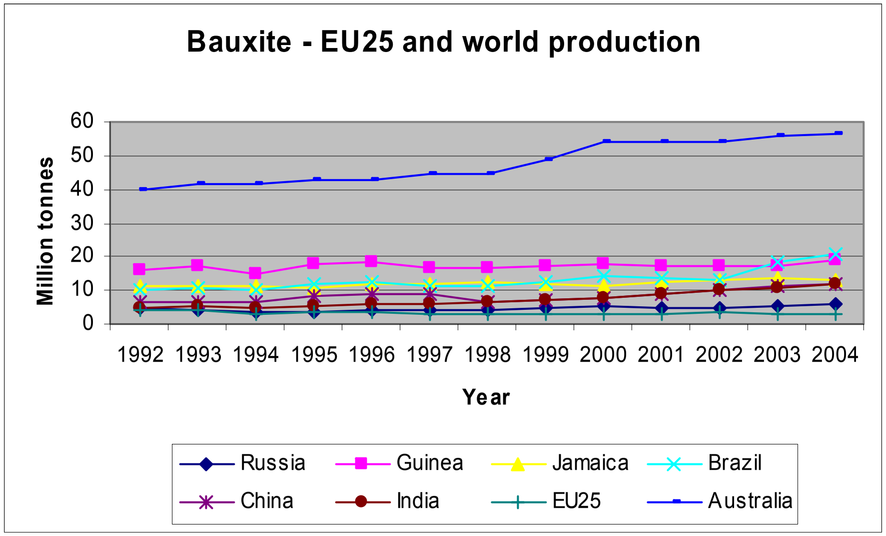

Talc - EU25 and world production
Million tonnes
5
4
3
2
1
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year
EU25
China
Brazil
USA

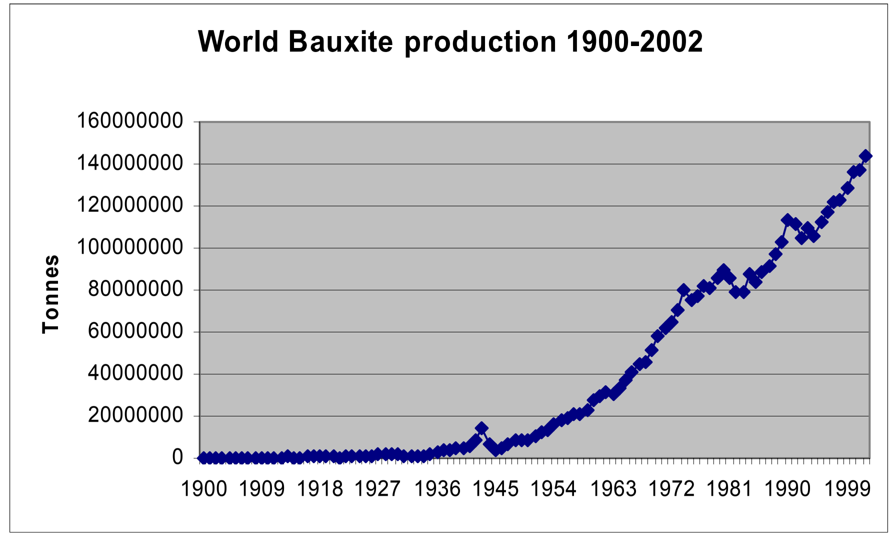

World Talc Production 1904-2002
Tonnes
12000000
10000000
8000000
6000000
4000000
2000000
0
1904
1910
1916
1922
1928
1934
1940
1946
1952
1958
1964
1970
1976
1982
1988
1994
2000

BAUXITE

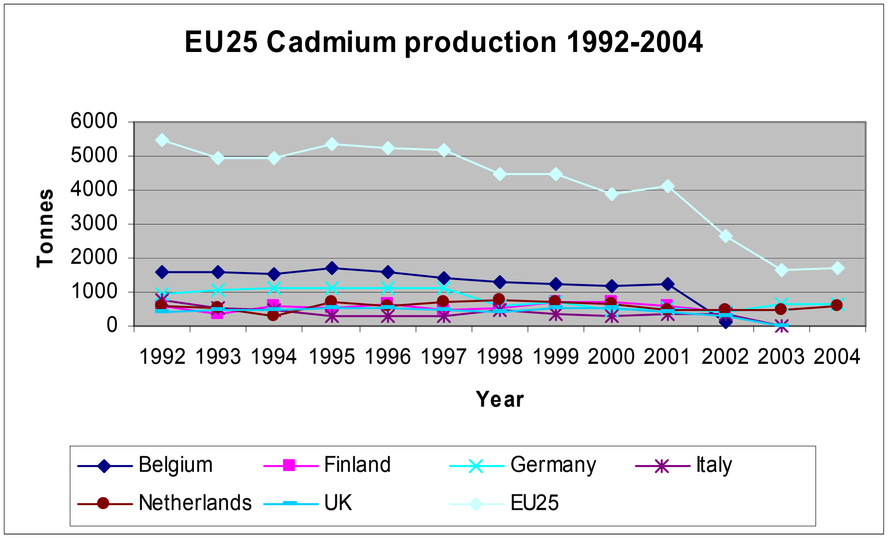

Bauxite EU25 production 1992-2004
Million tonnes
0
1
2
3
4
5
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
France
Greece
Hungary
EU25

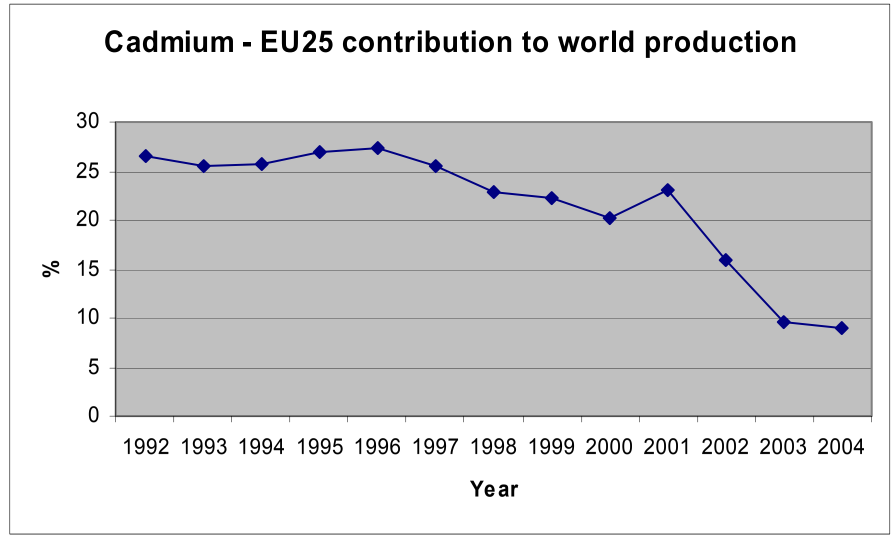

Bauxite - EU25 contribution to world production
%
0
0,5
1
1,5
2
2,5
3
3,5
4
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

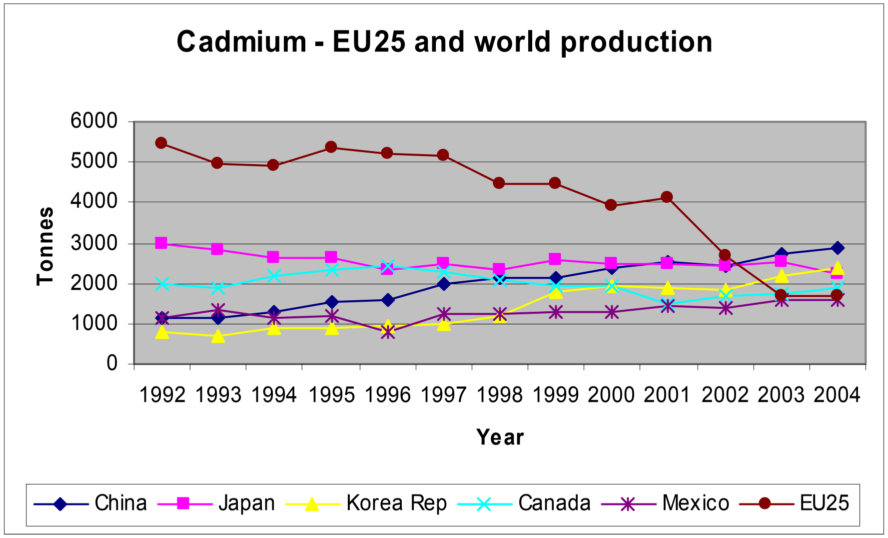

Bauxite - EU25 and world production
Million tonnes
60
50
40
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Russia
Guinea
Jamaica
Brazil
China
India
EU25
Australia

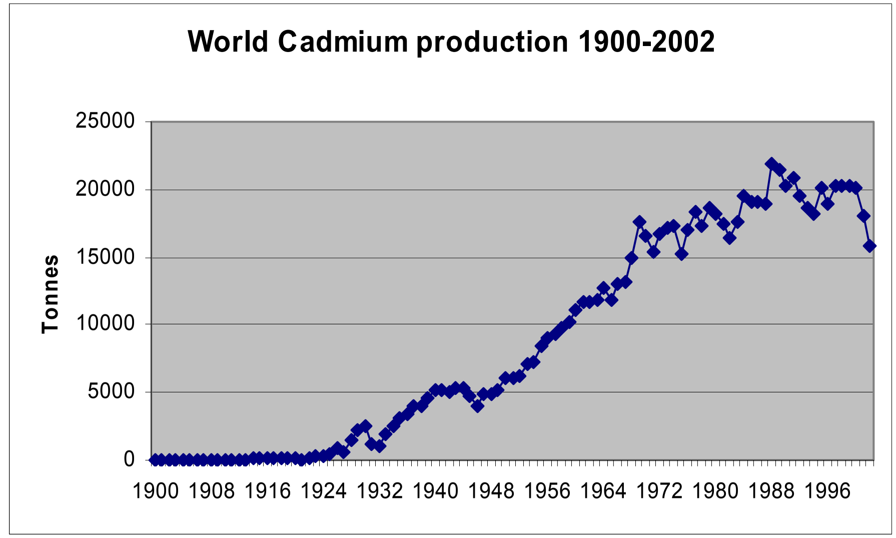

World Bauxite production 1900-2002
Tonnes
160000000
140000000
120000000
100000000
80000000
60000000
40000000
20000000
0
1900 1909 1918 1927 1936 1945 1954 1963 1972 1981 1990 1999

CADMIUM

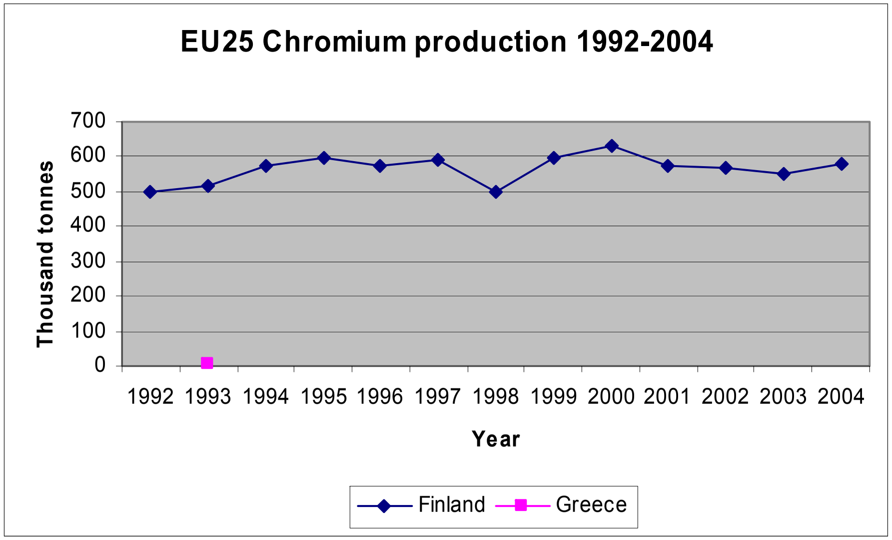

EU25 Cadmium production 1992-2004
Tonnes
6000
5000
4000
3000
2000
1000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Belgium
Finland
Germany
Italy
Netherlands
UK
EU25

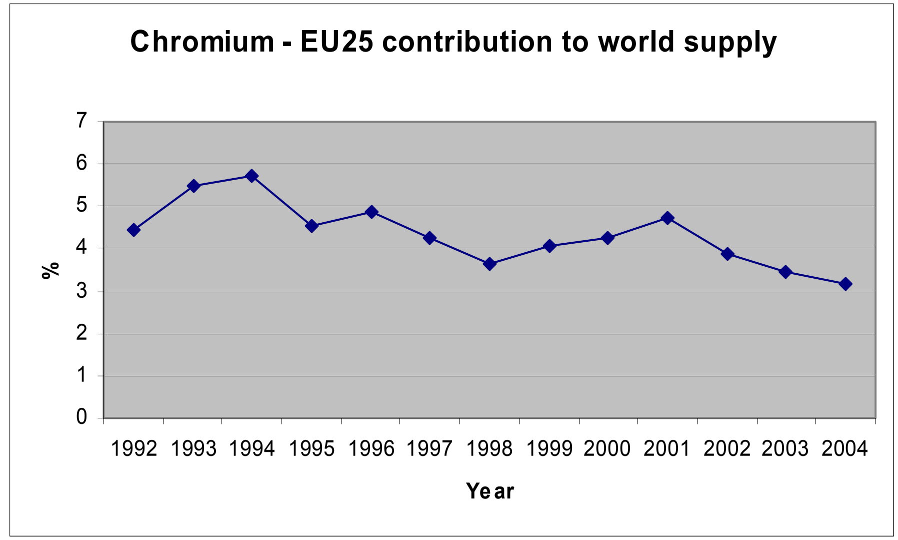

Cadmium - EU25 contribution to world production
%
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

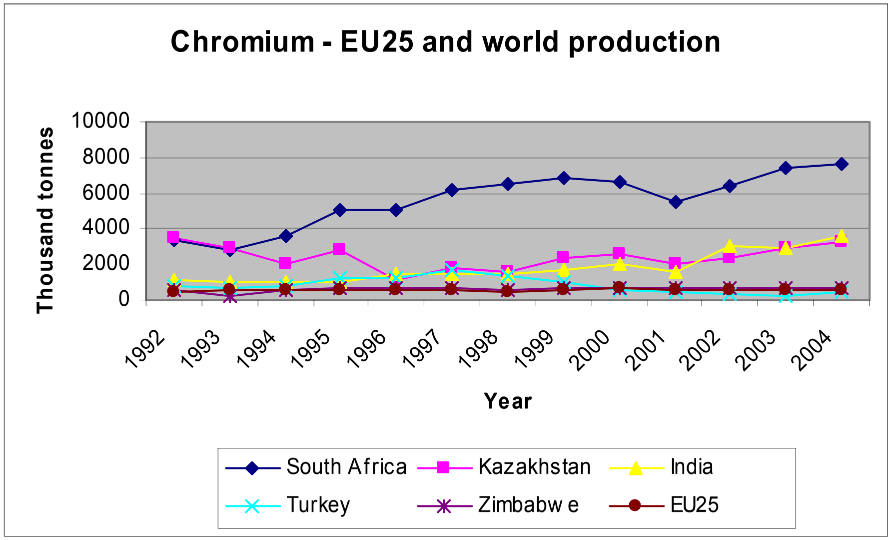

Cadmium - EU25 and world production
Tonnes
6000
5000
4000
3000
2000
1000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
China
Japan
Korea Rep
Canada
Mexico
EU25

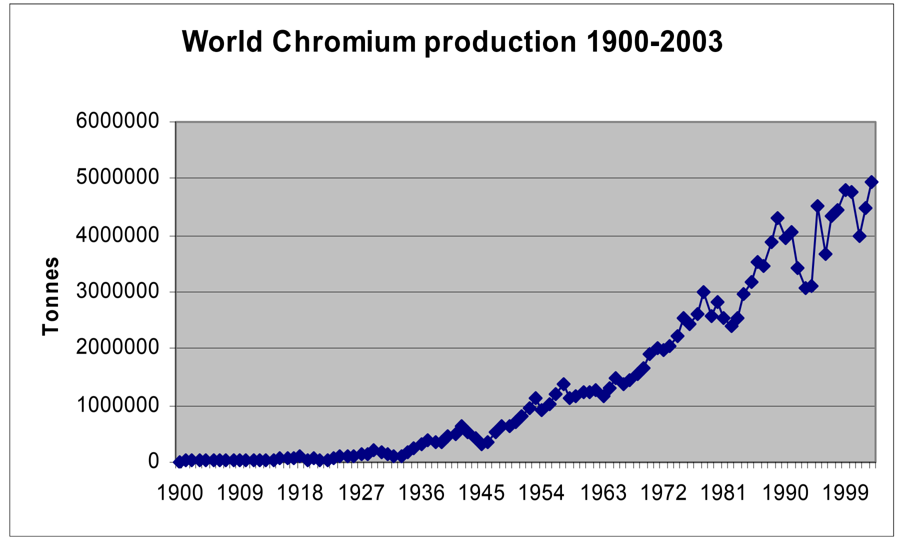

World Cadmium production 1900-2002
Tonnes
25000
20000
15000
10000
5000
0
1900 1908 1916 1924 1932 1940 1948 1956 1964 1972 1980 1988 1996

CHROMIUM

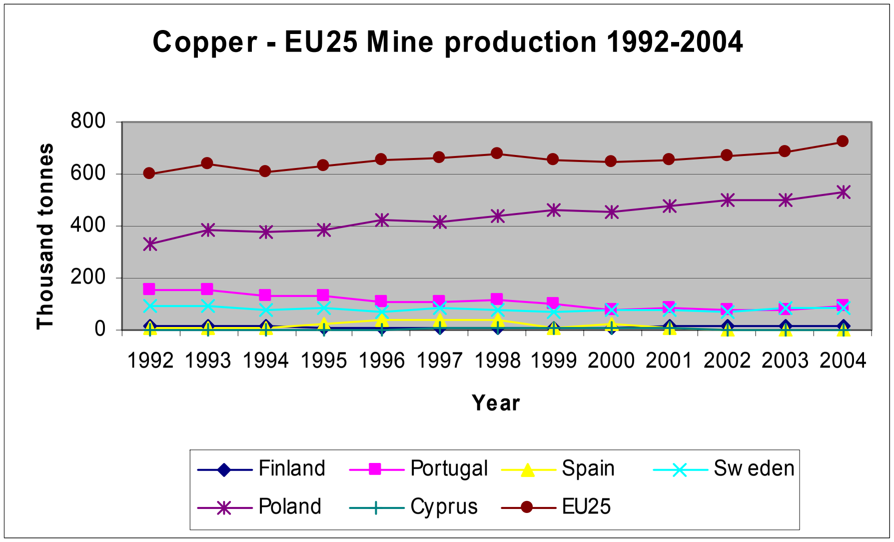

EU25 Chromium production 1992-2004
Thousand tonnes
700
600
500
400
300
200
100
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Finland
Greece

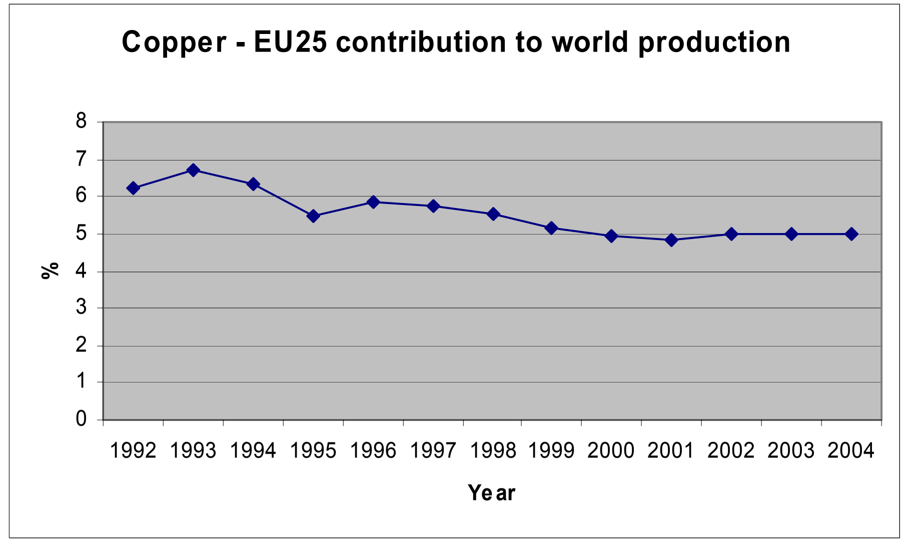

Chromium - EU25 contribution to world supply
%
7
6
5
4
3
2
1
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

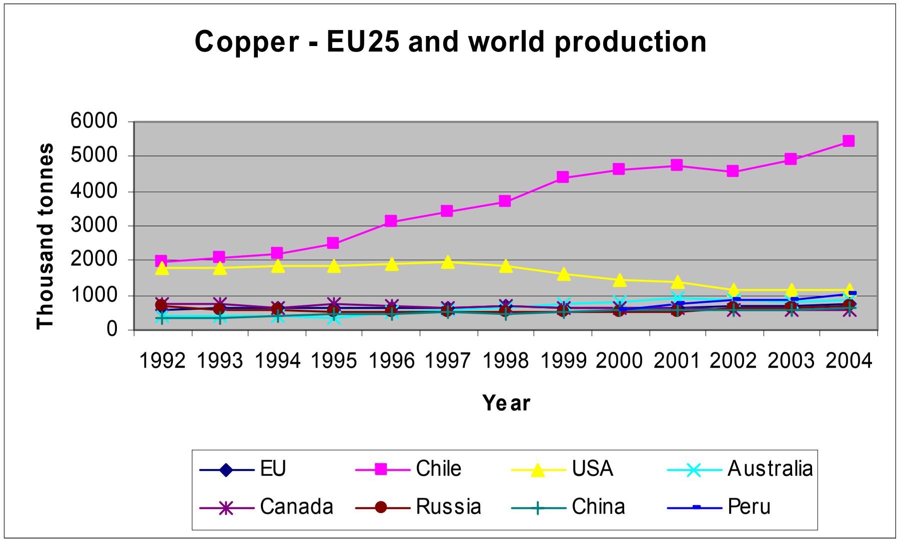

Chromium - EU25 and world production
Thousand tonnes
10000
8000
6000
4000
2000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year
South Africa
Kazakhstan
India
Turkey
Zimbabw e
EU25

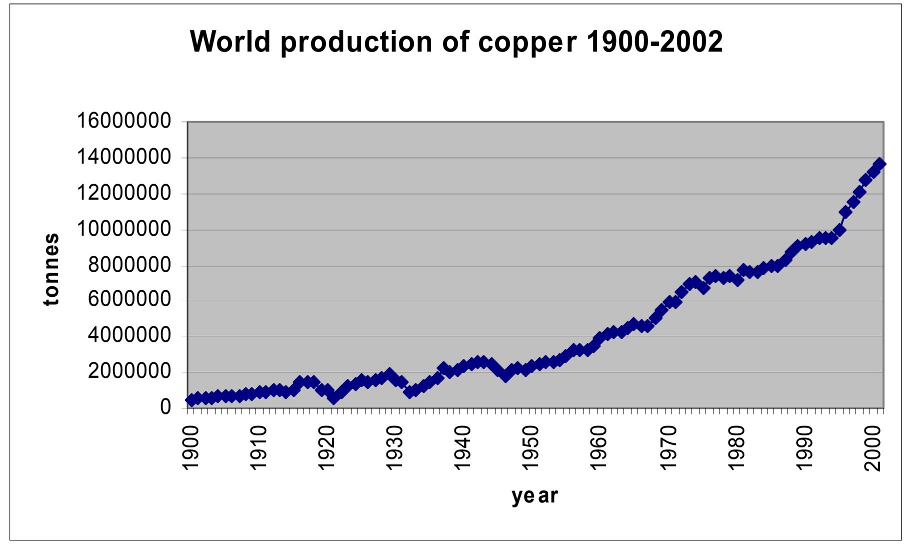

World Chromium production 1900-2003
Tonnes
6000000
5000000
4000000
3000000
2000000
1000000
0
1900
1909
1918
1927
1936
1945
1954
1963
1972
1981
1990
1999

COPPER

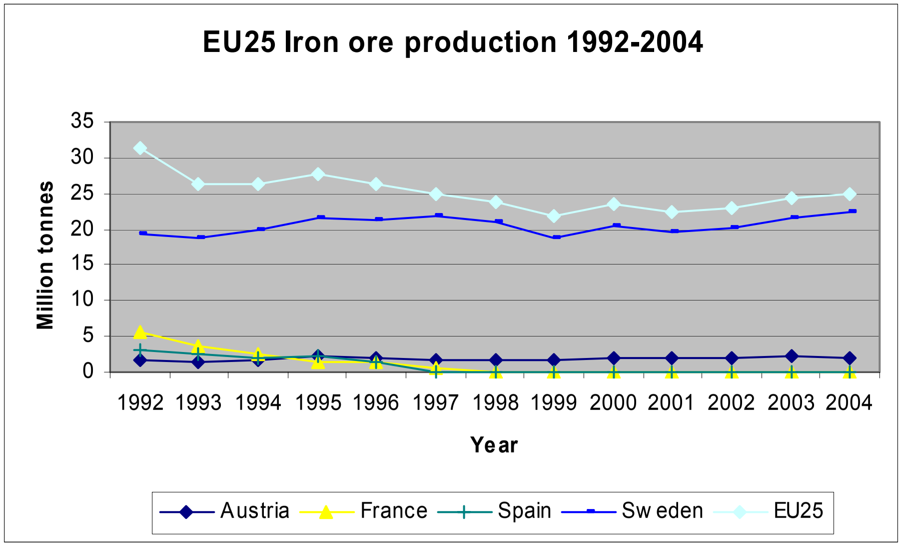

Copper - EU25 Mine production 1992-2004
Thousand tonnes
800
600
400
200
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Finland
Portugal
Spain
Sweden
Poland
Cyprus
EU25


Copper - EU25 contribution to world production
%
8
7
6
5
4
3
2
1
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

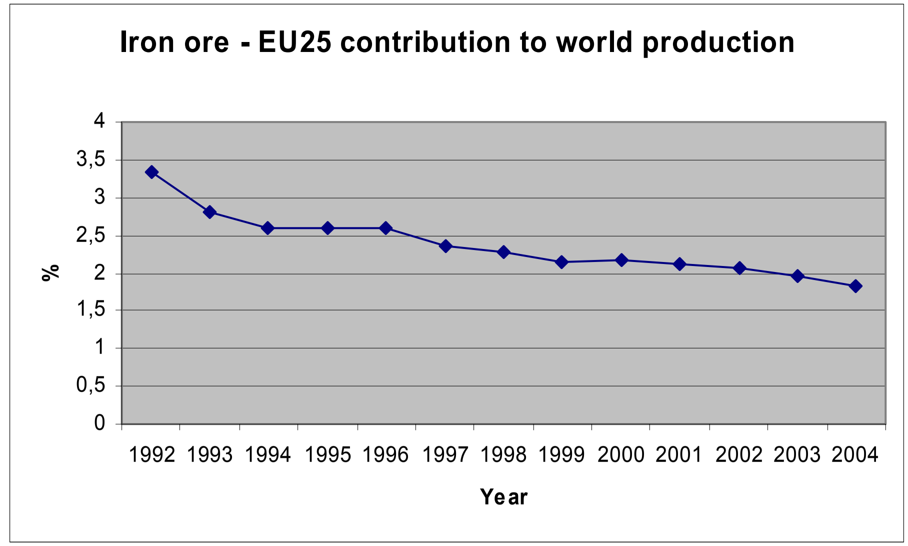

Copper - EU25 and world production
Thousand tonnes
6000
5000
4000
3000
2000
1000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
EU
Chile
USA
Australia
Canada
Russia
China
Peru


World production of copper 1900-2002
tonnes
16000000
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
year

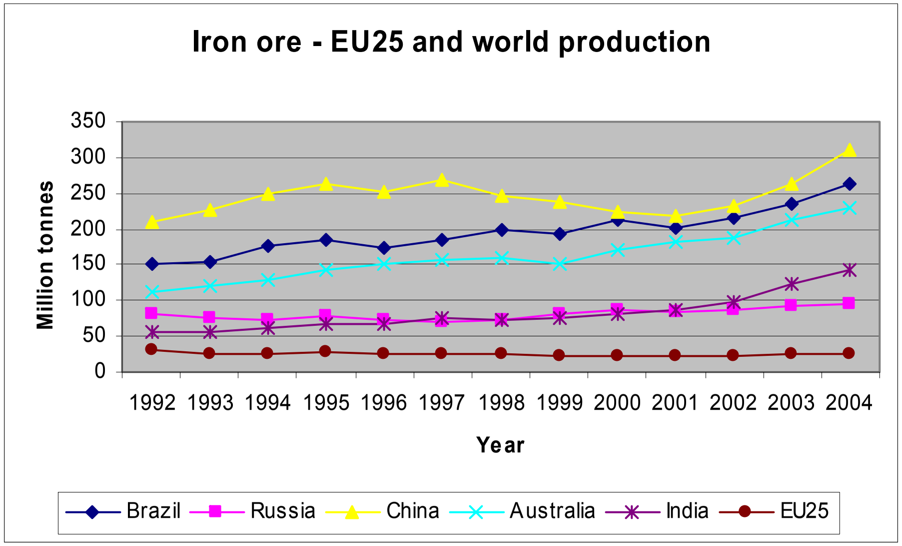
IRON ORE

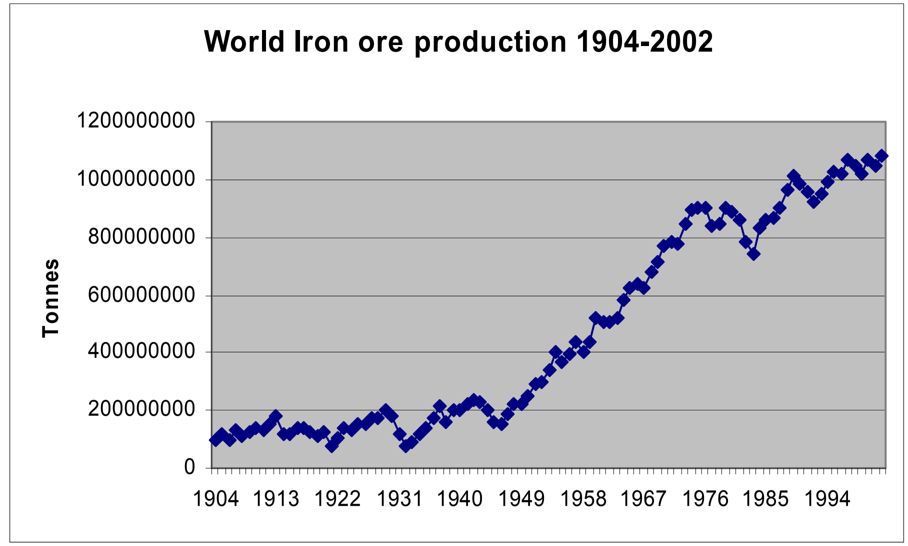


EU25 Iron ore production 1992-2004
Million tonnes
35
30
25
20
15
10
5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Austria
France
Spain
Sweden
EU25

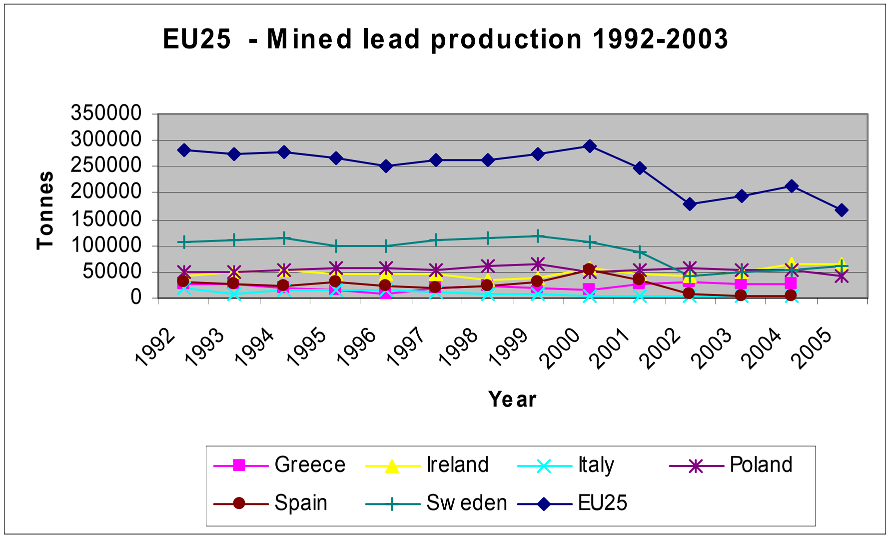


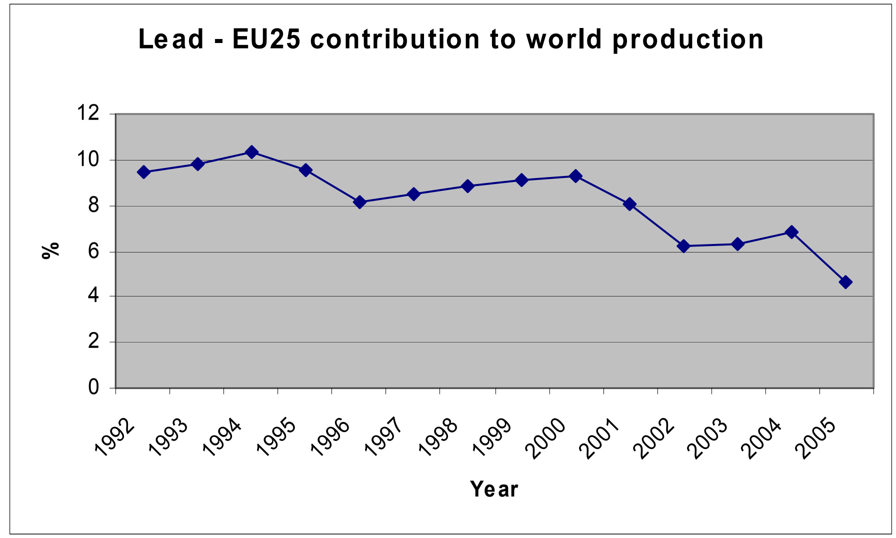
Iron ore - EU25 contribution to world production
%
4
3,5
3
2,5
2
1,5
1
0,5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

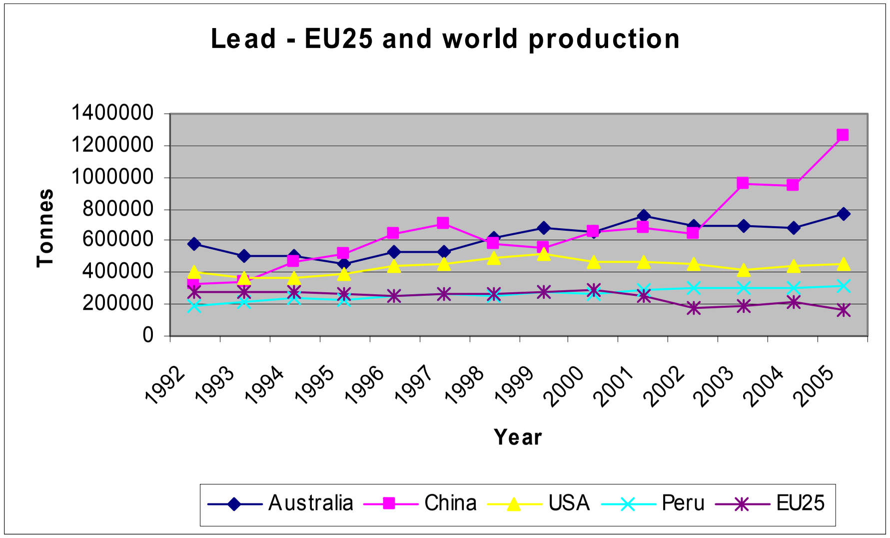

Iron ore - EU25 and world production
Million tonnes
350
300
250
200
150
100
50
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Brazil
Russia
China
Australia
India
EU25

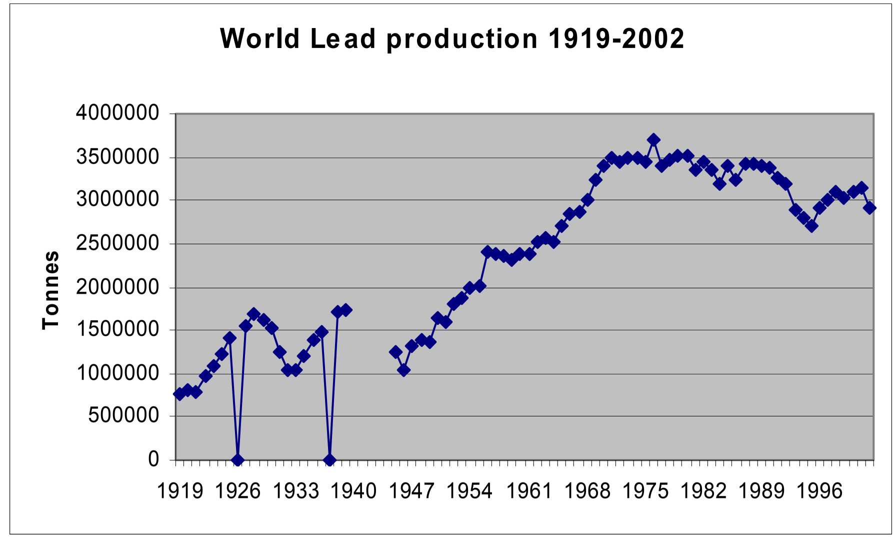

World Iron ore production 1904-2002
Tonnes
1200000000
1000000000
800000000
600000000
400000000
200000000
0
1904 1913 1922 1931 1940 1949 1958 1967 1976 1985 1994

LEAD

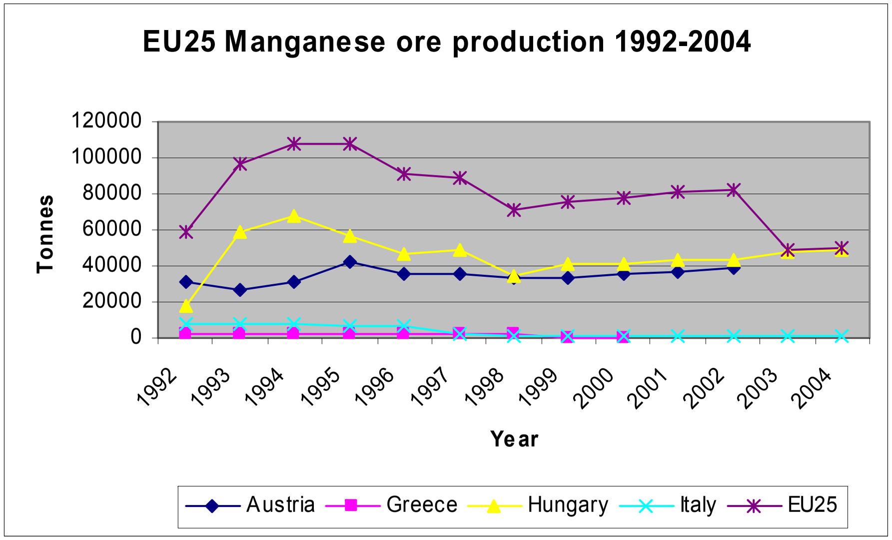

EU25 - Mined lead production 1992-2003
Tonnes
350000
300000
250000
200000
150000
100000
50000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year
Greece
Ireland
Italy
Poland
Spain
Sw eden
EU25

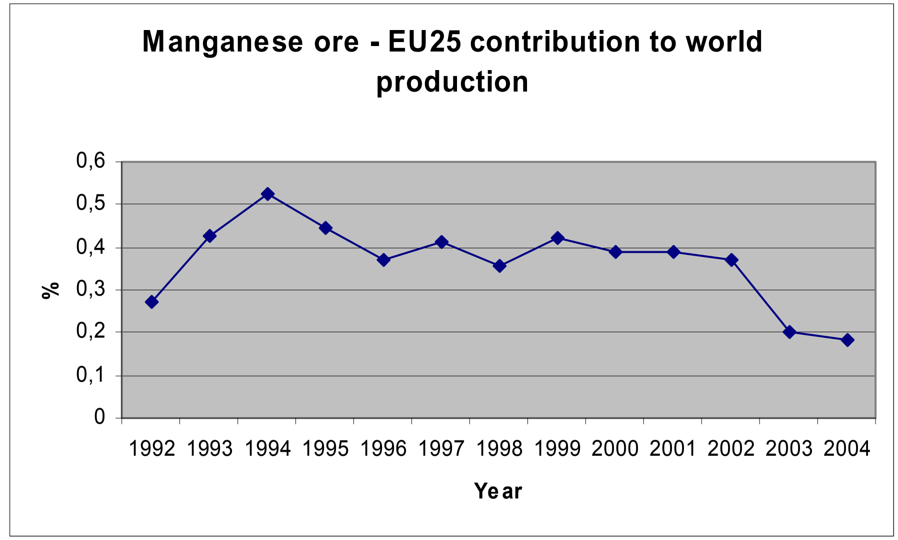

Lead - EU25 contribution to world production
%
12
10
8
6
4
2
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year


Lead - EU25 and world production
Tonnes
1400000
1200000
1000000
800000
600000
400000
200000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
Year
Australia
China
USA
Peru
EU25


World Lead production 1919-2002
Tonnes
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1919 1926 1933 1940 1947 1954 1961 1968 1975 1982 1989 1996

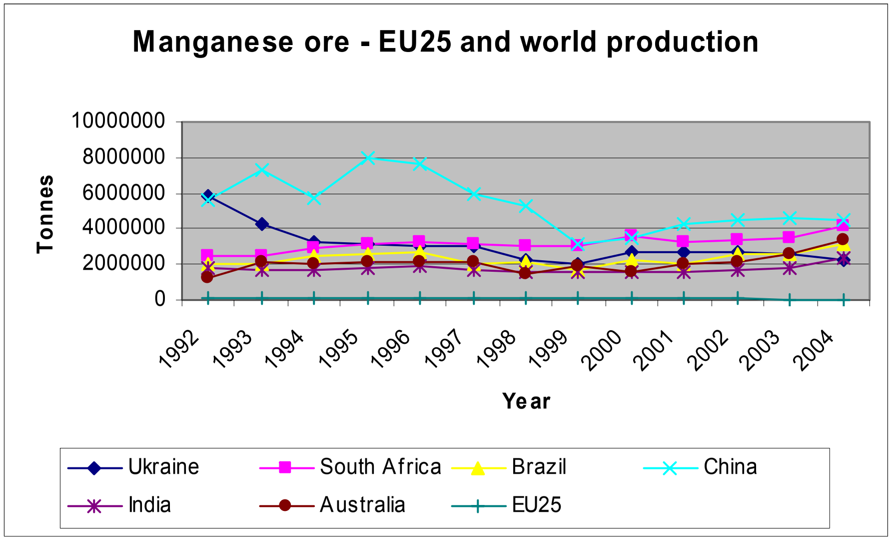
MANGANESE

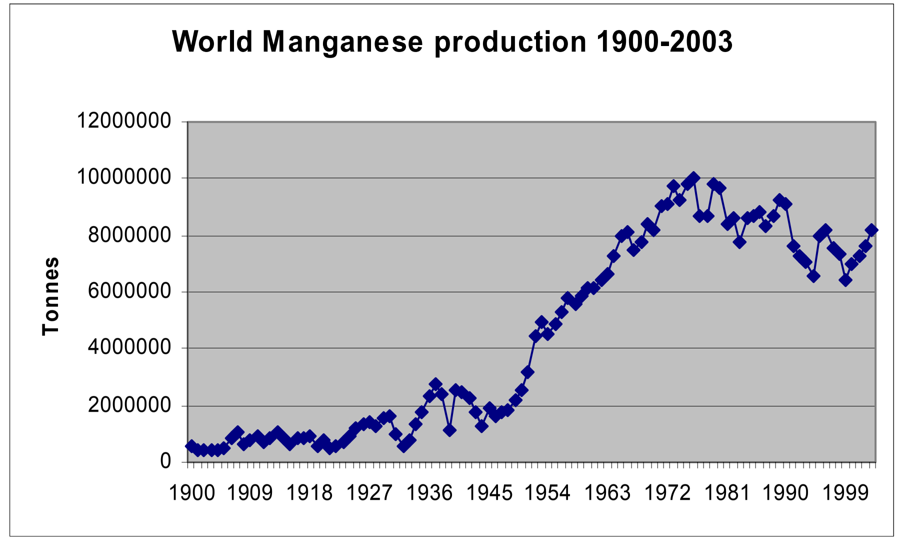




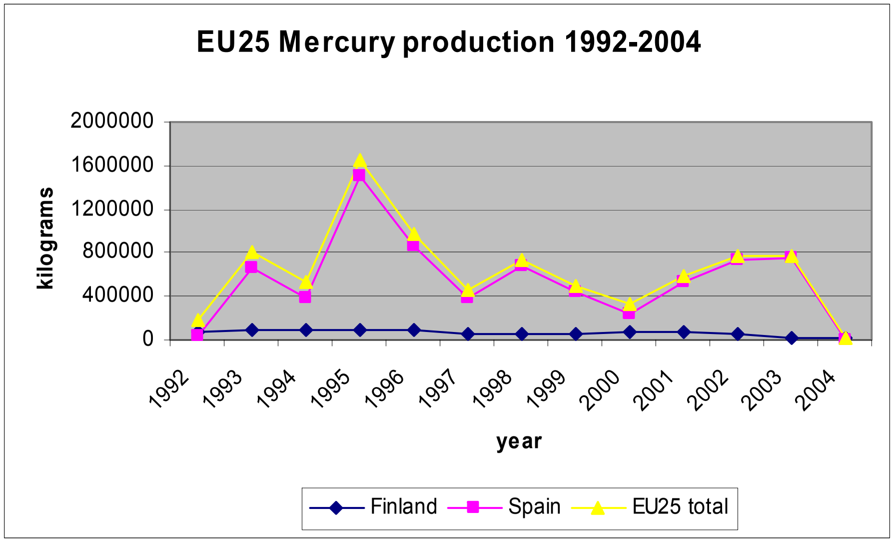
EN

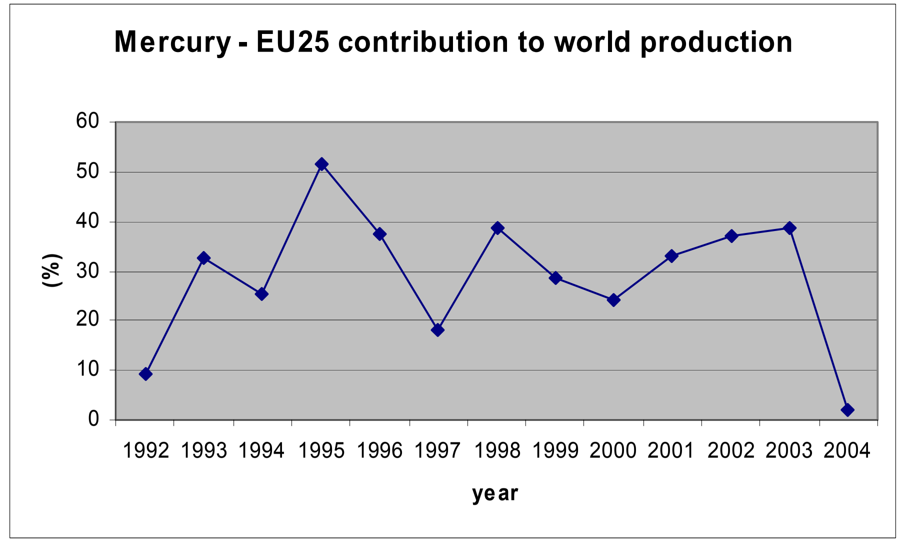
EN

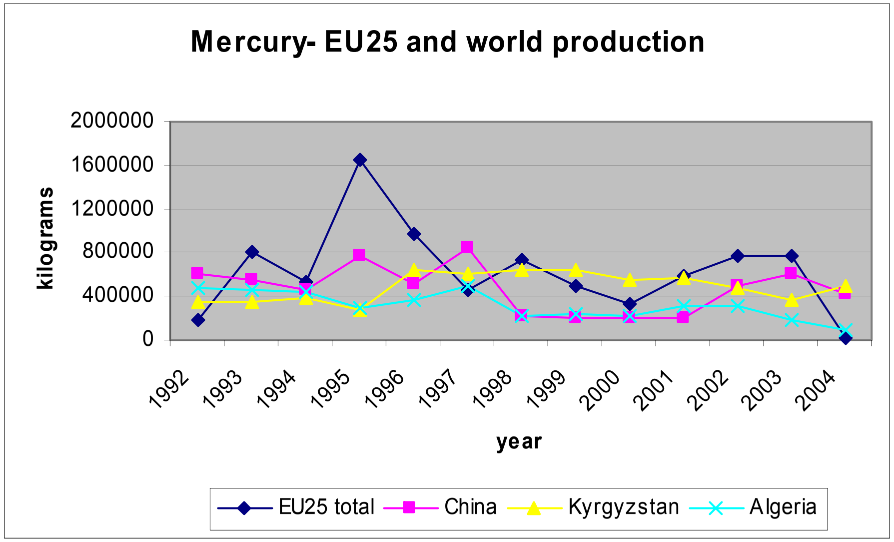

Manganese ore - EU25 and world production
Tonnes
10000000
8000000
6000000
4000000
2000000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year
Ukraine
South Africa
Brazil
China
India
Australia
EU25

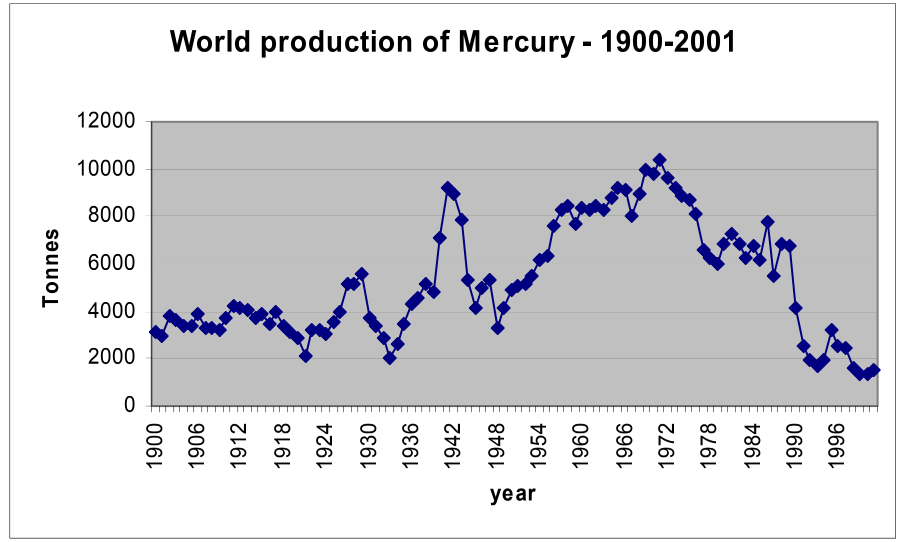

World Manganese production 1900-2003
Tonnes
12000000
10000000
8000000
6000000
4000000
2000000
0
1900
1909
1918
1927
1936
1945
1954
1963
1972
1981
1990
1999

MERCURY

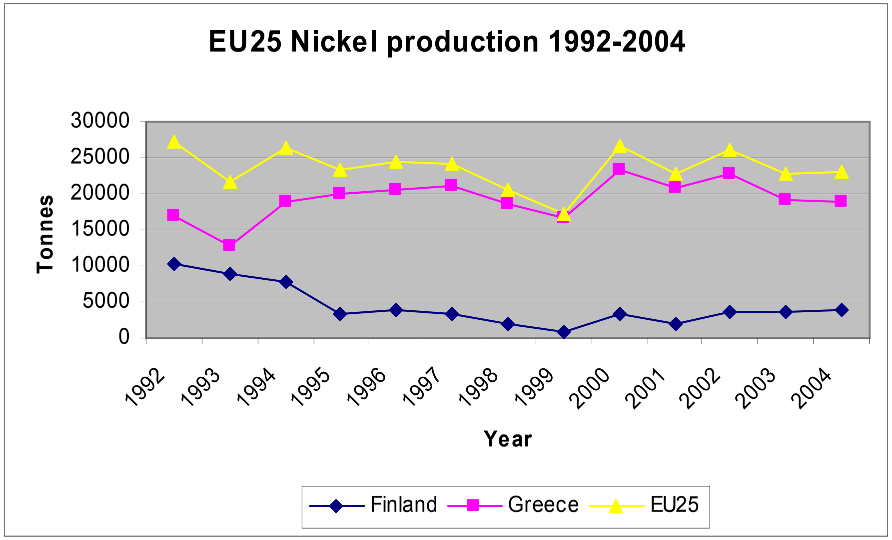

EU25 Mercury production 1992-2004
kilograms
2000000
1600000
1200000
800000
400000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
year
Finland
Spain
EU25 total


Mercury - EU25 contribution to world production
(%)
60
50
40
30
20
10
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
year

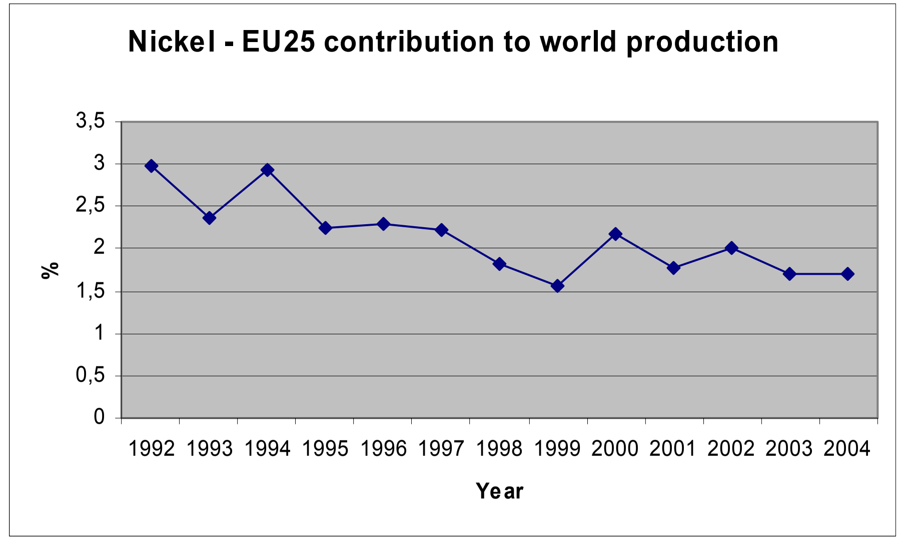

Mercury- EU25 and world production
2000000
1600000
1200000
800000
400000
0
kilograms
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
year
EU25 total
China
Kyrgyzstan
Algeria


World production of Mercury - 1900-2001
12000
10000
8000
6000
4000
2000
0
Tonnes
1900
1906
1912
1918
1924
1930
1936
1942
1948
1954
1960
1966
1972
1978
1984
1990
1996
year

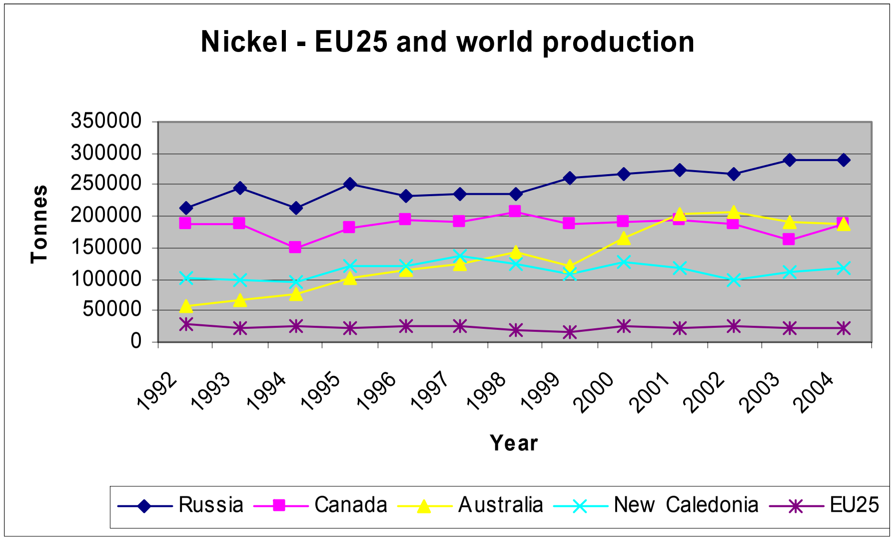
NICKEL

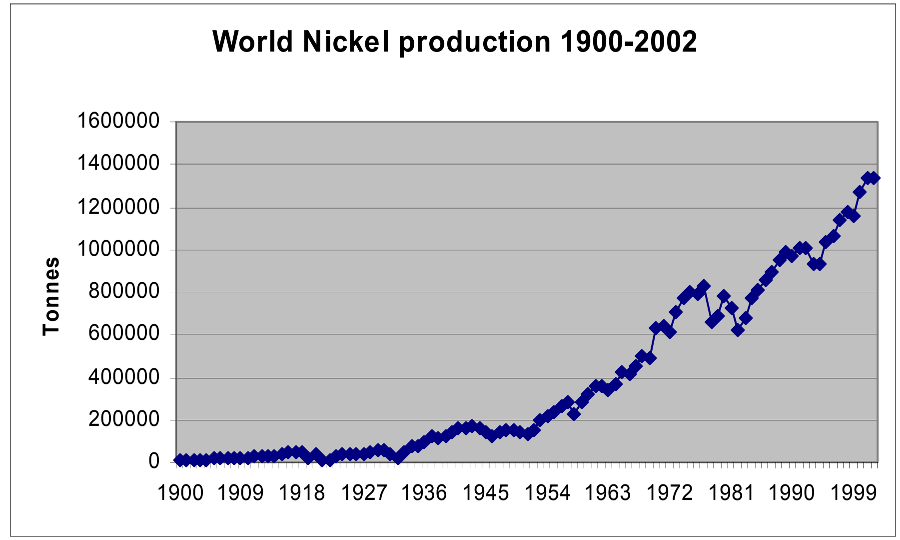


EU25 Nickel production 1992-2004
Tonnes
30000
25000
20000
15000
10000
5000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Finland
Greece
EU25

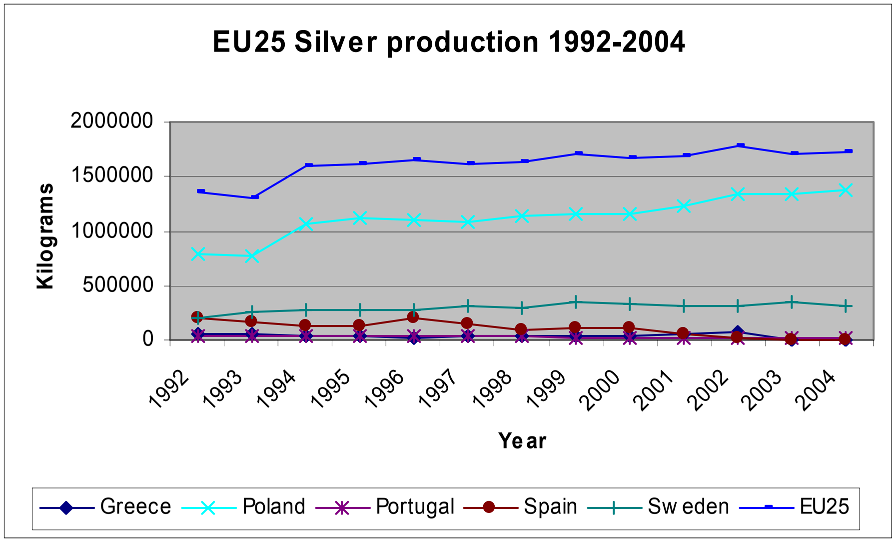


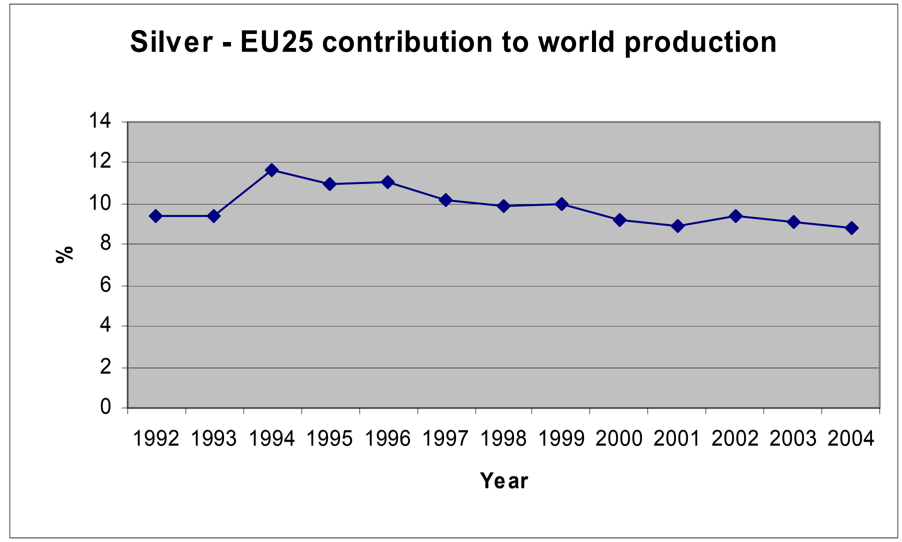
Nickel - EU25 contribution to world production
%
3,5
3
2,5
2
1,5
1
0,5
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

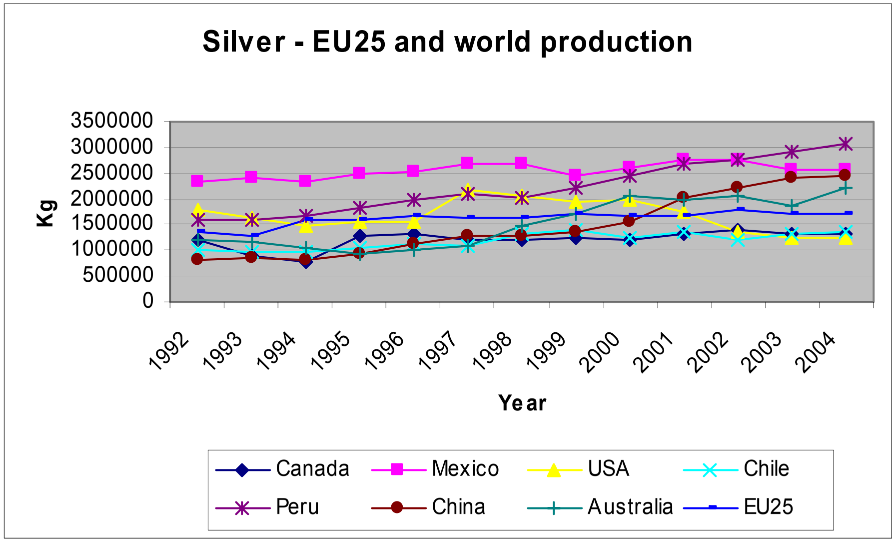

Nickel - EU25 and world production
Tonnes
350000
300000
250000
200000
150000
100000
50000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year
Russia
Canada
Australia
New Caledonia
EU25

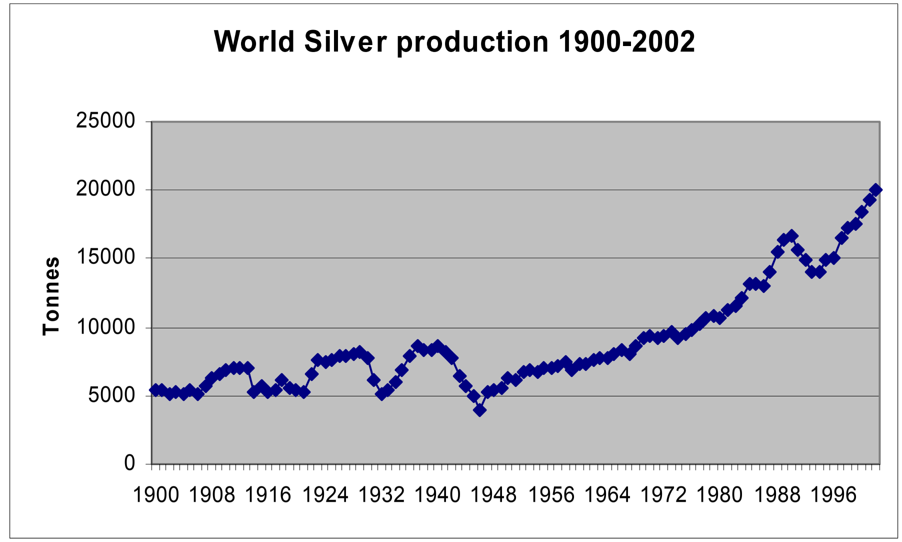

World Nickel production 1900-2002
Tonnes
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
1900
1909
1918
1927
1936
1945
1954
1963
1972
1981
1990
1999

SILVER

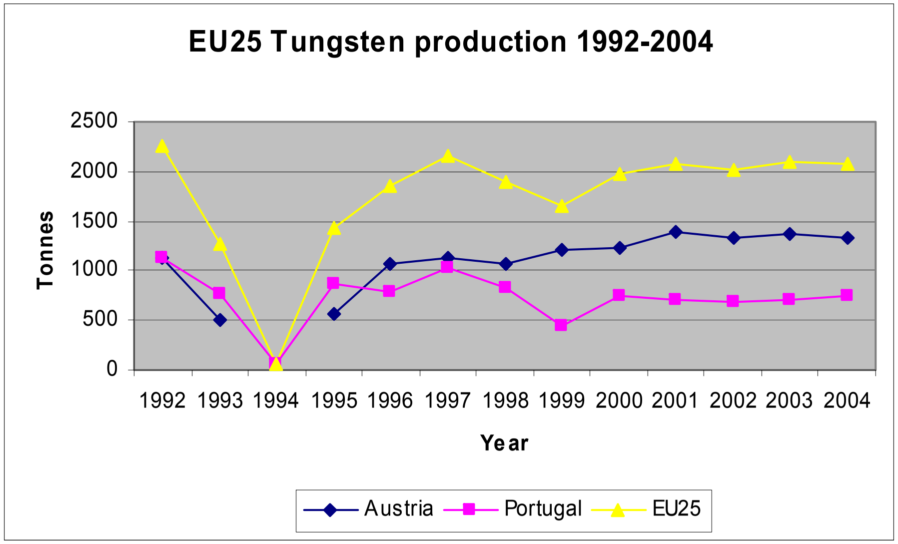

EU25 Silver production 1992-2004
Kilograms
2000000
1500000
1000000
500000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Greece
Poland
Portugal
Spain
Sw eden
EU25

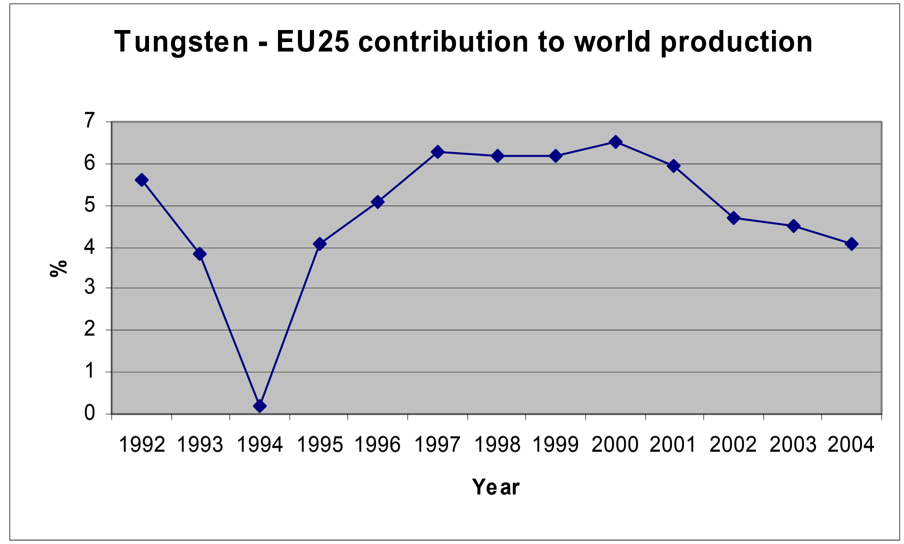

Silver - EU25 contribution to world production
%
14
12
10
8
6
4
2
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

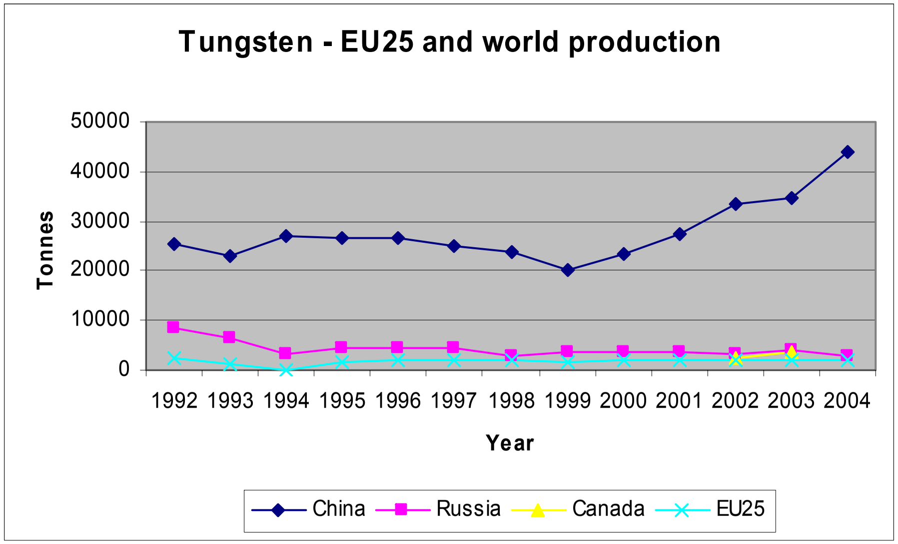

Silver - EU25 and world production
Kg
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year
Canada
Mexico
USA
Chile
Peru
China
Australia
EU25

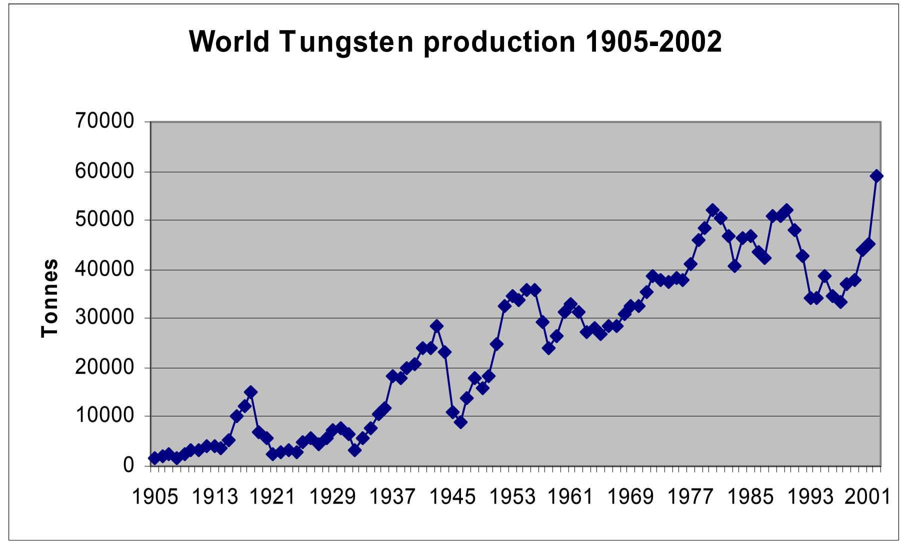

World Silver production 1900-2002
Tonnes
25000
20000
15000
10000
5000
0
1900
1908
1916
1924
1932
1940
1948
1956
1964
1972
1980
1988
1996

TUNGSTEN

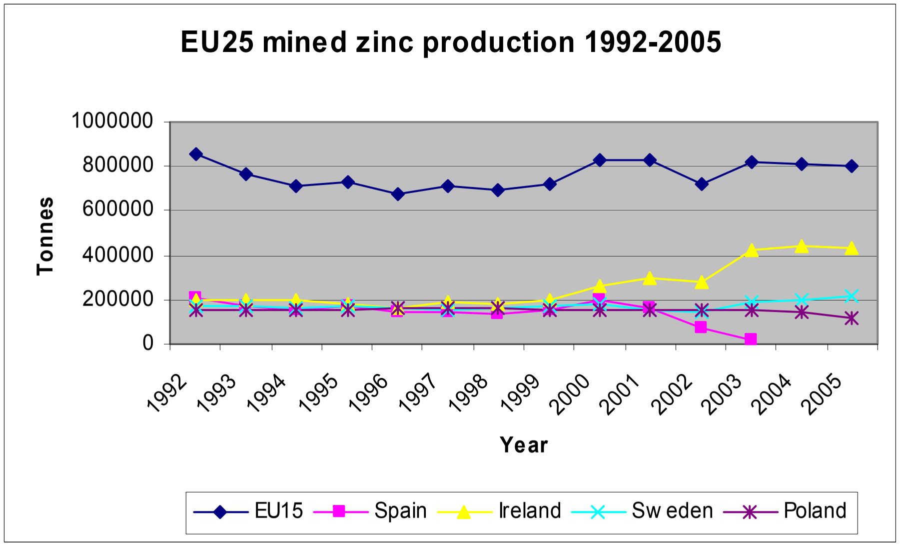

EU25 Tungsten production 1992-2004
Tonnes
2500
2000
1500
1000
500
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
Austria
Portugal
EU25


Tungsten - EU25 contribution to world production
%
7
6
5
4
3
2
1
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year

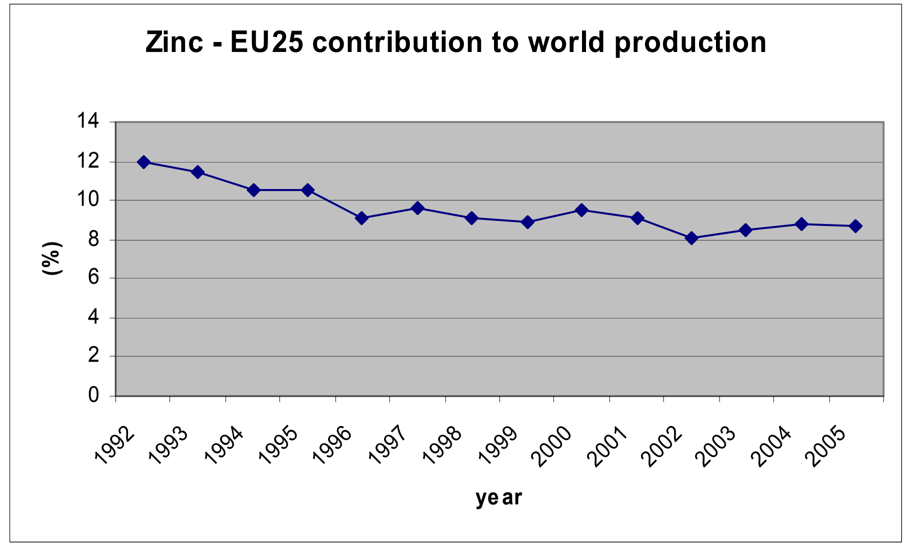

Tungsten - EU25 and world production
Tonnes
50000
40000
30000
20000
10000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
Year
China
Russia
Canada
EU25


World Tungsten production 1905-2002
Tonnes
70000
60000
50000
40000
30000
20000
10000
0
1905 1913 1921 1929 1937 1945 1953 1961 1969 1977 1985 1993 2001

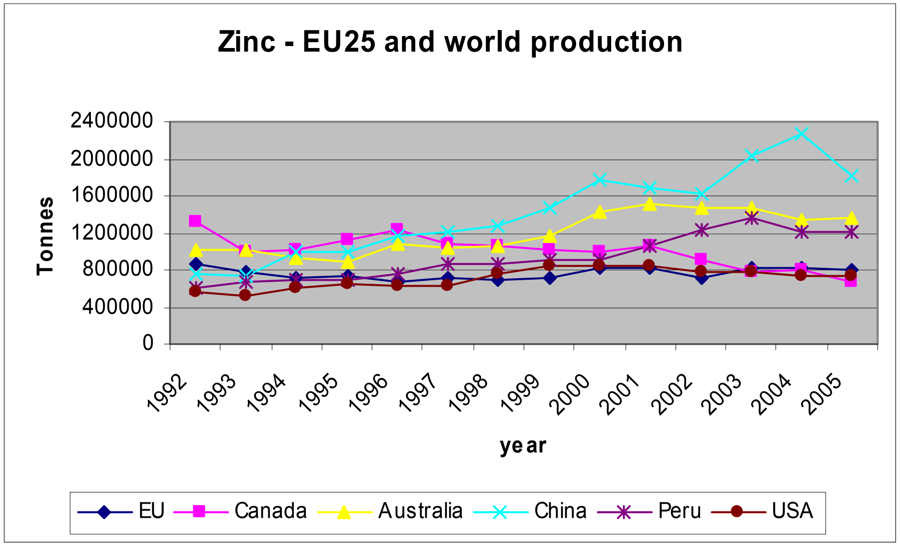
ZINC

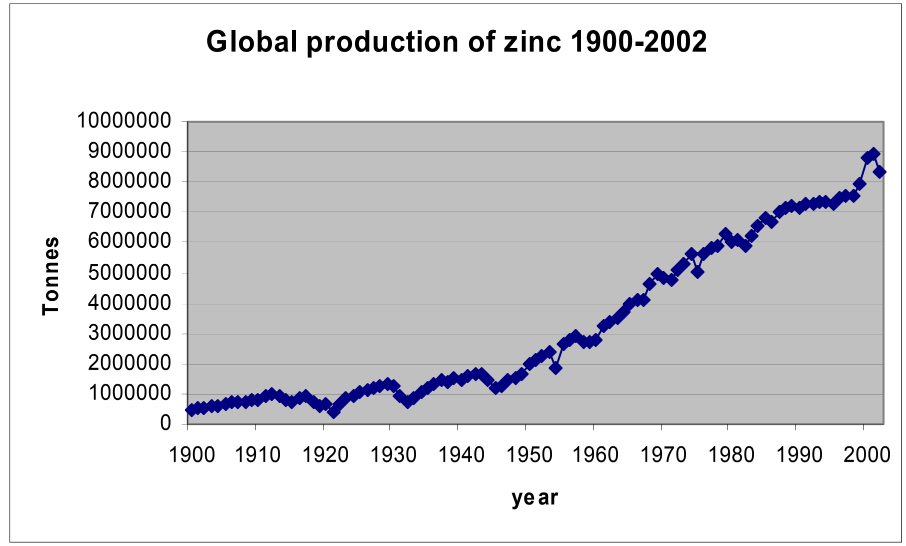


EU25 mined zinc production 1992-2005
Tonnes
1000000
800000
600000
400000
200000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year
EU15
Spain
Ireland
Sw eden
Poland



Zinc - EU25 contribution to world production
(%)
14
12
10
8
6
4
2
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
year


Zinc - EU25 and world production
Tonnes
2400000
2000000
1600000
1200000
800000
400000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
year
EU
Canada
Australia
China
Peru
USA


Global production of zinc 1900-2002
Tonnes
10000000
9000000
8000000
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000
year

ANNEX 2 - EXTENT OF MODERN GEOLOGICAL MAPPING AND RECORDED OVERLAP BETWEEN NATURA 2000 SITES AND MINERAL RESOURCES OR PROSPECTS

(based on responses by national geological surveys to a questionnaire prepared by EuroGeoSurveys)

	Cyprus	**Czech Republic**	**Denmark**	**France**
Q1. Is regional/national acquisition of public geoscientific data in support of mineral exploration (geology, metallogeny, geochemistry, geophysics, alluvial prospecting) part of the current publicly financed domestic activities of your Geological Survey?	Partly.	Yes – data are collected by the Geological Survey (Geofond).	Mapping of marine aggregates on the seabed.	Yes, but mainly focused on industrial minerals and aggregates.
Q2. If not, did such activities take place in the past and when did they stop?	1980s.			Yes. A systematic inventory was carried out for metallic commodities. The last main period was from 1975-1993.
Q3. Are there plans for future mineral exploration campaigns?	Yes.			No.
Q4. What is the percentage of your territory with outcropping/near outcropping formations that could bear metallic minerals concentrations?	0.1.	0.21.	0.	40% (200 000 km^2) - crystalline basement and direct sedimentary cover (Armorican Massif, Central Massif, Vosges, Pyrenees and Alps).
Q5. What is the percentage of that territory covered by high-resolution airborne geophysics (radiometry, maximum line spacing 500 m?)	No.	Radiometry -80%. Gamma ray spectrometry – 60%.	0.	Not clear.- For all airborne geophysics considered (radiometry, magnetism, electromagnetism) about <30%.
Q6. What is the percentage of that territory covered by high-resolution airborne geophysics (magnetism, maximum line spacing 500 m?)	0.5	0.8	0	For Armorican Massif, 10% Central Massif + Vosges, <5% Pyrenees. Focused on volcano.
Q7. What is the percentage of that territory covered by high-resolution airborne geophysics (electromagnetism, line spacing max. 500 m.?)	0.5	0	0	Sedimentary belts. Not much applied at reconnaissance stage, but more in follow-up studies. Resolution unknown.

Q8. Do you have a GIS-based database of national mineral deposits and prospects?	Being considered.	Yes, managed by the Czech Geological Survey. Data owned by the Ministry for Trade and Industry.	No.	Yes in detail for France (4000 geo-referenced deposits and occurrences - metallic and non-metallic commodities) and summary for the whole of Europe (12 000 geo-referenced deposits and occurrences - metallic and non-metallic commodities).
Q9. Do you have GIS-based information on the overlap between protected areas (Natura 2000 areas, natural reserves) and mineral deposits/prospects?	2%.	GIS operation possible on request.	No.	In progress.
Q10. What is the percentage of the territory defined in question 4 covered by high-resolution (density at least 1 sample per 2 km²), multi-element (25 elements and more) geochemical sampling?		Large database (about 950 000 samples) - not all used for mineral deposits or prospecting.	No.	>75% grassroots stage (150 000 km^2), including 430 000 stream samples, 153 000 heavy mineral concentrations, 105 000 hydro-geochemical samples, leading to 1 500 anomalies. Follow-up: 283 000 complementary samples, 25 km trenching, 443 km destructive drilling, 121 km cored drilling and 1 km of exploration galleries.

	Germany	**Italy**	**Latvia**
Q1. Is regional/national acquisition of public geoscientific data in support of mineral exploration (geology, metallogeny, geochemistry, geophysics, alluvial prospecting) part of the current publicly financed domestic activities of your Geological Survey?	Public geo-scientific data can be valuable for mineral exploration, e.g. seismic survey of North Sea floor is useful for sand and gravel prospecting.	There is full coverage of mineral resources and partial coverage of quarries. These activities are not always carried out directly by the Geological Survey of Italy. They are, however, carried out by the Italian Agency for Environmental Protection and for Technical Services (APAT), of which the Survey is part.	No.
Q2. If not, did such activities take place in the past and when did they stop?	1990.		Yes. 1990s.
Q3. Are there plans for future mineral exploration campaigns?	No.	There are plans to have 100% financing, including for quarries.	No.
Q4. What is the percentage of your territory with outcropping/near outcropping formations that could bear metallic minerals concentrations?	< 1%, excluding very low grade iron-containing rock types.	0.35.	0.
Q5. What is the percentage of that territory covered by high-resolution airborne geophysics (radiometry, maximum line spacing 500 m?)	< 5%.	Data not held by the geological survey.	

Q6. What is the percentage of that territory covered by high-resolution airborne geophysics (magnetism, maximum line spacing 500 m?)	Approximately 20%.	1.	
Q7. What is the percentage of that territory covered by high-resolution airborne geophysics (electromagnetism, maximum line spacing 500 m?)	Approximately 15%.	Data not held by the geological survey.	0.
Q8. Do you have a GIS-based database of national mineral deposits and prospects?	Development of a national GIS-based database containing information about mineral deposits is under discussion.		0.
Q9. Do you have GIS-based information on the overlap between protected areas (Natura 2000 areas, natural reserves) and mineral deposits/prospects?	Not managed centrally. The regional mining and geological authorities have this GIS-based information.	Yes, although it requires refining. All sites have been included in the database, but the exact delineation of the areas requires field visits which have only partly been carried out.	No.
Q10. What is the percentage of the territory defined in question 4 covered by high-resolution (density at least 1 sample per 2 km²) multi-element (25 elements and more) geochemical sampling?	70% of the German territory at 1sample per 3 km^2 with 23 elements; 4.2% of the German territory at 1.3 samples per 1 km^2 with 25-30 elements.	As above.	0.

	Netherlands	Poland
Q1. Is regional/national acquisition of public geoscientific data in support of mineral exploration (geology, metallogeny, geochemistry, geophysics, alluvial prospecting) part of the current publicly financed domestic activities of your Geological Survey?	For hydrocarbon exploration. No public funding for a national surveying programme for other minerals, but the geological survey carries out projects. Currently reassessing national aggregate and clay resources to establish an internet-based minerals information system. Project is funded by the Ministry for Public Works, Transport and Water Management and the joint provinces.	Yes, at regional scale.
Q2. If not, did such activities take place in the past and when did they stop?	Comprehensive mineral resource assessment carried out in the 1930s and 1940s. Later inventories have either been global (preparing overview maps for mineral planning purposes or dedicated publications), or carried out on sub-national scales (mostly commissioned by regional mineral permitting authorities).	
Q3. Are there plans for future mineral exploration campaigns?	It is intended to supplement the minerals information system with data on carbonate rock and silica sand. Funds are being raised for that purpose.	

Q4. What is the percentage of your territory with outcropping/near outcropping formations that could bear metallic minerals concentrations?	None present.	
Q5. What is the percentage of that territory covered by high-resolution airborne geophysics (radiometry, maximum line spacing 500 m?)		A spectrometric survey was conducted by ground measurements along N-S profiles every 15' (17 km) of longitude, with an offset of 1 000 m and 500 m in cases where the TC energy exceeded 5 500 counts/2 minutes. Aero survey covered approximately 18% of the Polish territory with total profile length of 441 km at 40 km flight level. Distance between profiles was 250 m.
Q6. What is the percentage of that territory covered by high-resolution airborne geophysics (magnetism, maximum line spacing 500 m?)		100% coverage of gravity and 80% magnetic measurements. About 30% covered by aeromagnetic survey, but the quality is not sufficient (the ground survey of that area is ongoing).
Q7. What is the percentage of that territory covered by high-resolution airborne geophysics (electromagnetism, maximum line spacing 500 m?)		0.01%.
Q8. Do you have a GIS-based database of national mineral deposits and prospects?	Yes.	Yes , but not yet fully integrated nor fully GIS-based.
Q9. Do you have GIS-based information on the overlap between protected areas (Natura 2000 areas, natural reserves) and mineral deposits/prospects?	Yes.	Partly, but Natura 2000 sites are not yet included.
Q10. What is the percentage of the territory defined in question 4 covered by high-resolution (density at least 1 sample per 2 km²) multi-element (25 elements and more) geochemical sampling?		0.2%.

	Portugal	**Sweden**	**Spain**	**UK**
Q1. Is regional/national acquisition of public geoscientific data in support of mineral exploration (geology, metallogeny, geochemistry, geophysics, alluvial prospecting) part of the current publicly financed domestic activities of your Geological Survey?	No.	Yes.	Yes.	No.

Q2. If not, did such activities take place in the past and when did they stop?	1990s.			2004.
Q3. Are there plans for future mineral exploration campaigns?	No.			No.
Q4. What is the percentage of your territory with outcropping/near outcropping formations that could bear metallic minerals concentrations?	70%.	<10%.	20%.	60%.
Q5. What is the percentage of that territory covered by high-resolution airborne geophysics (radiometry, maximum line spacing 500 m?)	20%.	75%.	3%.	10%.
Q6. What is the percentage of that territory covered by high-resolution airborne geophysics (magnetism, maximum line spacing 500 m?)	20%.	90%.	3%.	15%.
Q7. What is the percentage of that territory covered by high-resolution airborne geophysics (electromagnetism, maximum line spacing 500 m?)	20%.	70%.	<1%.	8%.
Q8. Do you have a GIS-based database of national mineral deposits and prospects?	Yes.	Yes.	Yes.	Yes.
Q9. Do you have GIS-based information on the overlap between protected areas (Natura 2000 areas, natural reserves) and mineral deposits/prospects?	No.	Partly.	No.	Yes.
Q10. What is the percentage of the territory defined in question 4 covered by high-resolution (density at least 1 sample per 2 km²) multi-element (25 elements and more) geochemical sampling?	Soils 6%. Stream sediments 11%.	0% based on defined requirements.		80% coverage with more than 25 elements; 95% coverage with 15 elements or more.