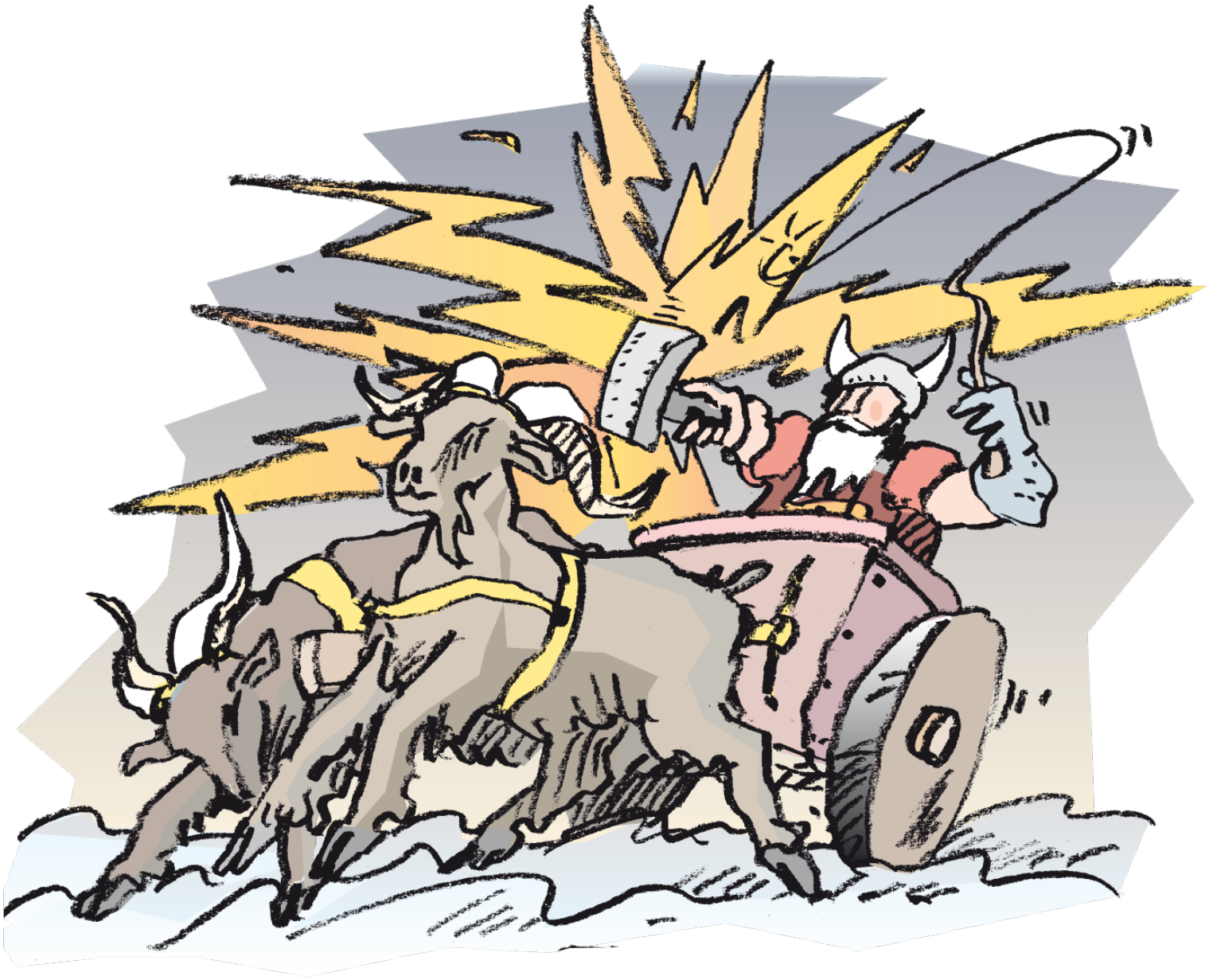
GEOLOGICAL SURVEY OF FINLAND
Report of Investigation 187
2010



GLOBAL MINING TOWARDS 2030

Food for thought for the Finnish mineral policy process 2010

Magnus Ericsson

GTK

GEOLOGIAN TUTKIMUSKESKUS **GEOLOGICAL SURVEY OF FINLAND**

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Espoo 2010

Front cover: Torium, Th, element 90 in the periodic table, is named after the Norse thundergod Thor, who rides the skies in his chariot pulled by his two goats Tanngrisni (gap-tooth) and Tanngnost (tooth grinder) in Nordic mythology. Thunder and lightning is produced when Thor swings his mighty hammer Mjölner fighting the evil giants of Midgård, the Earth.

Drawing by Kaianders Sempler, Ny Teknik 2007.

Ericsson, M. 2010. Global mining towards 2030. Food for thought for the Finnish mineral policy process 2010. *Geological Survey of Finland, Report of Investigation 187*, 18 pages, 9 figures and 1 map.

The global demand boom for metals will continue for at least the rest of the decade. The mining industry of Europe is centred in the Nordic countries. Exploration and mining in these countries is not only crucial to the supply of minerals for Europe, but is also the most vital part of the regional economic development of northern Sweden, Finland and Norway. The activities of exploration juniors as well as established mining companies create secure jobs where the mines are located, and these jobs cannot be moved to low-cost countries.

The sector needs proper recognition from government to flourish. It does not need financial support but only a fair deal of attention both in the long and short term to be able to fulfil its vital role in regional economic development and the European metal supply. The EU is beginning to wake up to the advantages of and need for a domestic European mining industry. New policy measures that will facilitate the mining industry within the union seem to be coming. A window of opportunity is now open for Finnish mining to take a quantum leap.

Keywords (GeoRef Thesaurus, AGI): mining industry, metal ores, mineral exploration, mining, production, demand, supply, policy, global, Scandinavia, Finland

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ISBN 978-952-217-130-6 (PDF)
ISSN 0781-4240

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Ericsson, M. 2010. Global mining towards 2030. Food for thought for the Finnish mineral policy process 2010. *Geologian tutkimuskeskus, Tutkimusraportti 187*, 18 sivua, 9 kuvaa ja 1 kartta.

Metallien kysyntä jatkuu maailmanlaajuisesti voimakkaana ainakin tämän vuosikymmenen ajan. Euroopan kaivosteollisuus on keskittynyt Pohjoismaihin. Näissä maissa tapahtuva malminetsintä ja kaivostoiminta on ratkaisevan tärkeää Euroopan mineraalituotannolle ja keskeinen tekijä Ruotsin, Suomen ja Norjan pohjoisosien taloudellisessa kehityksessä. Sekä uudet etsintäyhtiöt että jo vakiintuneet kaivostoiminnan harjoittajat luovat kaivosten sijaintialueille turvattuja työpaikkoja, joita ei voida siirtää halpatuotantomaihin.

Jotta ala menestyisi, valtiovallan on ymmärrettävä sen merkitys. Kaivosteollisuus ei kaipaa taloudellista tukea, vaan edellyttää ainoastaan, että sen asema turvataan sekä lyhyellä että pitkällä tähtäimellä. Näin ala kykenee edistämään alueiden kehittämistä ja tyydyttämään metallien kysyntää Euroopassa. Euroopan unioni on vähitellen ymmärtämässä Euroopan oman kaivosteollisuuden tarpeen ja siitä koituvat edut. Nyt näyttääkin siltä, että Unionin alueen kaivostoimintaa ollaan edistämässä uusin toimenpitein. Suomen kaivosteollisuudella on tilaisuus ottaa ratkaiseva askel.

Asiasanat (Geosanasto, GTK): kaivosteollisuus, metallimalmit, malminetsintä, louhinta, tuotanto, kysyntä, tarjonta, politiikka, globaali, Skandinavia, Suomi

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1 BACKGROUND

This comprehensive but brief review of the global mining and metals industries is divided into four parts: an introductory outline of mining during the second half of the 20th century, followed by discussion of the present global situation for mining and the general trends forming its future, then thirdly an overview of recent mineral policy trends and finally some bullet points on the implications of all these global developments for Finland. The analysis is provided as an independent input to the mineral strategy formulation process. The text is best read in conjunction with the illustrations used in the introductory presentation made at the mineral strategy kick-off seminar held in Esbo on 17th of March this year. Comments and questions are welcome.

2 MINING IN THE 20TH CENTURY

From 2004 to 2008, global mining experienced an extraordinary and unprecedented boom. Metal prices in general soared to heights not seen earlier and some metals even recorded all time highs as prices peaked in real terms. Some observers have called it a "super cycle", as the length of the period of high metal prices has exceeded the two earlier major booms since the Second World War, the Korean War boom, in the early 1950s, and the boom in the late 1970s/early 1980s. The term "super cycle" was coined in the mid-2000s when it became obvious that the strong Chinese economic development was going to continue at very high levels of Gross Domestic Product growth, often even double digit growth, for more than 20 years. Chinese growth started from low levels, but after 15 years the demand for metals that was created when building the Chinese society also reached absolute levels that affected the entire global mining industry.

Taking stock of a longer time series of metal prices, both shorter cycles and longer waves can be identified. Metal prices were on a declining trend in the first part of the 20th century until the mid-1930s, when they started increasing as war demands for metals grew. The long upturn continued to the 1970s, interrupted by cyclical swings. The rebuilding of Europe and other parts of the world after the war kept demand for metals high. Since then, mining followed a long continuous decline until the early 2000s, when the demand for metals both for infrastructure and personal use in developing countries exploded. Political and public interest in the mining industry waned and it was referred to as the "sun set" or "smoke stack" industry. An industry without a future, as metals and mineral in abundance would flow into Europe from the mines of the Third World. These developments show that mining is a *cyclical* industry, whether the profitability of the sector or the political interest it creates is considered.

It is also a *long term* business in that the creation of a new mine takes much longer than what is usual when starting a business in another industry sector. From starting exploration for a new deposit to building a mine and ramping up production to full speed, often 10–15 years have passed. Exploration for green field deposits is furthermore a *risky* venture, as the chances of finding a new deposit are low. The average success rate going from an exploration idea, a concept through to a mine of "normal" size is as low as 1 in 200, and perhaps even a worse rate of 1 in 400. Most exploration projects will hence fail and never result in a new mine.

Mining has always been a *global* industry. Industry practices and experiences have been exported since Medieval times and reached the Nordic countries in waves. When building the silver mines at Sala and the copper mines in Falun, the Swedish king already called for German experts in the early 1500s. Later, when the steel industry was to be revived in the 17th century, experts from Wallonia were called in.

These four characteristics make the mining industry different from most, if not all, other industries:

- Long term
- Cyclical
- Risky
- Global

In the section on *Supply* below, further specific features of the mining industry will be discussed.

The value of the various metals at the mine differs widely. Three metals account for between half and two-thirds of the total value of all metals: iron ore, copper and gold. These three thus dominate the mining world. In 2008, the total value at the mine stage of all metals, also including uranium and diamonds, was altogether 465 billion USD.

In terms of volumes produced, there are also huge differences. Globally, 1 700 million tons (Mt) of iron ore is produced annually. Copper production is only about 1% of that, or some 17 Mt. Copper production is eight thousand times greater than gold at only 2 400 t per year. The platinum group metals (PGM) are produced in even smaller volumes, about 10% of the gold production or a few hundred tons per year.

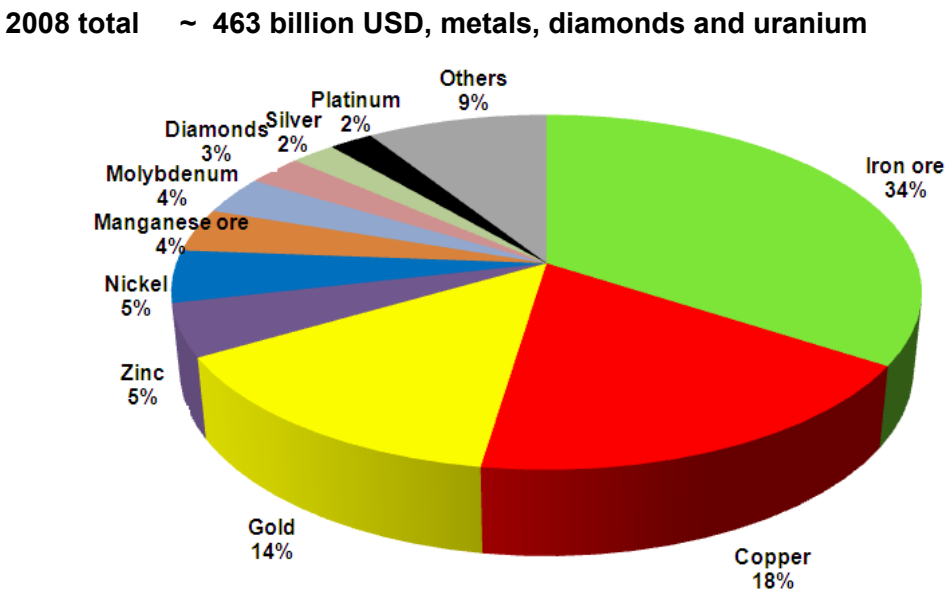


Figure 1. Relative value of global mine production 2008. Source: Raw Materials Data, Stockholm 2010.

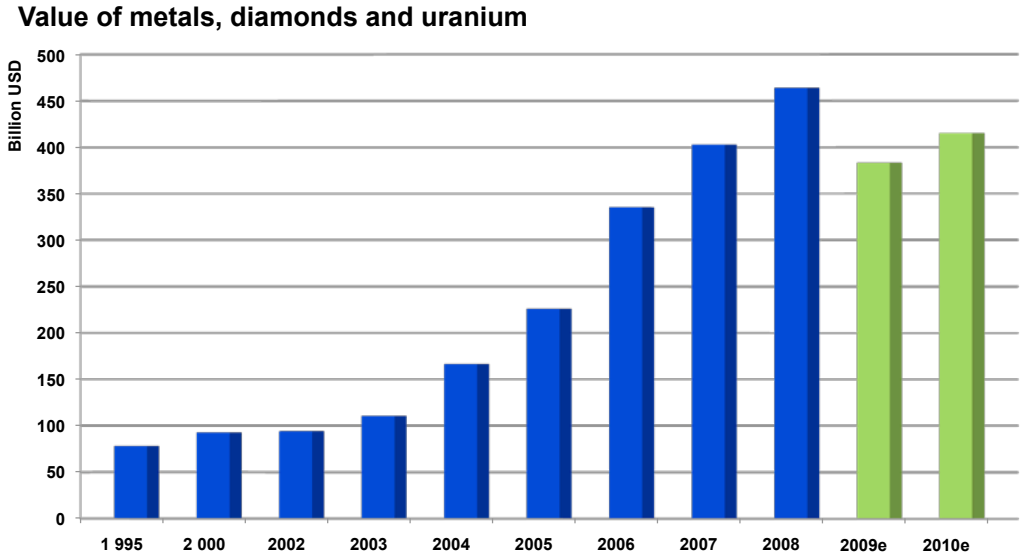


Figure 2. Value of global mining since 1995 (billion USD). Source: Raw Materials Data, Stockholm 2009.

The growth of the mining industry over the last decade is illustrated in Figure 2. The value created grew quickly until 2008, when the global financial crisis resulted in a steep decline in 2009. However, the fall was not at all as deep and long lasting as had been expected and recovery is already underway.

When the metal grades of the ores mined are considered, the volumes of rock handled by the mining industry can be calculated and the figures become mind boggling. In total, the metal mining industry handles some 18 000 Mt of rock annually, out of which some 65% is barren rock and 6 000 Mt is ore.

The mining industry is controlled by a relatively limited number of mostly transnational mining companies. In total, some 150 companies control about 85% of the total, global industrial mine production. Another 900 companies account for the remainder. At the bottom of the pyramid, there are between 4–6 000 junior companies, companies that only explore for metals and do not have a cash flow. Their numbers decreased very quickly during the global financial crisis in late 2008, but by early 2010 some of them were already reappearing. These companies could be characterised as the high-tech end of the mining industry. They are small, make rapid decisions and are risk willing, and often make use of new geological models and exploration techniques. If they are successful their share price can increase by many hundreds of per cent, while if they fail they simply disappear.

3 MINING TRENDS

Global mining has experienced an unprecedented period of strong growth during most of the 21st century. After the long raw materials boom following the Second World War ended in the early 1980s, a new hypothesis for general economic growth was gradually developed. It was thought that with technological progress, new materials and new processes would emerge, which would make possible the substitution of the old "established" metals such as steel, tin, copper, lead and zinc, with new materials having superior qualities and properties compared to the traditional metals. Further miniaturisation and more effective use of computer power in designing products would bring down the demand for metals in specific applications. Together with the rise of the service sector of national economies, this would make economic growth in developing countries possible without the same metal-intensive phases that the industrialized countries had passed through. But with the unabated growth of the Chinese economy, it gradually became obvious that the hypothesis underpinning much of conventional economic thinking during the end of the 1980s and all of the 1990s that economic growth could be sustained without industrialization also bringing along high metal intensities, would turn out to be false. When comparing the economic growth of Japan in the 1950s and Taiwan and South Korea a decade or two later with the growth pattern of China, it was obvious that not only their economic development trajectories were repeated but also the demand growth for metals.

When the long period of metal-intensive growth and rebuilding of the European and Japanese economies after the destruction of the Second World War and the general increase in the standard of living in North America was more or less completed in the 1970s, global mining entered into a phase of almost no growth at all. The demand for metals stagnated and the mining industry was further struck by its poor environmental and health and safety record. Politicians turned away from the mining industry, which was often producing at high costs and not very efficiently. The British prime minister, Thatcher, was able to squash the mine workers and the coal industry in the UK because demand was not as strong as it used to be. Towards the end of the century, the mining companies were fighting to survive, and rather than creating value for their share holders they were destroying value. The developing countries, which had put very high hopes on the potential to use their mining sectors as a lever for economic and political development in the de-colonialisation period of the 1960s and 1970s, had all seen their attempts fail, partly because of badly mishandling their newly nationalized companies, but also because of a poor market situation and depressed metal prices through to the early 2000s. The mining industry had not been reinvesting in either exploration to find new ore bodies or in developing known ore deposits, and definitely not in new technologies and processes. In short, the industry was in a bad condition when at the same time demand started to grow and continued to do so over many years.

Another factor that contributed to the market imbalances was the developments in Russia after the collapse of the Soviet Union in the early1990s. Traditionally, the Soviet Union and the states in East Europe had been more or less self sufficient in metals and minerals. The Soviet Union kept these countries supplied as part of their economic and political interdependence. This was the opposite situation compared to the West European and North American reliance on imports of metals and minerals from the Third World. After the break down of the Soviet system, the demand for metals almost instantaneously collapsed. However, the strong mining sector continued to produce for a number of years and most of its production was exported. The decline in demand and the excess production in Russia helped to hide the increasing Chinese import demands for a few years. The situation in the mid-2000s was hence the result of an extended period of underinvestment and a growing increase in demand.

3.1 Demand

Demand for metals is strongly linked to the general level of economic development. The per capita use of most metals grows slowly until a GDP per capita of 5–10 000 USD/year is reached. In that interval, metal use grows almost logarithmically and then flattens out above that level (see Figure 3). Most metals and most countries exhibit a similar pattern of growth or similar changes in the metals intensity of their economies. The absolute level at which the per capita use flattens depends on the structure of the economy and industry of each country. With a larger share of industry the use is normally higher than if the economy is more dominated by the service sector.

This fact is the basis for the strong demand of the Chinese economy, as it is passing through this interval of its economic development right now. In the case of

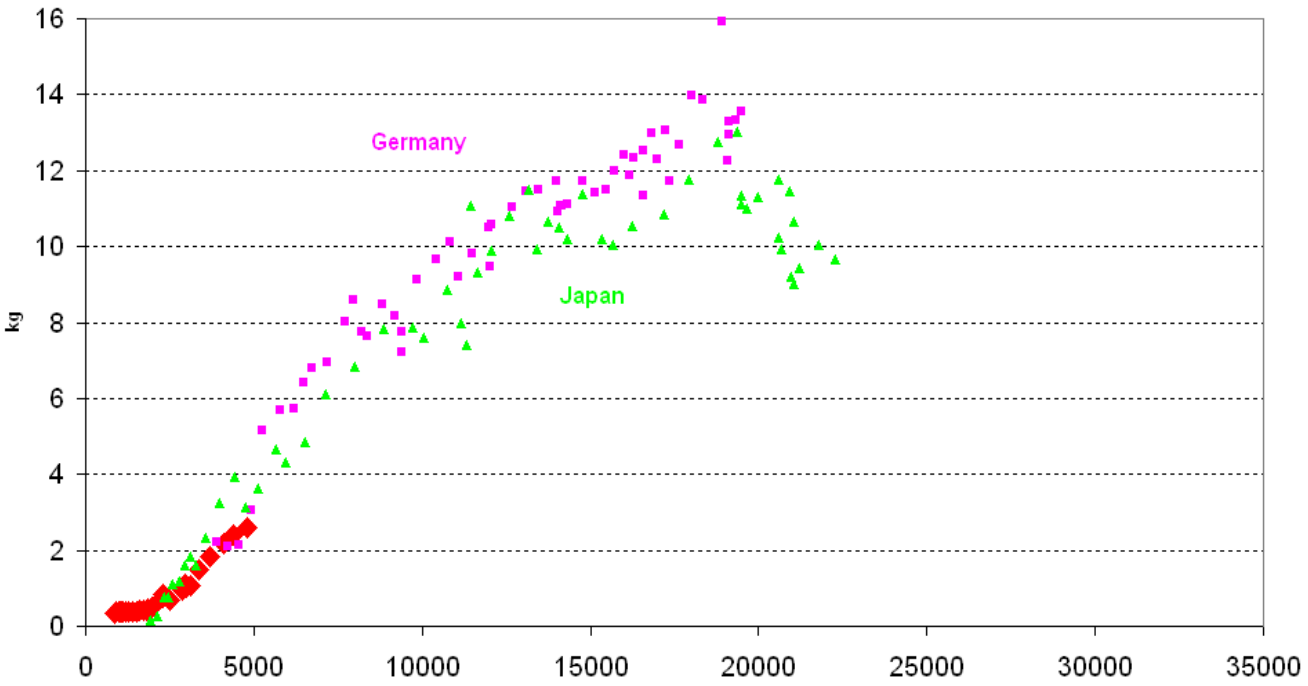


Figure 3. Per capita use of copper vs. economic development. Source: Häggström & Ericsson 2006.
Note: Red diamonds represent China.

China, demand is further strengthened by the sheer size of the Chinese economy and its population of more than one billion. Demand is further strengthened by the strong command element of the present Chinese model of a market economic system mixed with central planning, which in turn is partly a function of the old Chinese culture with a strong central government. It is, however, important to understand that there are two main elements in the demand for metals:

- Infrastructure construction and urbanization
- Personal use of metal-intensive white goods, housing and vehicles.

It is thus not only the centrally dictated X km of railroads or Y km of motorways that drives Chinese metal demand, but also the needs and striving of individuals for an air conditioner, a car and a new flat, all personal demands. In order to project the future metals demand, one key factor is demographic development, which is relatively easy to predict with good accuracy. The number of people in China or India in 20–30 years may be predicted and it is also possible to give fairly good estimates of the number of persons that will have a certain standard of living, i.e. will have the economic capacity to demand goods with a high metal content (see Figure 4).

This process has China as its main driving force at present, but there are many other countries that are both populous and at the same stage of development today, including Russia, Kazakhstan, Brazil, Turkey and several South East Asian countries. Not every country goes through exactly the same development, but the pattern is similar. India will not simply replicate the development path of China, as the differences in culture, the political system and other historical and geographical factors are too big. However, there is no doubt that when Indian GDP rises above 5 000 USD/year per capita, its metal demand will take off, in a similar way to which China's did. China will not simply carbon copy the US developments, as it neither wants to nor can do so.

At such a high level, there is no stopping the present super cycle or the demand boom from continuing for at least another 5 years, and most likely the rest of the decade. At the same time, however, it is crucial to understand that history does not repeat itself in a mechanistic manner. There will be changes, there will unforeseen events, there will be new Greek financial meltdowns or Icelandic volcanic ash clouds temporarily upsetting the growth in metal demand linked to economic development.

The situation might be summarised as follows: There has not been and will be no economic and social development without metals – but this sector remains cyclical.

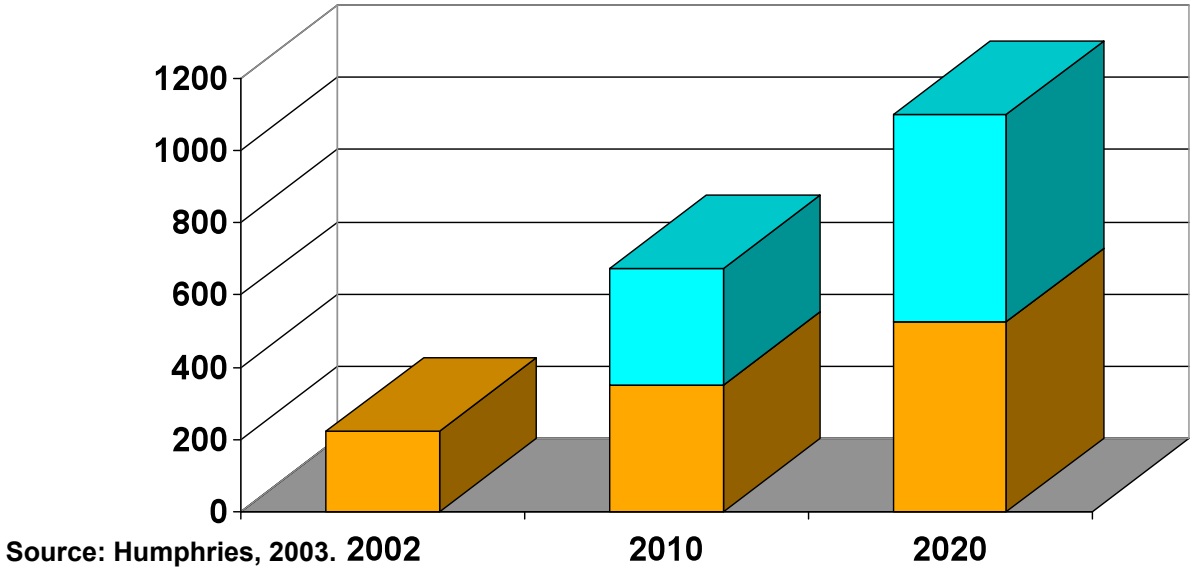


Figure 4. Population growth in Asia (million persons earning > 5 000 USD/year). Source: Häggström & Ericsson 2006.
Note: Red diamonds represent China.

3.2 Supply

In addition to the specificities discussed above, mining also differs from all other industries in that it has to be located at a specific spot and cannot move away from that place, i.e. where the mineral deposit is. This is both a problem and an opportunity from a societal point of view. On the one hand, each individual mine will be depleted, and hence minerals are often referred to as non-renewable. The isolated mining town that is deserted when the ore has run out and turned into a ghost town is a symbol of this non-sustainable aspect of mining. The term non-renewable is, however, to a large degree a misnomer. It is true in the sense that only a certain number of metal atoms are available in a given mine, but on the other hand all metal atoms are indestructible and will always remain on earth, even after their practical use is over. Furthermore, the definition of ore is an economic concept. It is not sufficient to have metal atoms in the ground, as they have to be extracted at a profit to be considered as resources or reserves. The non-renewability has caused a lot of controversy among economists as to the total availability of metals into the future: Will there be enough for future generations and even for all of the present generation? This so called "peak debate" has, however, taken the interest away from the key issue, which is not at all whether mankind will run out of minerals/metals but rather how society shall make sure that there will be a sufficient number of deposits around the world to cover the rapidly rising demands. It is the market forces that govern the availability of new deposits, not geology or chemistry. When demands grows, prices will increase and it will become feasible to extract metals from mines with higher production costs due to lower grades, higher depths, being further away from the markets or in more extreme climatic conditions. The higher price will reduce demand in itself, and at the same time substitution will take place, further reducing demand. Gradually, a new equilibrium will be reached between demand and supply. In spite of the increasing rate of metal production from primary sources during the entire 20th century, the available resources at the turn of the 21st century were larger than they were in 1950.

Over time there has also been a significant shift in the location of the world's mining industry, as illustrated in Figure 5. The centre of gravity initially lay in Europe, but with the growth of the American economy in the 19th century, mining moved across the Atlantic Ocean. Beginning in the latter part of the 20th century, most mining takes place south of the Equator.

Today, the mining industry is fairly widely and uniformly spread around the world and there is no regional domination such as is seen in oil/gas, where the deposits of the Middle East are superior to those in all other regions. Metals are more widespread and also found all over the world (see Map 1). All the

so-called BRIC countries are among the 10 most important mining countries. It is interesting that China is not only an engine for metal demand but also the largest mining country in the world if all metals are included. If coal were also included, its dominant role would be even greater.

3.3 Industry concentration

The number of mining companies is decreasing. The consolidation of the mining industry has increased in the wake of increasing mergers and acquisitions (M&A) activity when metal prices were peaking in 2007/2008. The share of the total value of mine production of metals accounted for by the largest, the three largest and the ten largest mining companies is presented in Figure 6 below. The concentration has increased significantly from a 23% market share among the top ten in 1995 to 35% in 2008. For the future, RMG predicts a continuously high activity in mining M&A as access to new credit lines eases and miners strengthen their balance sheets during 2009 and 2010. This trend will further increase the market share among the largest players. Figure 7 shows a wider range of market concentration for the most important metals. Lead is the most fragmented, whereas platinum production is concentrated in only a few companies and the top ten controlled 93% of platinum production in 2009.

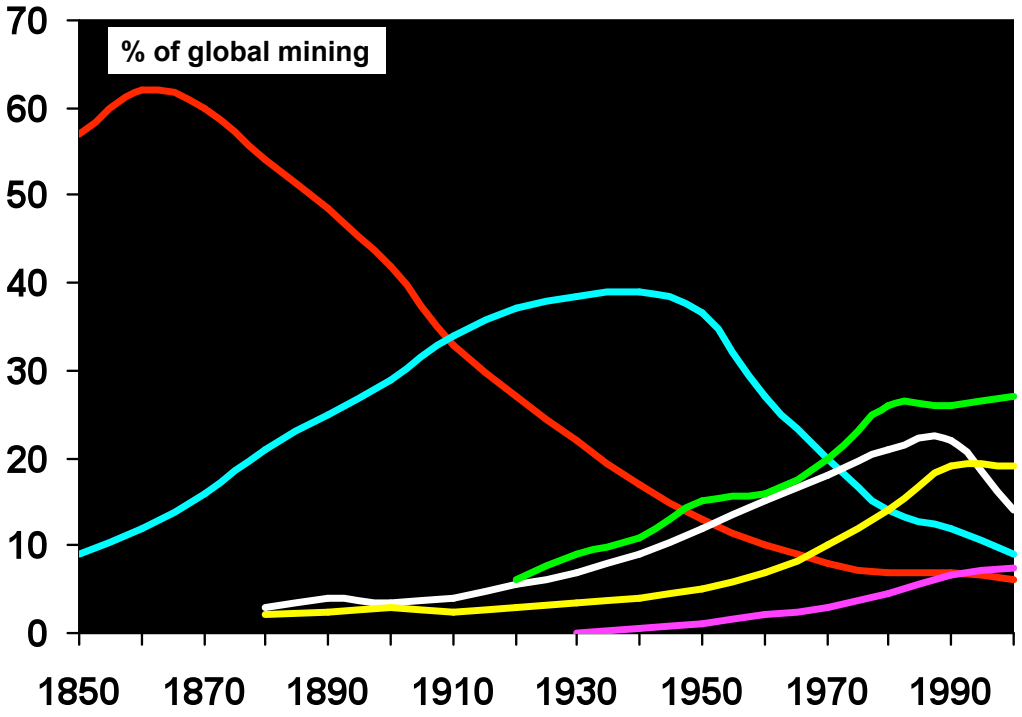
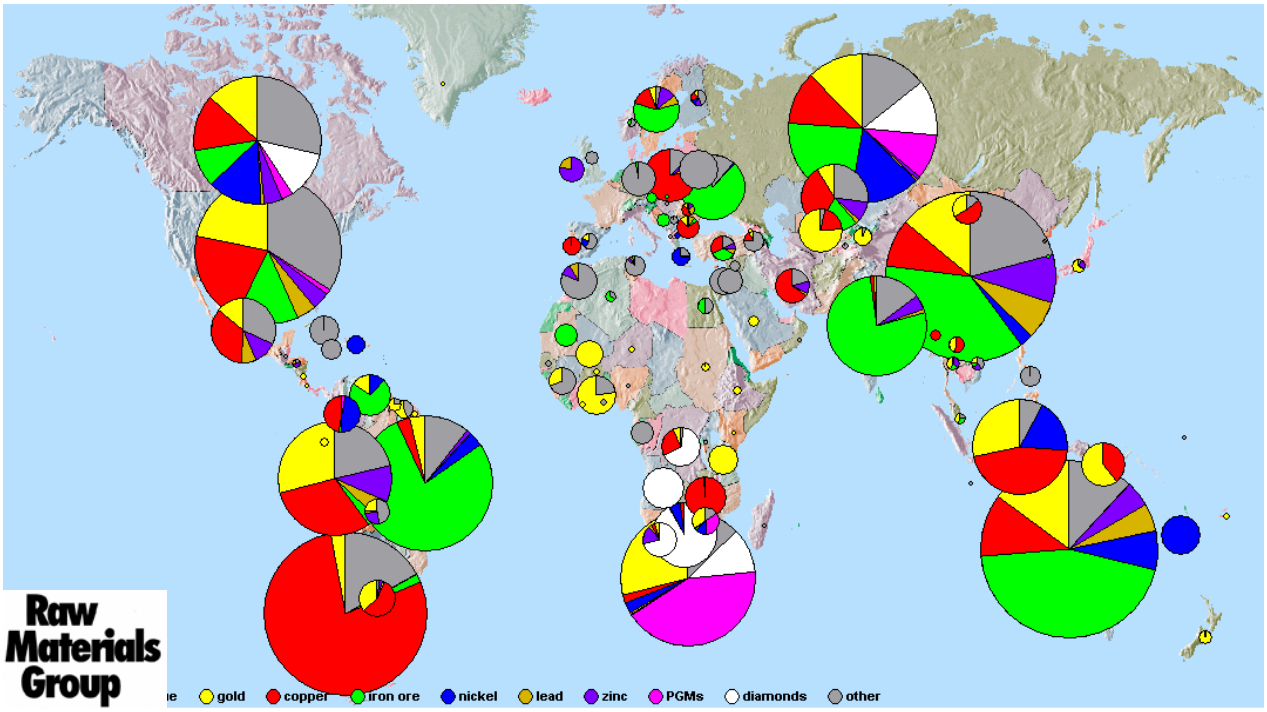


Figure 5. Global mine production (% of total world production). Source: Sames 1989.
Note: Red Europe, blue USA, white Russia/Soviet Union, yellow Canada and Australia, mauve China, green Peru, Brazil, Chile, South Africa, Congo (DRC) and Zambia.



Map 1. Global mine production 2008. Source: Raw Materials Data, Stockholm 2010.

3.4 Production costs – long-term trends

Mining and exploration is becoming increasingly difficult due to several factors:

- Mines are being found and developed in places more distant from regions where metal demand is high.
- These locations are in more extreme climates and where infrastructure is often non-existent.
- Mineral deposits are being found at deeper levels, making exploration and mining more difficult and costly.
- The chemical and mineralogical composition of the ores is becoming more complicated, making extraction of the metals more difficult.
- For environmental reasons, but also increasingly due to socio-economic factors, the process of obtaining permits is taking longer, hence delaying the start-up of mines by several years.
- In the mining boom of 2007/2008 there was also a lack of trained engineers, geologists and other staff. Equipment suppliers and service providers could not deliver at the pace the mining industry demanded.

All these factors contribute to increasing production costs and in the long term to maintaining high metal prices. The lack of trained personnel temporarily ceased to be a problem when metal demand fell off after the financial crisis hit in 2008, but this will soon again turn into a major bottleneck. There are simply not enough students opting for the mining industry globally. Equally, equipment suppliers have not increased their production capacities, and will also become limiting factors when demand picks up again. Even if metal demand in the next 5 years does not grow at the same high pace as in the 2004–2008 period, i.e. some 6–8% annually, but only at half that level or less, the number of new mines necessary every year to cover the demand will be more or less the same as at the beginning of the boom, as the absolute level of production growth necessary has increased so much in the years in between.

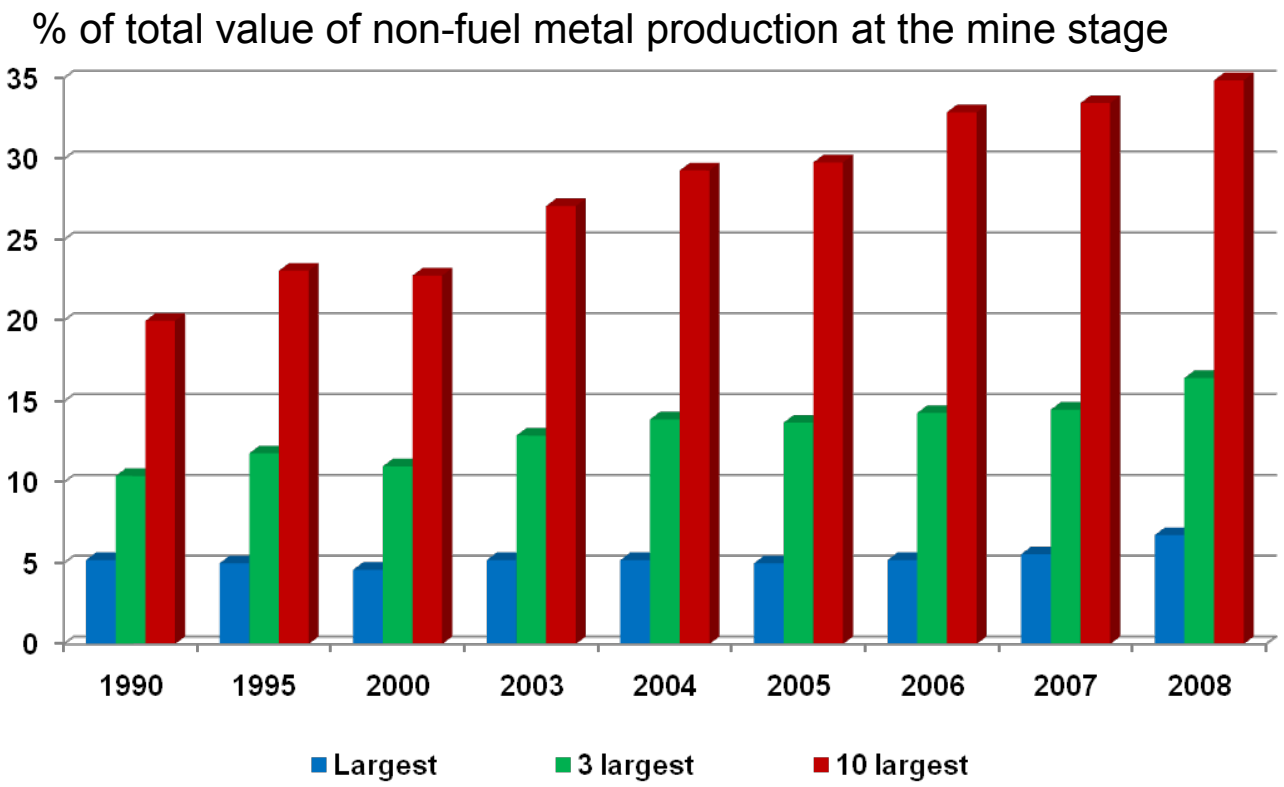


Figure 6. Share of the total value of mine production controlled by the largest companies (%). Source: Raw Materials Data, Stockholm 2010.

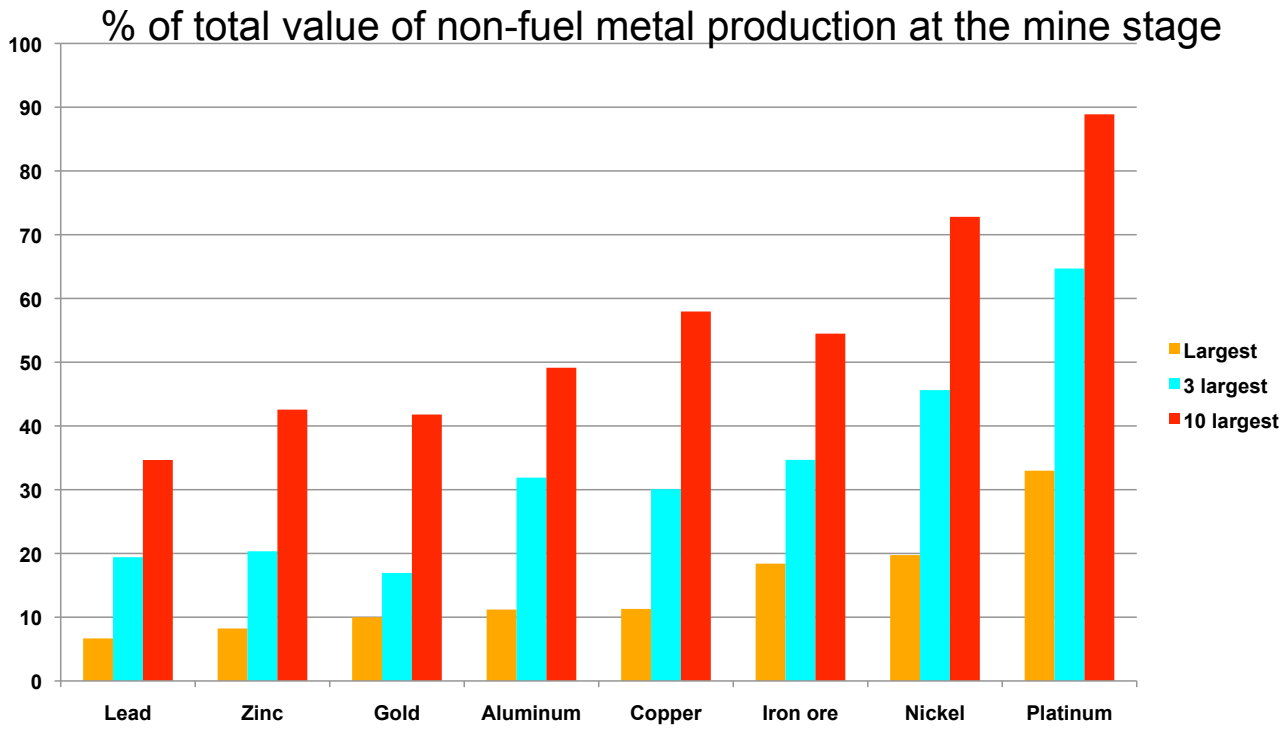


Figure 7. Control of selected metals by the largest companies. Source: Raw Materials Data, Stockholm 2010.

3.5 Investment trends

RMG's present projection for total mining industry capex is given in Figure 8 below. There was a sharp drop in 2009, but a recovery will follow in 2010. Given the recent strong metal demand in China, it is likely that the forecast in the figure (made in late 2009) will be greatly surpassed and the investment level in 2010 will most probably be higher than in 2007, and might even approach the 2008 levels. Europe is lagging as an investment target for new mines, but with the recent boom in both Finland and Sweden the number of new projects planned for Europe is increasing.

On a global scale, gold projects are generally smaller than copper projects, the average gold project being just above 200 MUSD and much smaller than the +500 MUSD average project size for copper. This is due to the fact that it is still possible to find small but high grade gold deposits that can be mined profitably by junior or mid-sized companies, while most new copper projects are huge, low grade open pit operations, typically far from existing infrastructure. Furthermore, given the structure of the gold sector with many juniors and small and medium-sized producers, there is a tendency towards smaller projects that are easier to finance. The average iron ore project is even bigger than the equivalent copper project, and continued to grow in 2009 from 670 to 750 MUSD.

The average size of a mine for a specific metal has not increased as much as the total production. The ten largest copper mines in 1990 were on average producing 300 kt of copper annually, while in 2009 the figure was just above 400 kt. This represents an increase of a little more than 30%, while copper production in the same period grew by over 80%. This indicates that production technologies have not kept up with production expansion in recent decades. New technologies and possibly completely new concepts are needed. The typical underground mining cycle of drilling, blasting and mucking has remained more or less unchanged, except for the size and productivity of the equipment used, for more than 200 years. Some industry observers expect mines to increasingly become underground operations, but the RMG has not been able to verify this trend and we do not think that the present domination of open-pit mining (85% of all ores are mined by open pit methods) will change dramatically, at least not in the next decade.

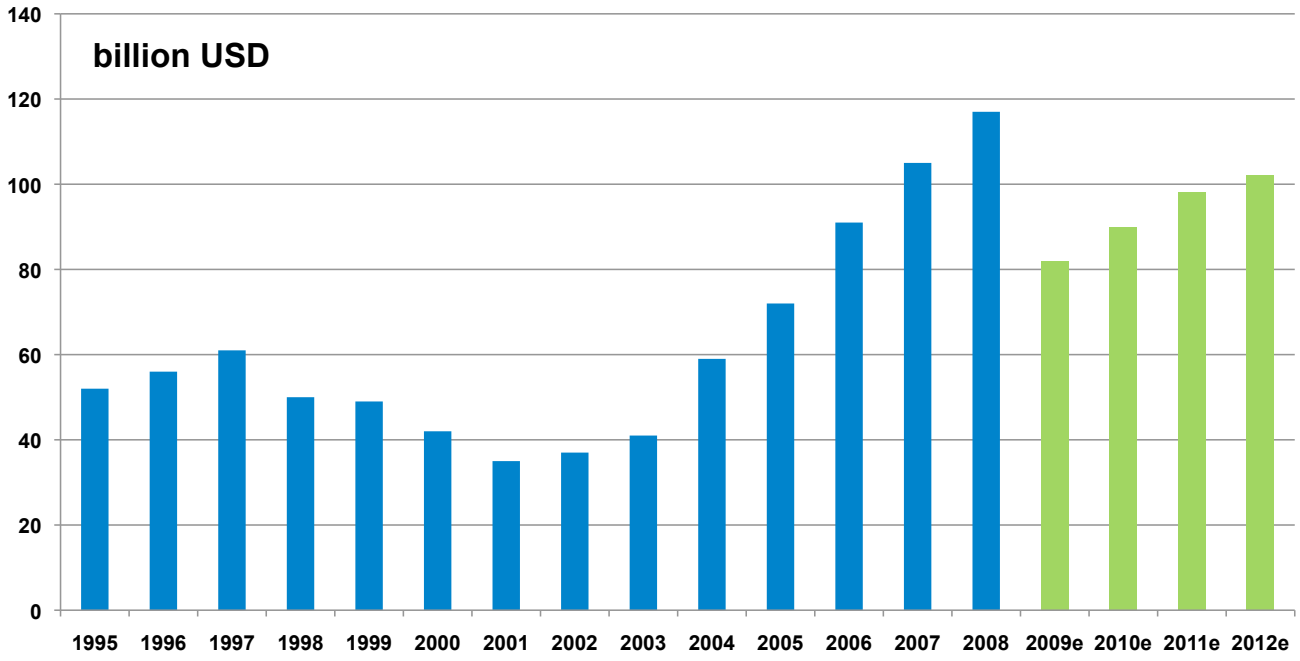


Figure 8. Global mining industry capex projections (billion USD). Source: Raw Materials Data, Stockholm 2010.

3.6 Exploration

Since the global financial crisis, exploration has seriously dropped and much more than mining has done. This is because junior companies, which before the financial crisis accounted for as much as 50–60% of the total global exploration expenditure, simply ran out of money. They had to conserve the little cash they had at hand and almost immediately and totally stopped their field activities, which consume cash at high rates. This is worrying from many angles: Firstly the continuing expansion of global mine production should implicate a steady increase in exploration expenditures, assuming that the effectiveness of each exploration dollar is constant. This is, however, not the case, as the inflation in exploration has been much higher than in the economy in general and reached between 15–20%/year in the Nordic countries in the recent boom years. In other parts of the world, the exploration cost increases have been even steeper. Secondly, the results of exploration in the last decade have been disappointing, with fewer deposits located per dollar spent. In order to balance the depleted deposits, exploration should thus increase more than the increase in mine production to keep a steady relation between reserves and production. To meet this goal, there is a need for government intervention to support the exploration industry through tax rebates or through support to R&D efforts to develop new exploration technology and models.

3.7 Metal prices

Given the projected steady growth of metal demand created mainly in China and other emerging economies, and after the expected recovery in the OECD region in a couple of years also supported by the industrialised countries and the slow and difficult opening of new mine capacity, the price forecast for the next 5–10 years is undoubtedly optimistic. There are certainly many factors that could reduce the rate of metal demand growth, but the main risks in such a positive forecast, at least today, seem to be that demand growth will be higher than projected. This has repeatedly been the mistake made by economists all over the world: underestimating the strength of the continued growth of the Chinese economy. The price forecast in Figure 9 is hence conservative and the main point is that prices will remain on a high level, and although they will most definitely be more volatile than they have been historically, they will not return to the catastrophic low levels of the early 2000s.

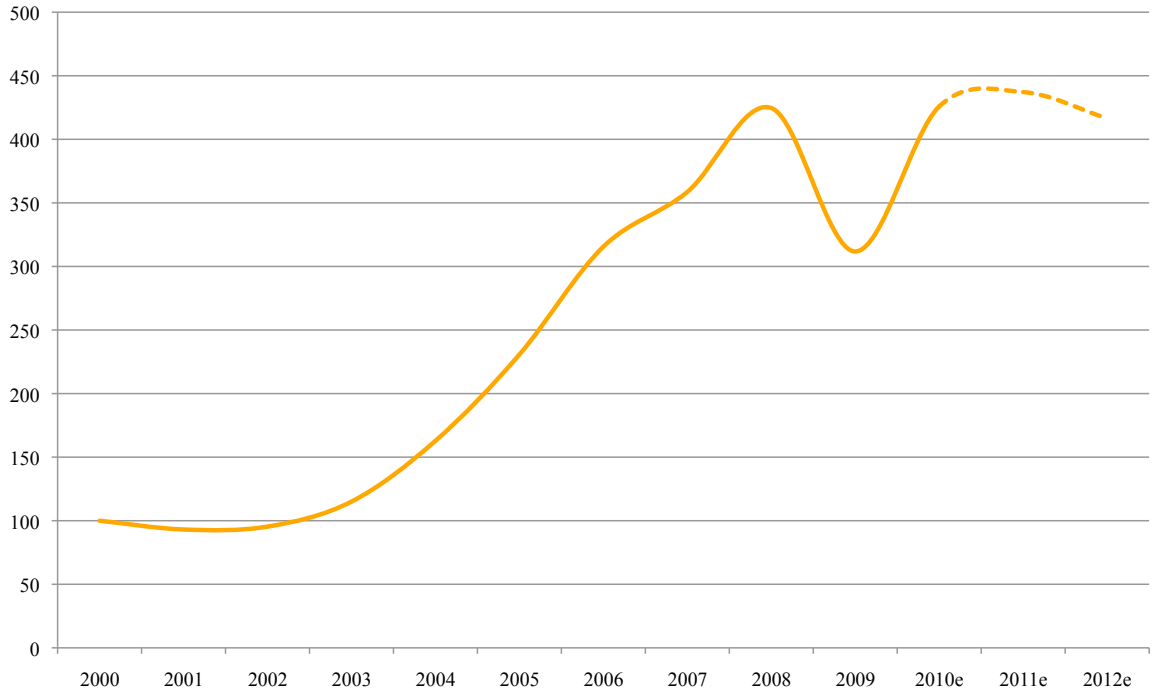


Figure 9. RMG (Raw Materials Group) metal price index. Source: Raw Materials Group, Stockholm 2010.
Note: 2000 is set at 100. The index consist of annual average prices for copper, gold, iron ore, lead, manganese, molybdenum, nickel, platinum, silver, tin and zinc. It is weighted according to the value of each metal at the mine stage.

4 TRENDS IN MINERAL POLICIES

During the last 50 years there have been two major shifts in the views of how mining may contribute to economic and social development in general. The end of the long boom period in the 1960s and early 1970s coincided with the end of the colonial era. Driven by the high prices and huge profits made by mining companies during the preceding boom, new ideas first expressed by the Algerians were developed that focused on minerals and metals as levers for economic development to the benefit of all classes of society. The mineral wealth should be controlled by society, and hence nationalisations, particularly of foreign owned mines, were carried out all over the world both in industrialised and developing nations. Ironically, these were made at the peak of the long-term wave in metal prices. Thirty years later, at the end of the 1990s, the re-privatisation of most mining companies was completed, now at the trough of the long price wave. Both decisions were tragically made with the worst possible timing.

In 2007 and 2008 the demands for a greater share of the benefits created by mining to go to the host country were heard in many countries. Actions were also taken in several countries to increase taxes, introduce royalties, control and regulate the permitting process, exempt certain areas from the potentially environmentally damaging activities of mining, introduce a moratorium on all exploration and mining activities and finally all the way to outright nationalisations. It is worth mentioning that the state influence in mining and smelting has increased in recent years with the growing strength of the Chinese mining and metal industries. RMG considers these sectors in reality to be state-controlled, as even if some of the companies are listed, they are in the final analysis controlled by government. With this definition, China controls over 10% of the total global mining industry. Other countries with important government holdings in the mining sector include Chile, Poland, India, Iran, Indonesia, Venezuela and Sweden.

Nationalisations and other state actions are clearly linked to the metal price cycle with a time lag of a few years. This becomes particularly obvious when including the period from the late 1980s to the early 2000s in the analysis. During these years, over 100 nations revamped their mining legislation in order to attract more investment in exploration and mining, despite the tough times that prevailed. Competition for exploration and mining investment has intensified and become truly global.

At the same time, the surge in metal demand from China linked to its declared policy to gain control over mineral deposits in overseas countries and secure its sources of supply also contributed to the awakening of politicians in all developed economies. The strategy of relying on cheap mineral resources from developing countries that has predominated in Europe is threatened. The need to revisit the policies that have been in place since the oil prices shocks in the late 1970s is becoming urgent. The US, Japan, the European Union and several of its member states, and China have all been engaged in studying the new situation with an increased competition for metals and reduced security of supply.

Traditionally, base metals such as copper and ferroalloys, for example vanadium and ferrochrome, mainly used in the production of specialty alloys and steels for weapons, were considered as strategic. The focus has, in recent years, shifted to elements such as gallium, indium and rare earths. These are used, respectively, for integrated circuits and cell phones, semi-conductors and coatings, and for magnets and many other applications. These metals are not at all as widely used as, for example, copper (globally 125 000 tonnes of rare earths are used every year, while the consumption of copper is over 100 times greater), but they are absolutely necessary for the smooth functioning of a high technology society. In recent years, the term "criticality" has been coined to express the dependency of industrialised countries on certain metals and minerals rather than the traditional term "strategic". Criticality in a recent US study is defined as a product of two components: *importance in use* and *availability* (National Research Council of the National Academies 2008).

In the EU, an integrated Raw Materials Policy Initiative has been launched. Aspects of criticality and the implications of the present scramble for mineral raw materials are being studied in detail. The initiative has three major pillars:

- Ensure *access to raw materials* from international markets under the same conditions as other industrial competitors;
- Set the right *framework conditions* within the EU in order to foster a sustainable supply of raw materials from European sources;
- Boost overall resource efficiency and promote recycling to *reduce the EU's consumption of primary raw materials* and decrease the relative import dependence.

The EU should actively pursue *raw materials diplomacy* with a view to securing access to raw materials… In particular:

- with Africa, by reinforcing its dialogue and actions in the area of access to raw materials and on natural resources management as well as transport infrastructure, within the implementation of the Joint Strategy and Action Plan 2008–2010;
- with emerging resource-rich economies such as China and Russia, by reinforcing the dialogue, including with the view to removing distortive measures;
- with resource-dependent countries such as the US and Japan, by identifying common interests and devising joint actions and common positions in international fora, e.g. joint projects with the US Geological Survey in areas open to international cooperation.

Countries rich in mineral resources could hence benefit from the present situation where both European and North American countries could be competing for their resources with China, India and Japan. Given that there are sufficient experienced and well trained staff and other resources available to the host country (and this is the case for all Nordic countries), this competitive situation could prove very beneficial and the conditions under which new projects are undertaken could be improved by a competitive bidding process.

5 NORDIC MINERAL POLICIES

The mining industry of Europe is centred in the Nordic countries, which together with the copper mines of Poland account for more than three quarters of the total EU metal mining sector. Exploration and mining in the Nordic countries is not only crucial to the supply of minerals for Europe, but it is also the most vital part of the regional economic development of northern Sweden, Finland and Norway. The activities of exploration juniors as well as established mining companies will create secure jobs where the mines are located and these jobs cannot be moved to low-cost countries.

The European Commission has launched the Raw Materials Initiative to deal with the security of the metal supply in Europe. As described above, this policy has three pillars. Facilitating mining in Europe is one of them. If this policy is to have any chance of success, it must include active participation, in particular from Finland and Sweden. These two countries are at present the key to expanding the self sufficiency of Europe.

Against this background there are a number of areas in which policy initiatives seem to be more important than in others. The following list is not intended to be complete, but simply lists a few issues to use as a starting point in the strategy discussion in Finland:

- A mining country must be open to influences from all around the world. Foreign companies should be allowed to bring in new ideas and new technologies, together with fresh capital and staff with new experiences.
- Chinese investments in Nordic mining will soon come.
- There must be a proper balance between the benefits to society and to the industry, with taxes and royalties paid in proportion to profits.
- All stakeholders, including land owners and land users (the Sami people), must feel that they are getting their fair share of the profits and advantages brought by the mining industry. The problems created must also be equally distributed and shared between the stakeholders.
- Existing regional advantages for the mining industry compared to other parts of the world should be developed and secured: infrastructure, both telecommunications and roads, rail and ports. The availability of trained staff on all levels should be prioritised.
- The ability of the state to control and govern the development of the mining sector must be safeguarded. The staffing of the authorities responsible for governance of the sector should be well equipped and with sufficient resources, both in terms of staff and budgets.
- The sector needs support to strengthen its R&D efforts, which have historically been too limited to meet the societal expectations of a stable metal supply.
- Exploration is a particularly neglected sector in this respect.
- The capital supply of the mining industry is an area that needs further improvement.
- The mining cluster should be supported to secure its continued competitiveness on the global markets.
- Sweden and Finland should jointly make sure that the EU mineral policy is shaped in close cooperation with the mining industry in the Nordic countries and the specific demands from the mining regions of northern Finland, Sweden and Norway.
- The opportunities to forge strong links with countries in the developing world by offering technology, equipment and engineering for new mines in

exchange for mineral supplies should be developed on an equal basis where both parties benefit from the cooperation. The Mining for Development initiative should be jointly pursued by Finland and Sweden.
- The mineral policies of the Nordic countries should be harmonised to avoid sub-optimisations.

This sector needs proper recognition from central authorities and government to flourish. It does not need financial support, but only a fair deal of attention both in the long and short term to be able to fulfil its vital role in regional economic development and the European metal supply. The EU is beginning to wake up to the advantages of and need for a domestic European mining industry. New policy measures that will facilitate the mining industry within the union seem to be coming. A window of opportunity is now open for Finnish mining to take a quantum leap.

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The mining industry of the Nordic countries in general and Finland in particular is booming in spite of the global financial crisis. After a long difficult period in the 1990s and early 2000s demand for metals is high. Mining is once again contributing to regional development in the northern parts of Finland, Sweden and Norway. The mining industry of the Nordic countries furhtermore has a crucial role in improving the security of supply of the entire European Union. Politicians in Helsinki and Stockholm must make sure that this vital role of the Nordic countries is understood in Brussels. With proper new policies at the national and the European level the mining industry of Finland could flourish well into the 2030s.

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This report is a background survey for the mineral strategy of Finland.

ISBN 978-952-217-130-6 (PDF)
ISSN 0781-4240