

Evaluating supply risks for mineral raw materials

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ABSTRACT

Concerns over the security of raw materials supply have long been expressed in industrialized countries, but only since the ascent of new economies like China and India the raw material supply seems to run the risk of becoming a bottleneck of the global economy. Sharp increases in raw material prices during the last years appear to be an evidence for the increasing raw material demand especially in China.

These concerns led to the launch of the EU “Raw Materials Initiative” (RMI) in 2008. The RMI states that “the fact that some important raw materials sources are located in parts of the world that do not have a market-based system, and/or are politically and/or economically unstable poses particular risks”.

To evaluate possible supply risks with a special focus on the needs of the European economy indicators like import dependence, political stability and country concentration are used.

Together with research institutions from France, Italy, the Netherlands, Poland, Sweden, Switzerland and UK the BGR is part of a new EU project called POLINARES (Policy for Natural Resources) that aims to analyse potential tension and conflicts related to natural resources.

ZUSAMMENFASSUNG

Seit Jahrzehnten spielen die Bedenken um die Sicherheit der Rohstoffversorgung in Industrienationen eine Rolle, aber erst jüngst, nach dem Aufstreben neuer Ökonomien wie China und Indien, besteht die Befürchtung, dass die Versorgung mit Rohstoffen zu einem Engpass für die globale Industrie werden könne. Der starke Anstieg der Rohstoffpreise in den letzten Jahren spiegelt auch den steigenden Rohstoffbedarf, besonders durch das Wachstum der chinesischen Ökonomie, wider. Diese Bedenken führten im November 2008 zur Veröffentlichung der sogenannten Rohstoffinitiative (RMI) durch die Europäische Kommission. In Bezug auf Hochtechnologiematerialien weist die RMI darauf hin, dass ein besonderes Risiko darin läge, dass

bedeutende Rohstoffvorkommen in Teilen der Welt vorkommen, in denen es keine Marktwirtschaft gibt oder die wirtschaftlich oder politisch instabil sind.

Mögliche Versorgungsrisiken können mithilfe von Indikatoren wie der Importabhängigkeit, der Länderkonzentration der Produktion und der politischen Stabilität der Lieferländer abgeschätzt werden.

In Zusammenarbeit mit Institutionen in Frankreich, Italien, den Niederlanden, Großbritannien, Polen, Schweden und der Schweiz bearbeitet die BGR das im Rahmen des FP7 durch die EU geförderte Projekt POLINARES (Policy on Natural Resources), welches zum Ziel hat, potentielle Spannungen und Konflikte in Bezug auf Rohstoffe zu analysieren.

RAW MATERIAL COMSUMPTION

Concerns over the security of raw materials supply have long been expressed in industrialized countries, but only since the ascent of new economies like China and India the raw material supply seems to run the risk of becoming a bottleneck of the global economy. Sharp increases in raw material prices during the last years appear to be an evidence for the increasing raw material demand especially in China. Over the last two decades China’s demand for resources grew substantially. In 1997 China consumed about 10% of the global iron ore and zinc production. Ten years later in 2007 the country’s consumption had increased to about 45 % of the global iron ore production and about 40 % of the zinc production. China’s significant role in the commodity markets is not only related to the strong raw material demand by the Chinese industry, but also to its growing export of raw materials and the expansion of the exploitation of domestic deposits as well as to the tendency of acquiring share in deposits, mines or mining companies abroad.

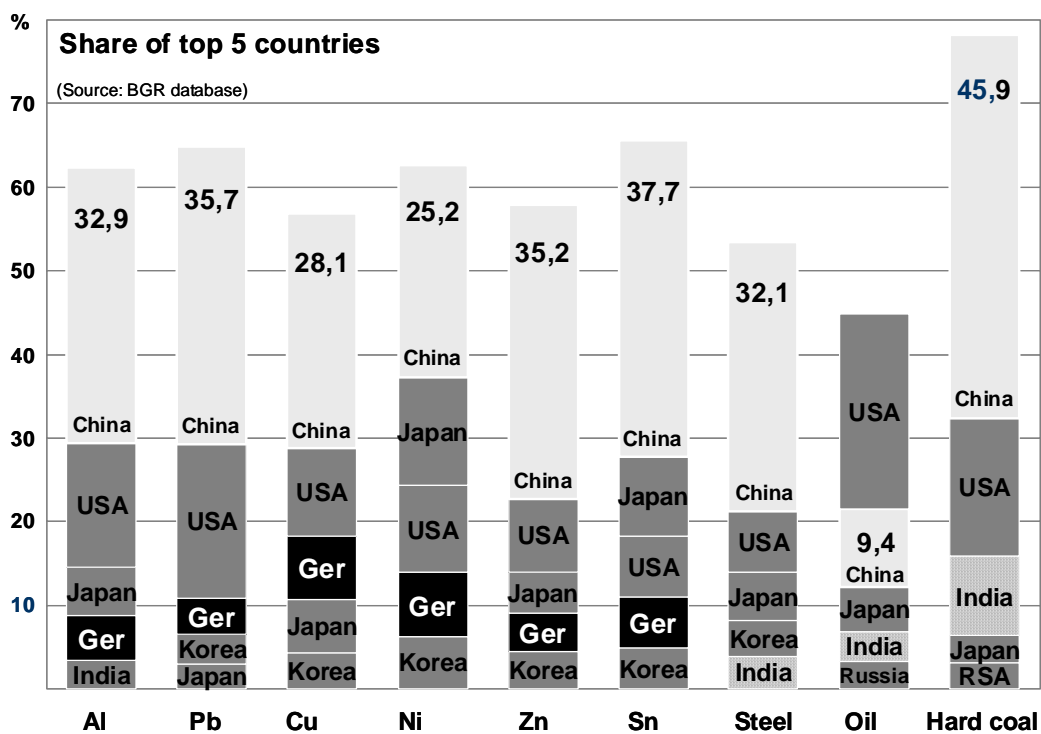


Figure 1: The five leading nations concerning the consumption of metals in 2008

European countries are largely import dependent with regard to metals. Only a minor amount of the European consumption of metals is mined in the EU. Examples for EU metal production are the copper mines in the Kupferschiefer in Poland, the copper-zinc mine Neves Corvo in Portugal or the Swedish copper mine Aitik and the iron ore mine Kiruna (Sweden). For several metals, including rare earths and PGMs, the EU countries completely rely on imports.

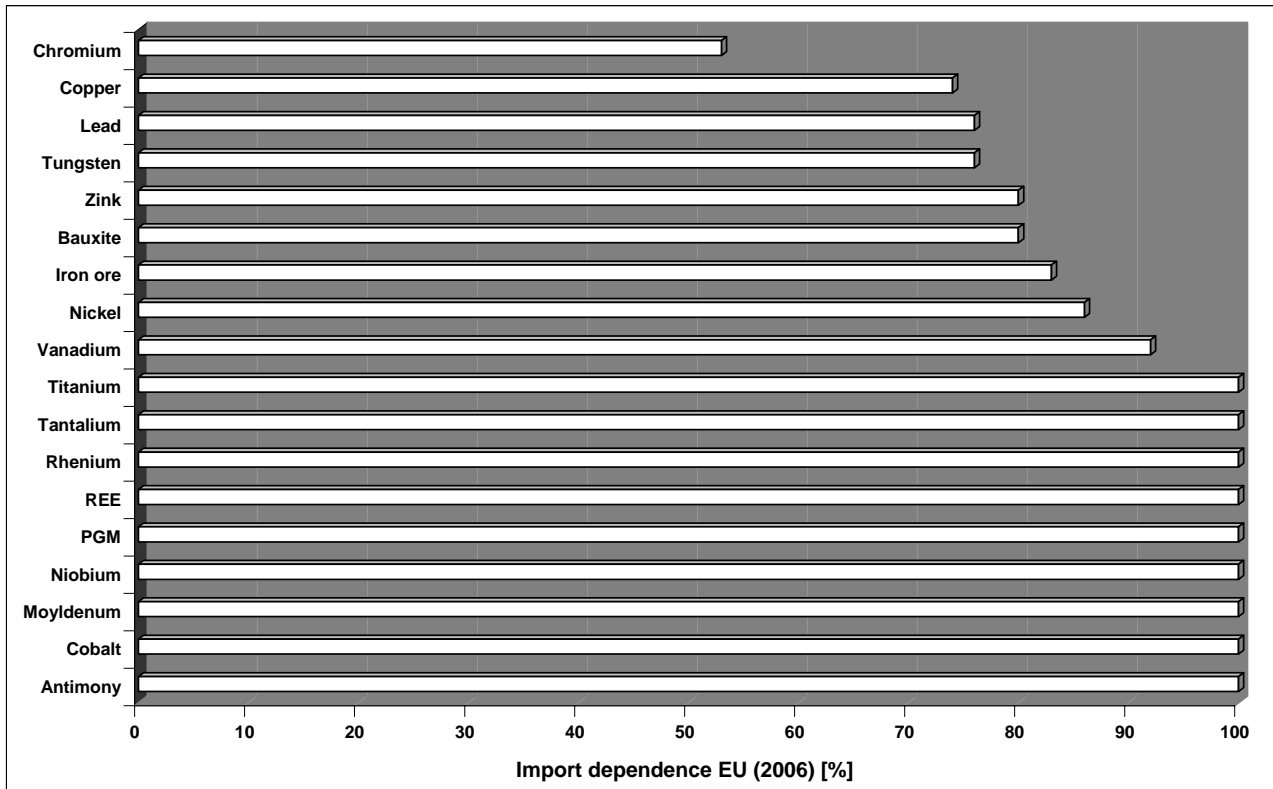


Figure 2: Import dependency of Europe 2006 (data source: BGS)

The commodity markets

After the resource boom of the years 2003 until 2008 the escalation of the crisis in the financial markets since October 2008 has also had massive consequences for the commodity markets. Enormous asset losses, the credit crunch, falling industrial production and rising unemployment lead to a considerable deceleration in global economic growth. Due to the falling demand and the shattering forecasts, metal commodity prices fell in 2008. The industrial production decreased and the world economic growth (GDP) shrank from 3.7 % in 2007 to -2.1 % in 2009 [1]. Compared to previous economic cycles an even stronger fall on metal prices occurred. For LME treated metals the prices decreased between 16 % (tin) to 43 % (nickel) between March and September 2008. Commodity prices started to recover at the end of 2008/early 2009 and net prices still remain more than double compared to those of 2003.

The German energy and raw material imports (ore and metals at the primary processing stage) increased from 54 billion € in 2003 to 127 billion € in 2008. The share of metals and non-metals was around 23 % in 2008; the percentage of energy raw materials was considerably higher at 72%. The value of German commodity imports in 2009 will fall substantially due to the general price collapse, but probably also as a result of the drop in orders.

Despite the effect of lower commodity prices from the consumer point of view, the financial crisis is leading to liquidity bottlenecks in the development of new mining projects. Numerous exploration and mining projects, as well as planned extensions in the mining sector, were put “on ice” in late 2008/early 2009. Mines and refineries operating in the upper third segment in terms of cost compared to other operators tended to be shut down. Given the prices 2008/early 2009, there is almost no incentive for implementing new commodity projects, including primary processing, for example aluminum, nickel and zinc, according to UBS calculations in 2007. This means that metal commodity supply will grow slower than anticipated for 2008. Depending on the specific commodity it is possible that supply bottlenecks may develop in respective commodity markets, in the next few years mainly driven by continued high growth in China and other emerging economies.

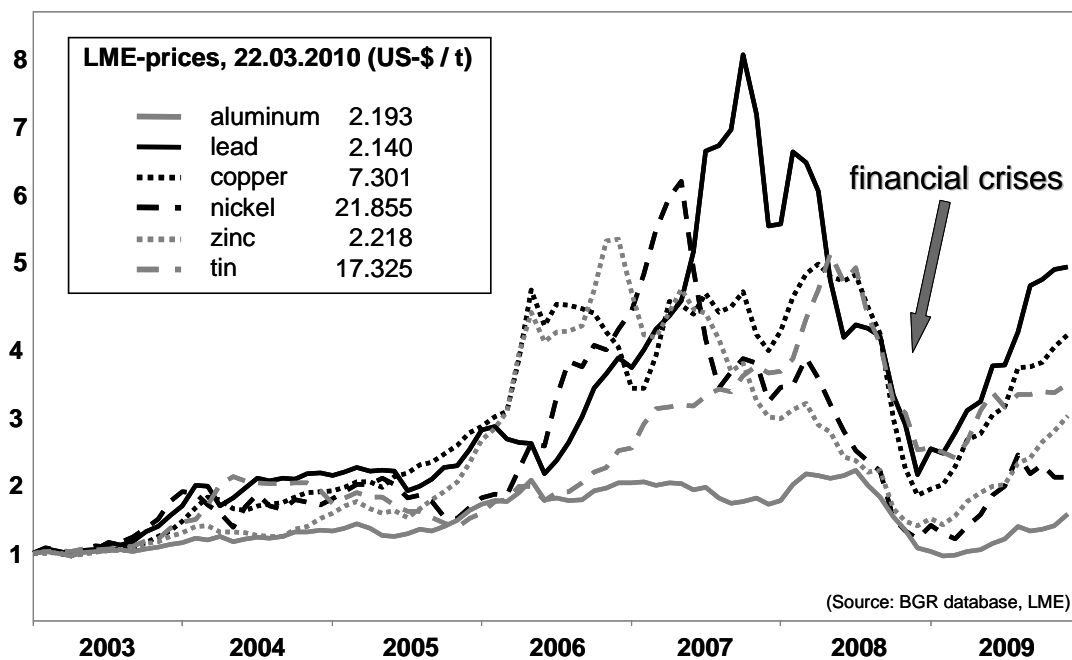


Figure 3: Relative price developments of LME metals 2003-2009.

THE RAW MATERIAL INITIATIVE

The increasing demand for raw materials by emerging economies like China and India, the rising commodity prices until 2008 and concerns over Europe’s future supply of raw materials led to the publication of the “Raw Material Initiative” (RMI) by the European Commission in November 2008 [3].

The RMI states that a secure access to raw materials is crucial for the EU’s economy. The RMI focuses on three pillars to tackle the problem of raw material supply for the European economy:

- Access to raw materials on world markets at undistorted conditions
- Foster sustainable supply of raw materials from European sources
- Reduce the EU's consumption of primary raw materials

The EU is self-sufficient in the production of construction minerals. The EU also has a large production of industrial minerals, but is a net importer for many of these materials. For metals the situation is different since Europe only produces a minor part of the global metal production. The European economy is highly dependent on primary metal imports. Some of those metals imported, base metals and especially high tech metals, are regarded as critical, because of their importance to the European industry. This raises concerns over the security of raw materials supply. The RMI states that “supply risk factors can have multiple dimensions: geological, technical, environmental and social, political and economic. Examples are: concentration of production at company or country level, increased demand, degree of import dependence, by-product or not, recycling potential, substitution possibilities, political and economic stability of producing countries...” The RMI stresses that the EU is highly dependent on imports of high-tech raw materials (e.g. cobalt, platinum, rare earths, titanium) and that sudden demand peaks might lead to supply risks.

ANALYSIS OF SUPPLY RISKS

Concerns over a secure raw materials supply imply questions over the geological availability of resources. Long term observations of production and reserve data indicate that from a geological point of view no supply shortages are to be expected. The often cited static lifetime of reserves is ineligible for forecasting future supply shortages, since the definition of reserves includes an economic aspect. If commodity prices rise, the amount of available reserves also increases. New deposits are to be discovered because of increased interest in exploration. Mines are then able to mine ore containing less metal, that before has been classified as non economic. Falling static lifetimes under a certain amount of years might indicate an increasing need for exploration activities, finally leading to new discoveries and thus expanding the amount of reserves.

Long term analysis of reserve data (reserves and reserve base) in relation to the actual production shows only minor changes in the resulting lifetime. It thus can be concluded that the geological availability of resources will not be a problem in the long run for the majority of materials if exploration, mining and processing continue to be successful and operational.

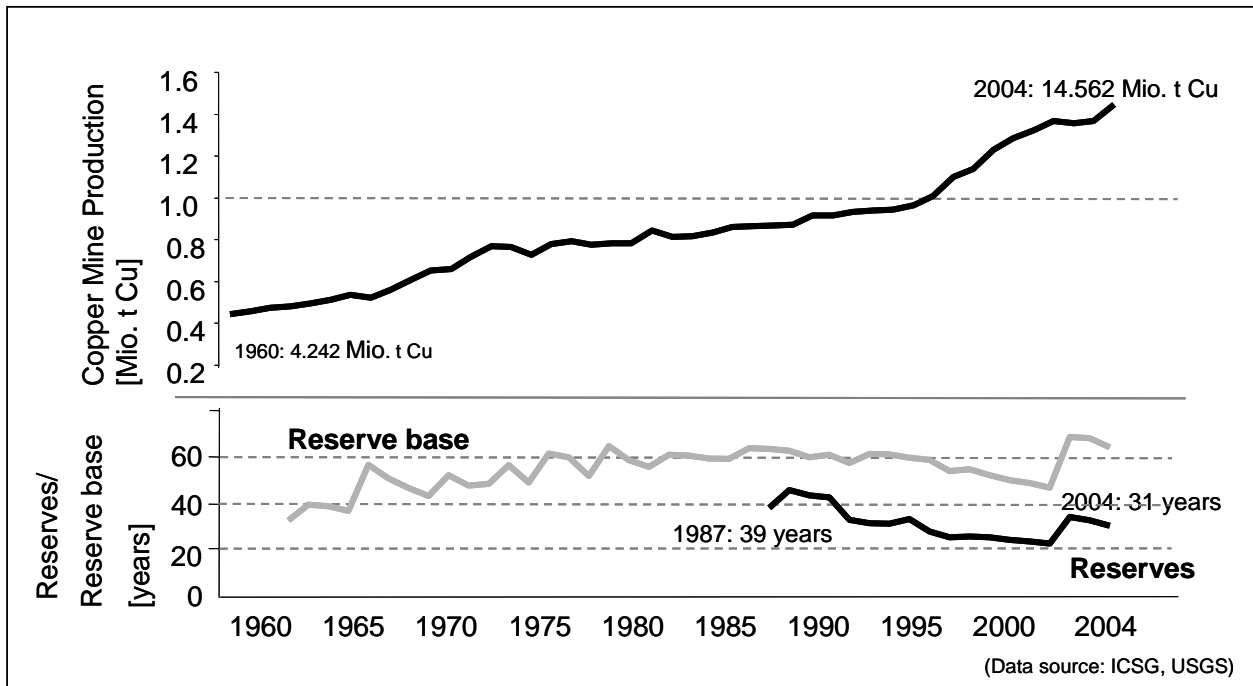


Figure 4: Long term availability of copper reserve in relation to the global copper production (data sources: ICSG, USGS)

Even if geological constraints do not account for future supply shortages, there might be supply risks in the future. The main risks for EU's future raw materials supply originate from other factors than natural abundance of resources. The availability of natural resources desperately needed in Europe might be linked to geopolitical factors, such as the political stability of the producing countries, company and country concentration, social issues, trade distortions and investments in exploration, mining and processing.

Some raw materials are geographically highly concentrated as it is the case for rare earths, which nearly completely originate from China. On the other hand the political situation in countries supplying raw materials to Europe can entail risks.

Raw materials with a high geographic concentration and a high country risk could be regarded as highly critical with respect to supply. The country concentration can be measured by the Herfindahl-Hirschman Index, while the World Bank's "World Governance Indicators" (WGI) are used to classify the countries stability. The WGIs combine six dimensions of governance: Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law and the Control of Corruption. The more critical the raw materials are according to the two indicators, the higher their risk of facing supply disruptions. Severe political tensions in countries with a high country risk or trade restrictions for materials with a high

geographical concentration (e.g. rare earth production in China) imposed by the producing countries could negatively influence the European supply.

Analysing the country risk and the country concentration for metals (mine production and refined metal) the results show the highest risks for rare earths, W, V, Sb, PGM and Nb (all mine production). Since the mid eighties China became a major producer of REE and today as much as 97 % of the global annual REE mine production originates from China. Also Platinum shows a high country concentration, because it is predominantly mined in South Africa. Palladium mine production is located in Russia and South Africa (Russia: 42% of the annual world production; South Africa 37% (2008)). Nearly the entire global vanadium mine production stems from three countries: Russia (26 %), South Africa (36 %) and China (36 %).

The highest risks for the refined metal production have been calculated for Mg, Bi and Hg.

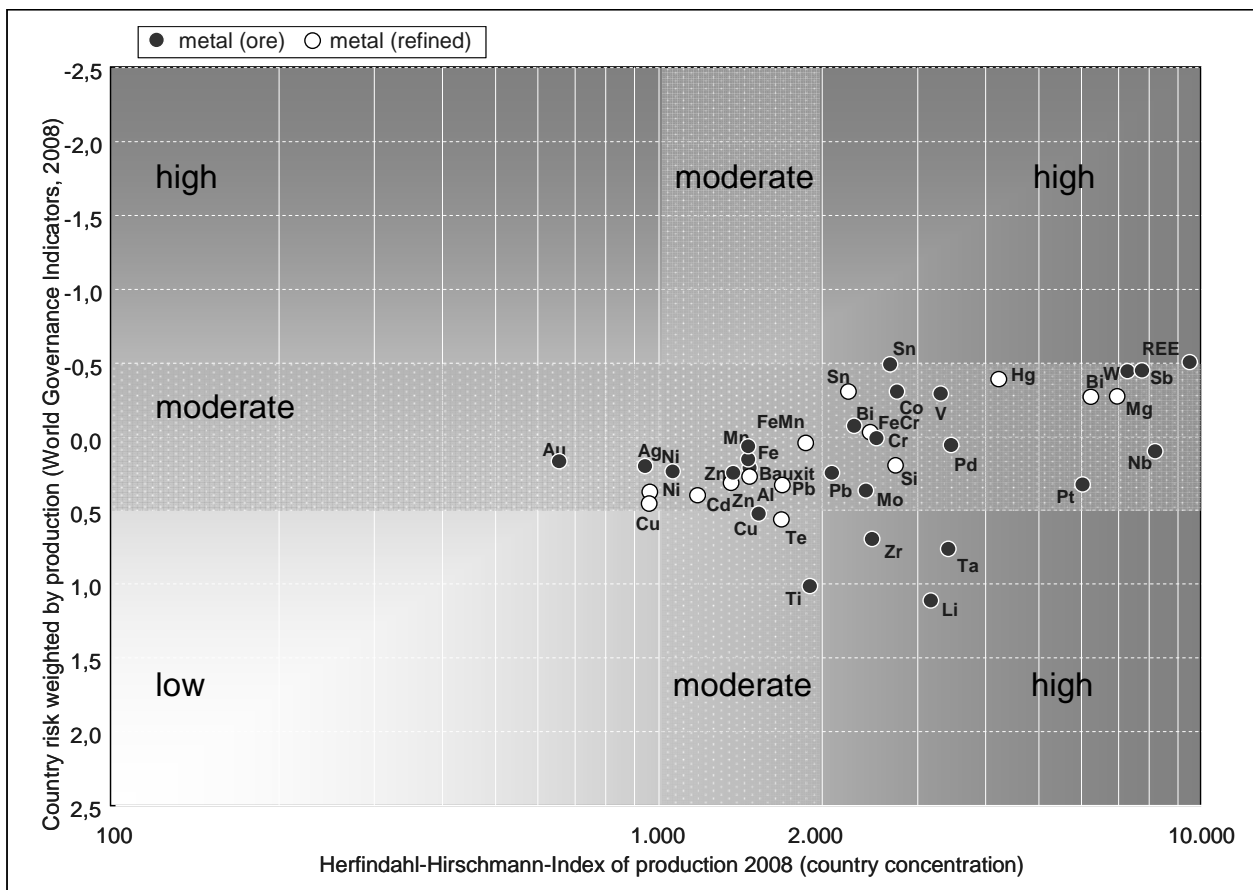


Figure 5: Criticality of several primary metals (metal ore and refined metal) according to country concentration and country risk

One has to bear in mind that the values for the country risk of metal production represent global averages and might however not reflect all risk aspects in detail. About 44 % of the global cobalt

production in 2007 for example originated from the DR Congo. Other producers were Canada (14 %), Australia (10 %) and others (Zambia (7 %), Cuba (7 %), Russia (6 %), China (3 %), New Caledonia (3 %), Brazil (2 %)). The resulting average country risk for cobalt is moderate, since the low rating in the WGI of the DR Congo is outweighed by the positive rating of Canada and Australia. On the other hand the highly instable political situation in the DR Congo could have a major impact on the cobalt supply if escalating.

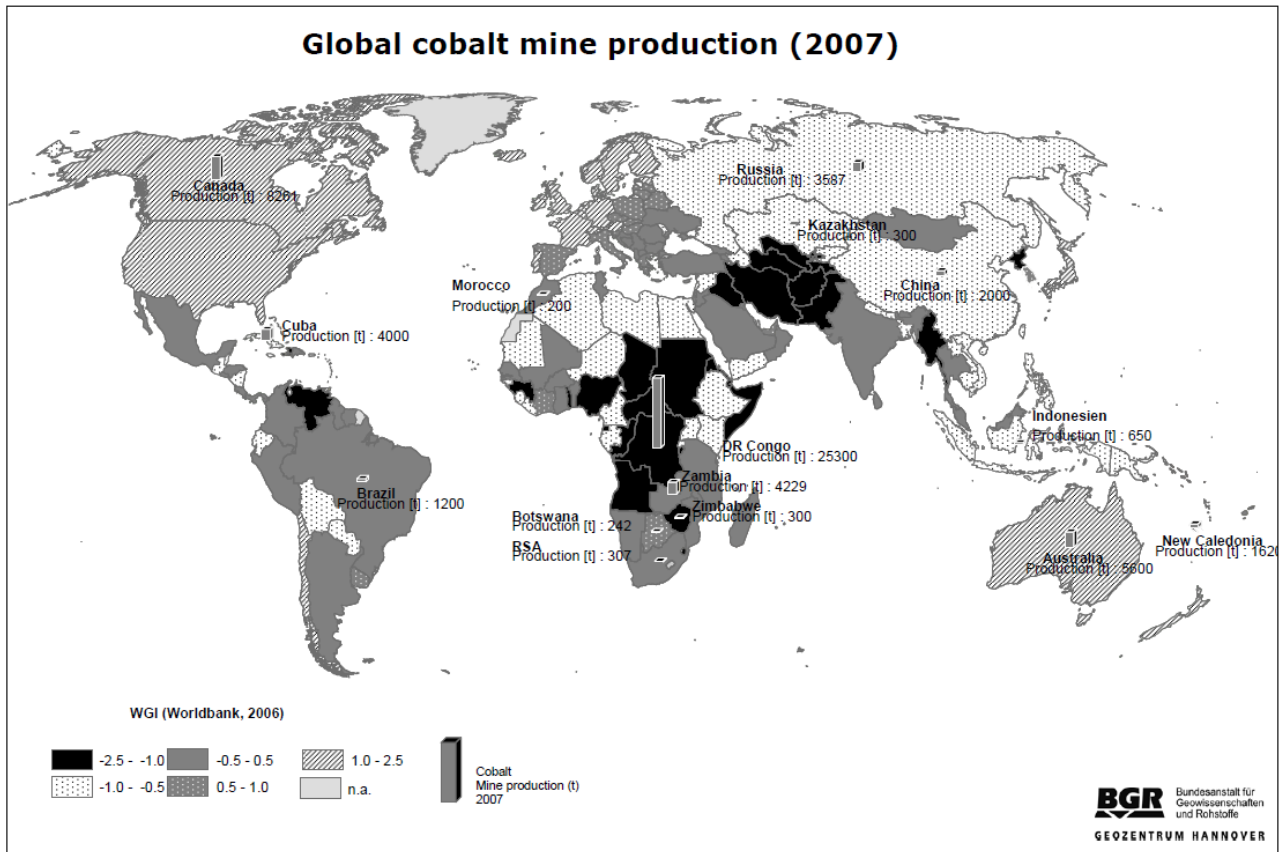


Figure 6: Global cobalt mine production and country risks according to the World Governance Indicators (WGI)

Other factors influencing the supply security of natural resources are recycling and substitution. Rising prices and supply shortages might lead to substitution. The substitutionability of materials of course is limited since the function has to be maintained. Also substitutes might be cost intensive, have a limited availability or their use might be restricted e.g. due to environmental reasons. In general high resource efficiency in the EU, including increased recycling rates, lowers the risk of supply shortages, but is not sufficient to secure the raw material need of modern industrial economies.

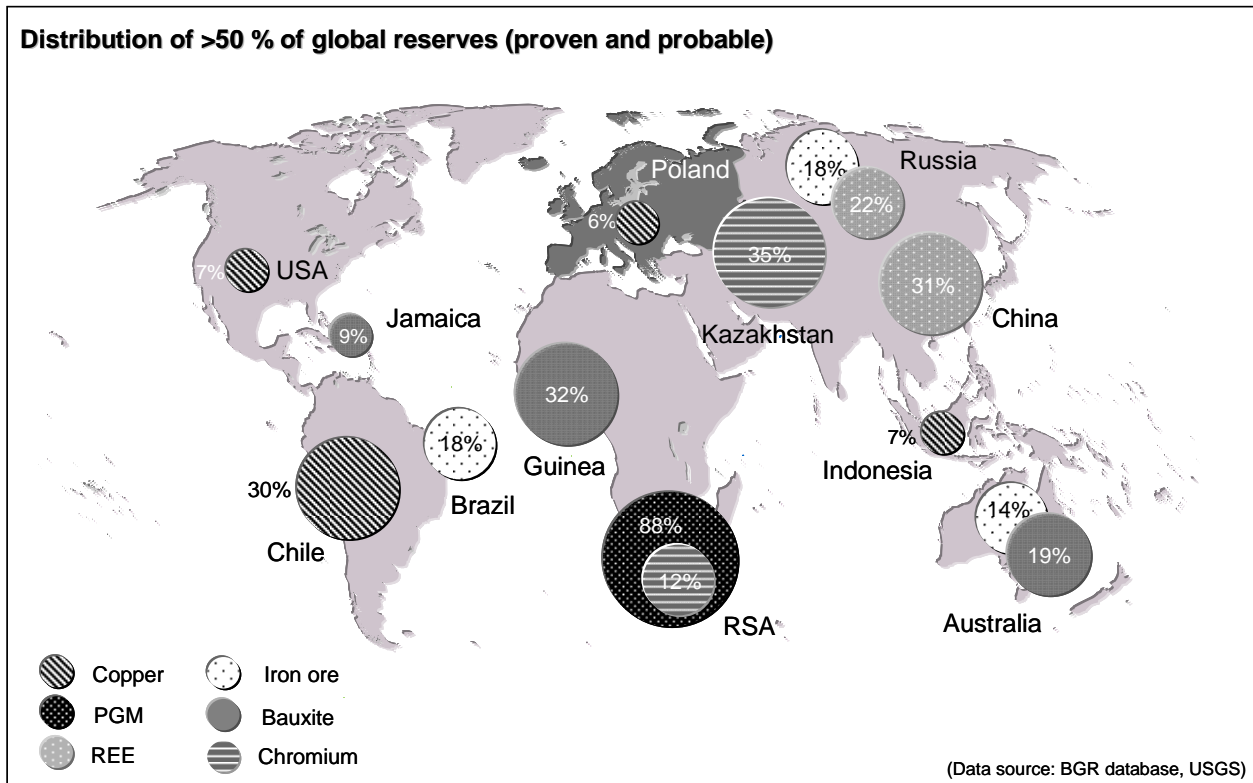


Figure 7: Global distribution of major reserves of copper, PGM, REE, iron ore, bauxite and chromium (2008)

A further dimension that has to be taken into account are future demand changes induced by emerging technologies. An extensive study on raw materials in emerging technologies has been published by the Fraunhofer ISI [2]. Estimates for Gallium, Neodymium, Indium, Germanium, Scandium, Platinum and Tantalum indicate that in 2030 the demand for these metals will exceed today's world production. For further discussion on assessing the long-term supply risk for mineral raw materials we refer to Rosenau-Tornow et al. [4]. In addition to the indicators used here exploration expenditure, company concentration, production costs and others can be used in order to refine the model.

Resources and conflicts - the Polinares project

The continuing economic development of poorer nations will inevitably require an ever-increasing supply of energy and mineral resources, at least for the foreseeable future, notwithstanding the ongoing deployment of new sources of energy, new materials and new technologies. The pressure on the environment, at local, regional and global scales will continue to rise, and fears over the long term availability of natural resources will progressively grow.

In the context of oil, gas and minerals, tension and conflict can occur at a local, sub-national scale, or at national, regional or global scales. Indeed economic globalisation has led to a progressive enlargement of the actual and potential geographic and political scope for tension and conflict. The actors include national and sub-national governments, militias, liberation movements, corporations and international organisations. The nature of the competition, tension or conflict can be economic, political or military, and may range from minor trade disputes to major armed conflict.

In January 2010 an international consortium of institutions, including the BGR, launched the POLINARES (Policy for natural resources) project to analyse the fundamental aspects underlying resources conflicts. The participating institutions in the FP7 financed project are: University of Dundee (UK), University of Westminster (UK), CIEP (Netherlands), BGR (Germany), CNRS (France), ENERDATA (France), Raw Materials Group (Sweden), FEEM (Italy), Fraunhofer ISI (Germany), Gulf Research Centre Foundation (Switzerland), The Hague Centre for Strategic Studies (Netherlands), and Osrodek Studiow Wschodnich (Poland).

POLINARES concentrates on the global challenges faced with respect to access to oil, gas and mineral resources over the next 20 years and proposes solutions for the various policy actors, including the EU. Combined theoretical and empirical analyses will use expertise from a wide range of disciplines including political science, economics, geology, engineering, technology, law and security studies. The initial aim will be to understand the causes of past and current conflict and tension relating to access to these resources and identify emergent sources of future conflict and tension. New frameworks for analysis will be developed using historical experience and political and economic theories. Future availability and demands for energy and other selected minerals will be assessed to provide the basis for evaluation of potential future sources of tension and conflict. Technical and economic data for critical resources will be analysed for key factors determining recent and future supply and demand, and to develop scenarios for the future. Current and recent practices and strategies of key actors will be examined to understand, refine and calibrate theoretical models developed. Building on scenarios developed to identify and assess the major future risks for tension and conflict, POLINARES will integrate assessments of future supply and demand with the understanding of the behaviour of actors and their interactions and interdependencies. Later, the project is devoted to identifying future policy approaches. POLINARES will establish a new set of criteria for evaluating past, current and future policy approaches, and will develop new understanding from how experience in other natural resource sectors of different approaches have been and can be used. A novel set of policy approaches and

will be established aimed at mitigating anticipated tensions and conflicts, and will identify clearly the roles which the EU can play in promoting such policy approaches and options.

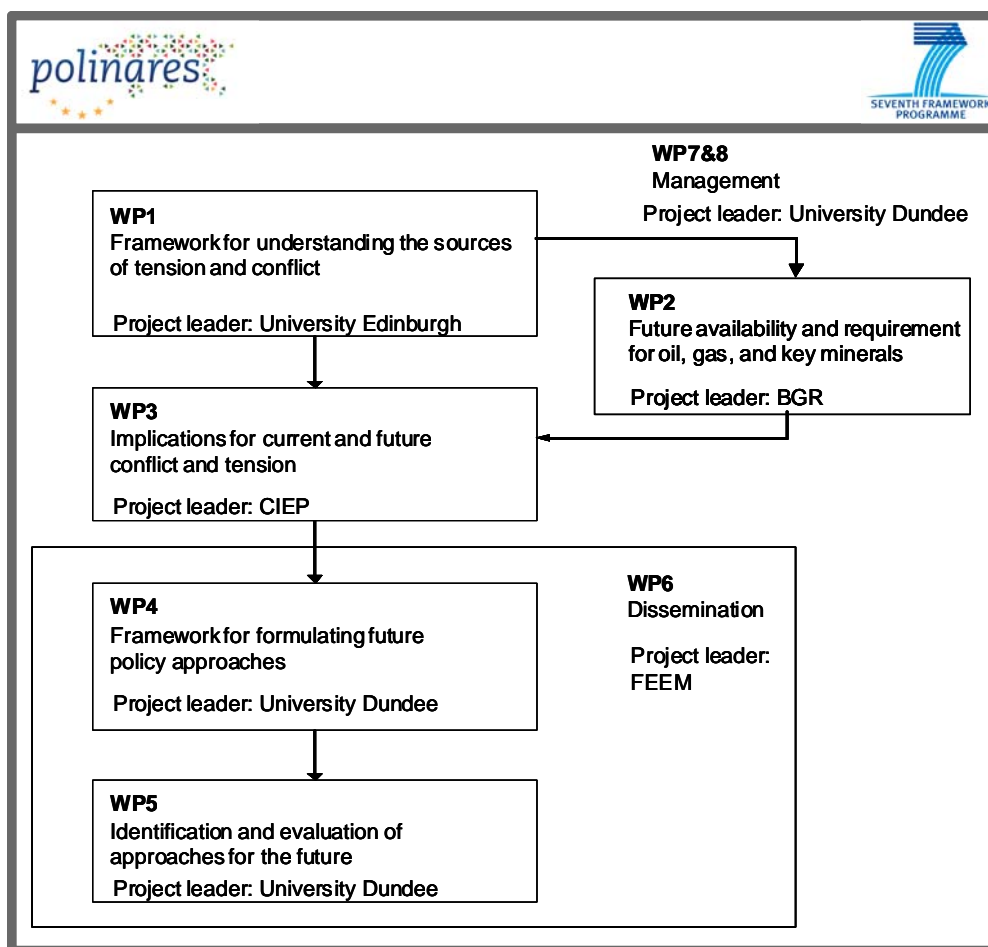


Figure 8: Work packages of the FP7 financed Polinares project

SUMMARY

The main aspects of analysing the risks of raw material supply to the EU are: the political situation in producing countries, the concentration of production, the import dependence and the economic importance of a material and finally the future demand. Recycling and substitution may reduce the import dependence and are therefore to be considered.

The import dependency of Europe's raw materials supply together with the increasing market power of China and other emerging countries raises concerns over the security of supply. Using indicators like the country concentration, the country risk and the import dependence (respectively the share of domestic mine production to net imports) leads to the conclusion that especially rare earth elements and some electronic metals bear a high risk for supply shortages to the EU. Their total value might not be very high compared to other metals used in huge amounts, but the REE are

of high economic importance since they are used in high tech appliances. The use of REE might even increase in the future due to their use in emerging technologies.

Europe's industry completely depends on REE import and these imports are nearly exclusively supplied by China. Like rare earths also PGMs are used in modern technologies and again Europe is completely dependent on imports, in this case mainly originating from South Africa (and partly Russia and China). In other cases like cobalt for example, the overall country concentration is not extremely high, but the main supplier (in the case of cobalt the DR Congo) bears a high geopolitical risk.

Although the geological availability is not the key issue for raw material supply mineral reserves and resources continuously need to be developed. As mining will contribute more than 80 % to future global raw material supply, more innovations are needed in developing exploration, mining and processing technology.

LITERATURE

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