

The Global Challenge of Mineral Scarcity¹

Authors: Michel Rademaker² and Jaakko Kooroshy³, The Hague Centre for Strategic Studies (HCSS)

Essay for the Conference: *Enriching the Planet, Empowering Europe - Optimising the use of natural resources for a more sustainable economy*, The Hague, 26 & 27 April 2010, cf: <http://www.dingendael.nl/resource scarcity>

Introduction

Over the past decade, global mineral markets have experienced the longest boom in prices since World War II as demand grew rapidly and supply struggled to keep pace. This has created fears of mineral scarcity and brought mining and metals back on the policy agenda, from which they had been notably absent for decades. Concerns in these debates have focused especially on a number of minor and specialty metals that are key to emerging high-tech applications and most notably many 'green' technologies. Material security concerns and growing fears that these 'high-tech metals' are used for resource diplomacy by mineral-rich states such as China, have recently increased the visibility of the issue.

However, do growing demand, slow supply growth and high prices for metals really matter to Europe? Europe's construction, chemicals, automotive, aerospace, machinery and equipment sectors all critically depend on metals supply. But the value of the metals used in most cases represents only a fraction of the costs of the end-products in these industries products and the European economy therefore certainly is able to deal with significant price increases in metal markets. Nonetheless, there are a number of reasons why policy-makers should concern themselves with the recent developments in mineral markets. This essay provides a short overview of key trends in metals demand and supply and discusses the implications of growing metal scarcity for Europe as well as the emerging European policy response.⁴

Rapid Growth in Demand...

As a large fraction of the world population continues to industrialize and urbanize in large developing countries with China at the helm, many analysts believe that the world economy has entered an unusually resource-intensive phase of expansion or a so-called "super cycle". Such a super cycle is associated with a "prolonged (decades) long-trend rise in real commodity prices" and mineral prices in particular.⁵ In studying long-term developments of copper prices, Alan Heap of the Citigroup identified two such demand-driven super cycles since the late 19th century, one around the turn of the century driven by the industrialization of the US and a second after WWII spurred by the industrialization of Japan (see figure 1).

Heap conjectured that the world stood at the beginnings of a third super cycle. This result has been confirmed by a recent IMF staff study, which analyzed long-term price developments for six different base metals with advanced econometric techniques, identifying three such cycles over the past century in place of two (see figure 2).⁶

¹ This essay was made possible due to contributions of the EU research project *Polinares*, Policy Research On Natural Resources. The authors would like to thank Rob de Wijk, Rem Korteweg, Jan Rood, and Louise van Schaik for helpful comments.

² Michel Rademaker is the deputy director of The Hague Centre for Strategic Studies, www.hcss.nl.

³ Jaakko Kooroshy is policy analyst at The Hague Centre for Strategic Studies, www.hcss.nl.

⁴ Given limited scope of this paper we focus here on base metals and minor metals. Similar, though less prominent debates have also covered industrial minerals, fossil fertilizers, and precious metals such as gold.

⁵ Heap (2005), *China—The Engine of a Commodities Super Cycle*, Citigroup Smith Barney.

⁶ Cuddington & Jerret (2008), *Super Cycles in Real Metal Prices*, IMF Staff Papers 55 (4), pp. 514-565.



Government of the Netherlands



netherlands institute of international relations
clingendael

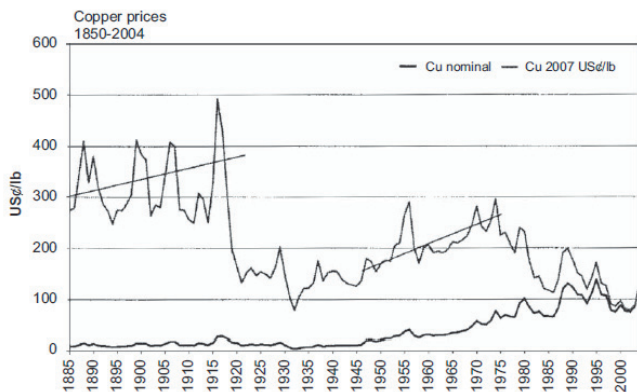


Figure 1 Super cycles in Copper prices as identified by Heap (2005)

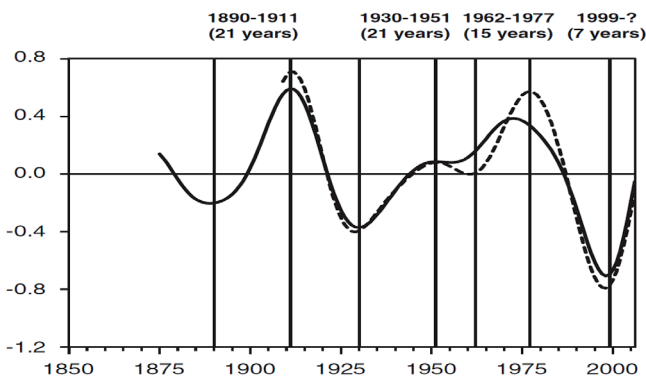


Figure 2 Super cycles in long-term prices of six base metals, as identified by IMF staff (2008)

Super cycle theories certainly remain controversial, but there is no doubt that the increase in demand for mineral resources has put enormous pressure on global mineral markets over the past decade.⁷ It is also clear that this demand growth has overwhelmingly originated from emerging economies and China in particular (see figure 3). The extraordinarily high demand for metals in China over the past years can be explained by sustained, massive investments in infrastructure, rapid urbanization, and the relocation of a substantial fraction of global manufacturing capacity to China. As high GDP growth rates, rapid urbanization and large infrastructure investments continue not only in China, but also in several other large emerging economies over the coming years, experts expect sustained high demand growth for a number of base metals.

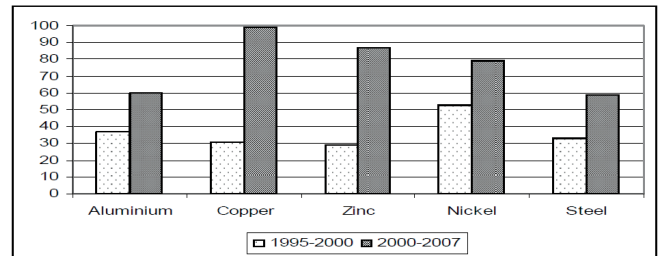


Figure 3 China's Share in Global Demand Growth for Base Metals 1995-2007⁸

However, not only the demand for base metals will keep growing rapidly. Many key emerging technologies require growing amounts of a large number of more 'exotic' specialty and minor metals, such as Rare Earth Elements (REEs), Lithium, Tungsten, Tantalum, Indium, or the Platinum Group Metals (PGM). These elements have become an indispensable part of high-tech applications such as mobile phones, flat screens or hybrid cars as well as a long list of other applications in aerospace, automobile, defense, optical, semiconductor, and advanced chemical industries, as well as in many emission-reduction technologies.

While such 'high-tech metals' are often used in only very small quantities in individual products, demand has been growing very quickly as new applications appear almost daily. Future demand for individual elements is very difficult to forecast as it depends critically on new technological innovations and the rate of diffusion of specific emergent technologies, such as hybrid cars or specific types of wind turbines for example.⁹ Nonetheless, there is little doubt that demand for these high-tech metals in general will keep growing precipitously over the coming years and that they will continue to play a critical role in the high-tech industries of the future.

... and Struggling Supply

While demand kept growing rapidly, suppliers have struggled to keep pace over the past years and often have missed their production targets.¹⁰ This led to a sharp tightening of mineral markets and a volatile rally in prices. Over a decade, prices for base metals quadrupled in nominal terms from their lows during the Asian Crisis and in real terms reached levels not seen since the commodity shocks of the 1970s (see figure 4). For high-tech metals, the ride has been even rockier. Temporary bottlenecks in supply or precipitously increasing demand due to a new technical application have caused severe price shocks for several of these metals over the past decade. A good example is that of indium, for which the price jumped more than 800% between 2002 and 2005, mainly due to its usage in evermore popular flat screen displays and TV panels.¹¹

⁷ Humphreys (2009), *The Great Metals Boom: A Retrospective*, Resources Policy 35, pp. 1-13.

⁸ From Farooki (2009), *China's Structural Demand and the Commodity Super Cycle: Implications for Africa*, paper prepared for the Leeds University Research Workshop China Africa Development.

⁹ Oakdene Hollins Research & Consulting (2010), *Lanthanide Resources and Alternatives*, Report for the UK Department for Transport and the UK Department for Business, Innovation and Skills.

¹⁰ Humphreys (2009), *The Great Metals Boom: A Retrospective*, Resources Policy 35, pp. 1-13.

¹¹ USGS Mineral Commodities Summaries 2007, p. 78.

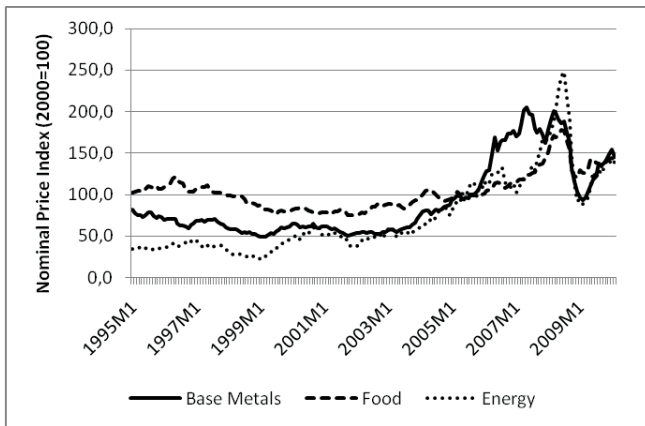


Figure 4 Nominal Price developments for primary resources (1995-2005)¹²

The price boom for metals came to a sudden end in March 2008, when the onset of the financial crisis lowered demand projections considerably. Over less than a year, base metal prices lost more than half of their value leading to widespread pain in the mining industry. Analysts quickly began to decry the ‘super cycle’ as a commodity price bubble that was inflated by profit-hungry speculators.¹³ However, the crisis in metal markets turned out to be short-lived and base metal prices have again been on a firm upward trajectory since February 2009. Up until today, metal prices have regained roughly half of the loss they sustained during the crisis, an impressive performance given a world economy that has been busy with trying to recover from its worst crisis in decades. If global demand keeps recovering as analysts expect, supply is likely to come under renewed pressure, possibly leading to a return of record prices.

The massive price rally in minerals created fears of shortages and debates on the threat of ‘mineral scarcity’ among policymakers and in the media. These discussions have mainly focused on worries that an ever growing world population and global economy might quickly be reaching the ecological limits of the planet and that non-renewable resources will soon be ‘running out’.

In contrast to this, careful analysis shows that the reasons for the sputtering growth in the supply of natural resources are much more complex.¹⁴ The cyclical nature of the mining industry, long lead times for setting up new mines and a sore lack of investments are at least as much to blame for relatively slow supply growth as the exhaustion of available resources. In fact, there is plenty more to be found on our planet, even if these resources are not so easy to find, convenient to access, and easy to extract as the resources we have been consuming in the past.¹⁵

However, at least for base metals with a long history of extraction,

there is no denying that the exhaustion of many existing mines and the shrinking size, increasing remoteness, greater depth, and lower ore grade of new mineable deposits pose a significant challenge to expanding global supplies.¹⁶ Mining and refining of base metals has become technically more difficult and increasingly energy intense, as the ‘low hanging fruit’ has been picked. These factors are threatening to drive up production costs in conventional mining considerably and create worries that future production may not keep pace with the voracious growth of demand.

For many high-tech metals, producers have also experienced difficulties to expand supplies at the pace of demand. However, it is key to understand that for most of these minor and specialty metals, the lion share of world production comes from only a handful of mines around the world and supply growth is constrained by different factors than in the base metal case. After all, most of these elements are not necessarily less abundant in the earth’s crust than base metals, but their mining has typically started much later in history, and annual production volumes are only a fraction of those for base metals. Geological constraints to increasing supply thus play a limited role here. Instead, investments into mining high-tech metals have been insufficient despite high prices and projections for growing demand. Figure 5 provides an overview of the most salient reasons that are causing under-investments in high-tech metals production.

Factor	Constraints
Competition	opaque cost curves of competitors
	concentrated asset ownership among suppliers, non-competitive market structure
	ability to hedge against price depression is limited
Prices	forward curve visibility is poor
Marketing	Lack of transparent markets with large amounts of buyers creates risks beyond the mine gate.
Substitutability	Potential of substitution in key applications creates risks for a sudden collapse in demand
Scale	Investments relatively small in comparison to base metal mining, creating unfavorable balance towards overhead in terms of market research, R&D

Figure 5 Concerns for Large-Scale Investors in High-tech Metals Mining¹⁷

¹² HCSS, based on monthly price indices from the IMF Commodity Prices Database.

¹³ Humphreys (2009), *The Great Metals Boom: A Retrospective*, Resources Policy 35, pp. 1-13.

¹⁴ HCSS (2009), *Scarcity of Minerals: A strategic security issue*. Report available for download at www.hcss.nl

¹⁵ Tilton (2003), *On Borrowed Time? Assessing the Threat of Mineral Depletion*, Washington, DC: Resources for the Future.

¹⁶ Diederer (2009), *Metal Mineral Scarcity: A Call for Managed Austerity and the Elements of Hope*. TNO Defence, Security and Safety.

¹⁷ HCSS, based on by Barclays Natural Resource Investments, (2010) *An Investor’s Perspective on Exotic and Specialty Metals Sector*, presentation at Rare Earths, Specialty & Minor Metals Investment Summit, March 18th, London.

Does Mineral Scarcity Matter to Europe and the World?

In most end-products, the value of the metals contained represents only a fraction of the costs for the European consumer and the European economy is certainly able to weather significant price increases in metal markets. Nonetheless, there is cause for concern. Europe produces only 3% of the global supply of metals and is therefore to a very large extent dependent on imports from the rest of the world (see figure 6).¹⁸ A steep increase in real prices of metals implies therefore that wealth is transferred from import-dependent European countries to commodity suppliers. More importantly however, resource rich countries are able to provide their industries an unfair advantage over their European competitors, a strategy that several emerging economies have recently engaged in. Especially in the high-tech sector, where new technologies critically depend on minor or specialty metals, unequal access can be cause of concern.

Faced with the prospect of increasing demand and tightening supply of minerals used in critical applications, access to scarce minerals and stockpiles are also increasingly framed as issues of vital interest or national security. China, the US and Japan are for example all aggressively pursuing strategies that guarantee their high-tech industries' access to specific metals such as Rare Earth Elements (REEs), a development that may come at the detriment of European interests.¹⁹ Due to import dependence and concentrated supplies, European industries are vulnerable to sudden supply shocks due industrial policy of suppliers or trade and political disputes.

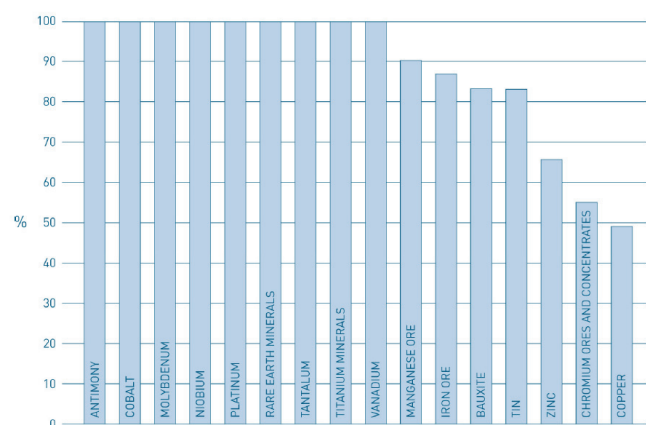


Figure 6 EU Net Imports of Metals as Percentage of Apparent Consumption²⁰

¹⁸ EU Commission(2008), Communication from the Commission to the European Parliament and the Council: The Raw Materials Initiative—Meeting Our Critical Needs for Growth and Jobs in Europe, Brussels.

¹⁹ HCSS (2009), Scarcity of Minerals: A strategic security issue. Report available for download at www.hcss.nl

²⁰ HCSS, based on EU Commission (2008), Commission Staff Working Document Accompanying the Raw Materials Initiative, Brussels.

A particularly serious issue in this context is the dependence of many emerging 'green technologies' on a number of high-tech metals and especially large quantities of REEs.²¹ The limited supply of these materials has the potential to develop into a serious drag on the transition to more sustainable energy generation and use. Today, China controls the supply of REEs and has been moving aggressively to curb supplies to the rest of the world as its domestic demand increases and it seeks to move up the value chain. While large viable reserves exist outside of China, new mining projects have been advancing very slowly, mainly because of profitability concerns and lack of investments.²²

Increasing resource scarcity could also intensify both intra- and inter-state conflict. The role of diamonds in fuelling violent conflicts in Sub-Saharan Africa has been well documented. But conflicts can also thrive on other mining products, especially where artisanal mining is involved. Tantalum (or 'Coltan' after the mineral that contains this crucial high-tech metal) mining in Congo is a case in point. High prices can make such business much more profitable. As the recent Western concerns over Chinese policy on REE exports and its investments into the African mining sector shows, tight markets can also work to exacerbate trade and investment disputes, making the world as a whole a more dangerous and less stable place to live in.²³

Meeting the Challenge of Mineral Scarcity

Well-designed policies can help Europe and its industries to adapt to increasing mineral scarcity and help to mitigate negative consequences of mineral scarcity. With regard to Europe's policy towards minerals three goals are important: To decrease dependency on metal supplies from the rest of the world, to support global mining industries in increasing output, and to ensure fair and secure access to minerals.

Decreasing dependency on foreign supplies means both to become 'metals-lean', i.e. to reduce waste and make consumption of metals in industries more efficient, as well as to increase European supplies of metals. In some cases, this may mean opening new mines in Europe. Much more importantly however, it means turning to recycling as a key source of future material supply for industries. Recycling industries are still far from having realized their full potential, especially when it comes to high-tech metals, and could become very profitable businesses in the future..

²¹ Jacobson & Delucchi (2009), Evaluating the Feasibility of a Large-Scale Wind, Water, and Sun Energy Infrastructure, University of Stanford Working Paper.

²² Oakdene Hollins Research & Consulting (2010), Lanthanide Resources and Alternatives, Report for the UK Department for Transport and the UK Department for Business, Innovation and Skills.

²³ UNEP (2009), From Conflict to Peacebuilding – the Role of Natural Resources and the Environment.

In order to support the expansion of global supply of minerals over the coming years, European countries could work to increase investments into the conventional mining sector and invest systematically into R&D for the resource extraction technologies of the future. In a highly cyclical industry with long lead times which often operates in countries with limited infrastructure and weak institutional frameworks, investments from the private sector are often suboptimal. This is particularly the case for high-tech metals. Public support for ensuring adequate investment levels into the production of metals with strategic importance for European industries is therefore crucial. Such investment support could take place e.g. through public-private partnerships in FDI or loan guarantees. As large, easily accessible deposits of high ore-grades are being exhausted, there is also no denial that expanding supplies of minerals throughout the 21st century will demand orientation towards new resource frontiers. Examples of such frontiers are ultra-deep mining or deep-sea mining, but also advanced refining technologies that allow processing lower ore-grades. Europe could contribute to such cutting-edge technologies.

Finally, Europe could also do more to ensure that global markets provide continuity and reliable access to critical mineral supplies at fair and transparent prices. In our view, a firm and united European position on these issues should be actively promoted in multilateral fora like the WTO, OECD, or the G-20, and issues of access and supply should be treated in multilateral settings rather than at the bilateral level. Pursuing transparency in pricing and the encouragement of a stable and predictable regulatory environment in key producer countries, most notably China, are also needed.

Until now, the European Union's policy response to this issue has been relatively slow and hesitant. The UK, Germany, and France have made some steps towards defining critical mineral resources for their industries and some Nordic countries have sought to harmonize their development policy with mining interests.²⁴ Also mineral scarcity has been addressed in some policy documents on natural resource scarcity e.g. in the UK or the Netherlands.²⁵ But in general the issue has been low on the European and most member states' policy agenda. A notable exception to this has been the Raw Materials Initiative of the European Commission that has sought to bring the issue of critical raw materials to the fore and is particularly focused on the issue of high-tech metals.²⁶ Figure 7 summarizes the comprehensive policy recommendations of the Raw Materials Initiative for the European Commission, individual Member States and the European industries, which overlap considerably with the recommendations made above. The EU has also recently launched a multi-year research project on natural resource scarcity under its Seventh Framework program. In this so-called POLINARES project, 12 European knowledge institutions cooperate in developing guidelines for European Policy on Natural Resources.²⁷

²⁴ For Germany see M. Frondel, G. Angerer et al. (2007), Trends der Angebots- und Nachfragesituation bei mineralischen Rohstoffen, RWI Essen, ISI, BGR; for France see C. Hocquard (2008), "Les nouveaux matériaux stratégiques, métaux high tech, métaux verts, vers une convergence," Mag'Mat, No. 26; Oakdene Hollins (2008), Material Security. Ensuring Resource Availability for the UK Economy. Chester: C-Tech Innovation Ltd; for Nordic initiatives on mining and development see Global Uttmaning, Raw Materials Group (2009), Mining for Development a Preparatory Study.

²⁵ For the Netherlands see Projectgroep Schaarste en Transitie (2009) Schaarste en transitie: kennisvragen voor toekomstig beleid, Dutch Ministry of Foreign Affairs, Dutch Ministry of Housing, Spatial Planning and the Environment. For the UK see HM Treasury (2008), Global Commodities: A long-term vision for stable secure and sustainable global markets, London: Crown.

²⁶ EU Commission(2008), Communication from the Commission to the European Parliament and the Council: The Raw Materials Initiative—Meeting Our Critical Needs for Growth and Jobs in Europe, Brussels.

²⁷ More information on POLINARES can be found at the project website: www.polinares.eu

Pillar	Policy Recommendations	Level of Response
First: Undistorted Access to Raw Materials	Identify/ define critical raw materials	European Commission (EC), Member States (MS), Industry
	include provisions on access to raw materials in bi/multilateral trade agreements	EC, MS
	launch EU raw material diplomacy with resource rich countries	EC, MS
	identify & challenge trade distortion measures taken by third countries	EC, MS, Industry
	issue yearly progress reports on the implementation of trade aspects	EC, MS, Industry
	promote sustainable access to raw materials in development policy	EC, MS
Second: Regulatory Framework Conditions	exchange best practices in land use planning and administration of exploration/ extraction	MS
	develop guidelines on reconciliation of extraction activities in areas with environmental protection	EC
	promote skills and focused research on innovative exploration & extraction technologies	EC, MS, Industry
	encourage better networking between national geological surveys	MS
Third: Resource Efficiency & Reduction of EU primary raw material consumption	foster substitution of raw materials	EC, MS, Industry
	promote recycling	EC, MS, Industry
	facilitate the use of secondary raw materials	EC, MS, Industry

Figure 7 The EU Commission's Raw Materials Initiative²⁸

In our view, the European Union and member states governments should seek to move swiftly to address this issue and create more situational awareness amongst policy-makers, business leaders and the public. Mineral markets, especially those for high-tech metals must be more closely monitored and no-regret policy options, such as moving towards increased recycling, should be vigorously pursued. Creating a more cohesive joint European position on the issue of mineral scarcity and coordinating national policy response at the European level should be made an urgent priority. The EU Raw Materials Initiative provides an excellent forum and numerous concrete recommendations on how to address mineral scarcity.

²⁸ HCSS, based on EU Commission (2008), Communication from the Commission to the European Parliament and the Council: The Raw Materials Initiative—Meeting Our Critical Needs for Growth and Jobs in Europe, Brussels.