Resource Security Risks in Perspective

Complexity and Nuance

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Access to resources has become an issue which has gained much political and public attention in recent years, as resource markets have become tighter. This paper is the second of a twin briefing paper on the debate surrounding security of energy and mineral resources. The first paper provided a critical analysis of the 'critical minerals' approach and identified several underlying fundamental concerns.[2] This second paper elaborates on this analysis and is divided into the following four parts:

Part I: Assessing Major Risks and Debunking Some Misconceptions,
Part II: Access to Resources, Prices and Competitiveness,
Part III: Confidence in Global Markets – Entering a New Era? and
Part IV: Thinking about Policy Responses to Resource Security Issues.

Part I addresses some misconceptions related to resource security while placing some other concerns in a more nuanced perspective. Several case studies are discussed, both contemporary (such as China and rare earths) and historical (such as the cobalt crisis in the late 1970s). Part II addresses specific concerns related to prices, pricing mechanisms and competitiveness, while the third part discusses several concerns relating to the functioning of global markets. The fourth and final part discusses policy responses.

While there are certainly valid fundamental concerns related to a dependency on imported energy and mineral resources, a balanced view is often missing in the debate. This paper tries to provide that balanced approach.

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[2] See: *Critical Thinking about Critical Minerals: Assessing Risks Related to Resource Security,* 2011, CIEP-BGR joint Briefing Paper, 2011. Available online at: www.clingendael.nl/ciep.

Introduction

The previous (first) briefing paper noted how contemporary concerns regarding resource security have strong historical parallels. Not only have the fundamental concerns related to import dependency on energy and mineral resources remained essentially the same, but also the subsequent analysis and proposed policy measures are very similar to the debate on resource security which took place in the 1970s and 1980s.

In addition, the paper analysed criticality studies for minerals. This brought forward a number of shortcomings, namely that these studies:

- Lack predictive power beyond the short term,
- Easily overstate the economic impact of a possible supply disruption of 'critical' minerals,
- Fail to distinguish between short-term and long-term problems,
- Insufficiently take into account the diversity and particular characteristics of the resource markets that are analysed, and
- Focus exclusively on risks related to the mining and export of raw materials but disregard the larger production chain (e.g. refining, transport, and trade in semi-products).

Overall, this led to the conclusion that criticality studies should be interpreted with caution if used to guide future policy and have only a limited use as a foundation for longer-term resource security strategies.[3]

The first briefing paper further identified four major concerns related to resource security, which also underlie the analysis of the criticality studies:

(1) Accidental supply disruptions or price hikes,
(2) Intentional supply disruptions by the use of exports or pricing as a political instrument,
(3) Unequal market conditions causing an uneven economic playing field, and
(4) Governance issues related to the resource sector.

Finally, the first briefing paper called for a deeper understanding of how resource markets function and insight into their diversity and complexity.

This second briefing paper will highlight some of the issues which play an important role in the resource security debate. A number of concerns will be analysed more in-depth, including some which tend to be overemphasised by mineral criticality studies, such as:

- The role of dominant producers and related risks,
- The risk of politically motivated supply disruptions and their longer-term effects, and
- The economic impact of short-term supply disruptions.

As mentioned above, the paper will start by debunking some of the persistent misconceptions in the resource security debate and placing other concerns in an appropriate perspective. The second part will address issues related to access to resources, pricing and competitiveness, as these are especially significant concerns which recur in the debate. The third part deals with concerns related to the functioning of global markets. The last part is then is devoted to discussing policy solutions.

[3] "[H]aving a short-list of minerals might raise a false sense of certainty that it are these minerals – and not others – that will be a problem in coming years and decades, whereas that is still highly dependent upon political, economic and technological developments which are very hard to predict. It seems wise not to hide or neglect this uncertainty but rather incorporate it into the approach of policy solutions, as this might very well influence what can be considered the best strategy on resource security." *Critical Thinking about Critical Minerals. Assessing Risks Related to Resource Security,* 2011, CIEP-BGR Joint Briefing Paper, 2011. Available online at: www.clingendael.nl/ciep.

Part I: Assessing Major Risks and Debunking Some Misconceptions

In the resource security debate, there are a number of issues that often confuse the assessment of potential risks. Moreover, as noted in the first briefing paper, some of the fears regarding resource availability seem to be caused by misconceptions about the functioning, complexity and diversity of resource markets. We will address a number of these issues in the following sections.

Concerns about Depletion: The Dynamics of Resource Reserves

Concerns about the imminent threat of absolute resource depletion, e.g. as held by 'peak oil' or 'peak mineral' theorists, have been long debated and are addressed extensively in the literature.[4] The crucial observation to be made is that reserve statistics are dynamic: 'reserves' are those resource concentrations which companies have proven they can profitably extract given the legal provisions, extractive and processing technologies, and prices of a certain moment. Hence, reserves are a function of these factors. In the words of Michael Shafer:

"Total world reserves, in other words, are anything but what the term implies."[5]

An overview of the historical development of the reserve-production (R/P) ratios of the main energy fuels and minerals shows that they have not followed a threatening decline but rather have consistently hovered at levels allowing production to continue at least a couple of decades into the future. Figure 1 shows this using oil as an example, while Figure 2 shows the historical development of the production, reserves and R/P ratios for some minerals. The reasons for this can be explained as follows:

"Reserves are created through detailed mapping of promising resources, and can be seen as a capital equipment resulting from costly investments in exploration. A firm in the mineral or fossil fuel business will invest only so much in exploration as is required to maintain an adequate buffer of reserves to permit efficient planning of its operations. It will not create reserves beyond this level for the same reason that it will not invest in equipment over and above its current needs at any point in time. Investments in resource industries have extended gestation periods. With growing output, a stock of reserves corresponding to 30 years of present output will last for the next 15-20 years' activity, which is adequate for the resource firm's planning operation. Investments in exploration will be undertaken only when exploitation has reduced remaining reserves below the desirable level. Investments in reserves above this level are not economical and will not be undertaken by profit maximizing firms."[6]

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[4] See also two working papers (nos. 6 and 7) published as part of the EU FP7 POLINARES project: Patrick Criqui and Sylvain Rossiaud, 'Peak Oil: Myth or "Impending Doom"?' and Magnus Ericsson and Patrik Söderholm, 'Mineral Depletion and Peak Production', both September 2010. Available online at: http://www.polinares.eu/docs/d1-1/polinares_wp1_peak_debates_oil.pdf and http://www.polinares.eu/docs/d1-1/polinares_wp1_peak_debates_minerals.pdf.

[5] Michael Shafer, 'Mineral Myths', *Foreign Policy*, vol. 47, 1982.

[6] Marian Radetzki, 'Is Resource Depletion a Threat to Human Progress? Oil and Other Critical Exhaustible Materials', 2002. Similarly: "Mining companies normally only invest what they require for their short-term needs to prove reserves and thus to justify commercial investment decisions over a period of, say, 20 years. They don't necessarily aim at proving the full ore body. There is no indication that the extractive industry would fail to continue to maintain this record." quoted from: European Commission, *Critical Raw Materials for the EU*, Report of the Ad-hoc Working Group on Defining Critical Raw Materials, 30 July 2010, p. 16.

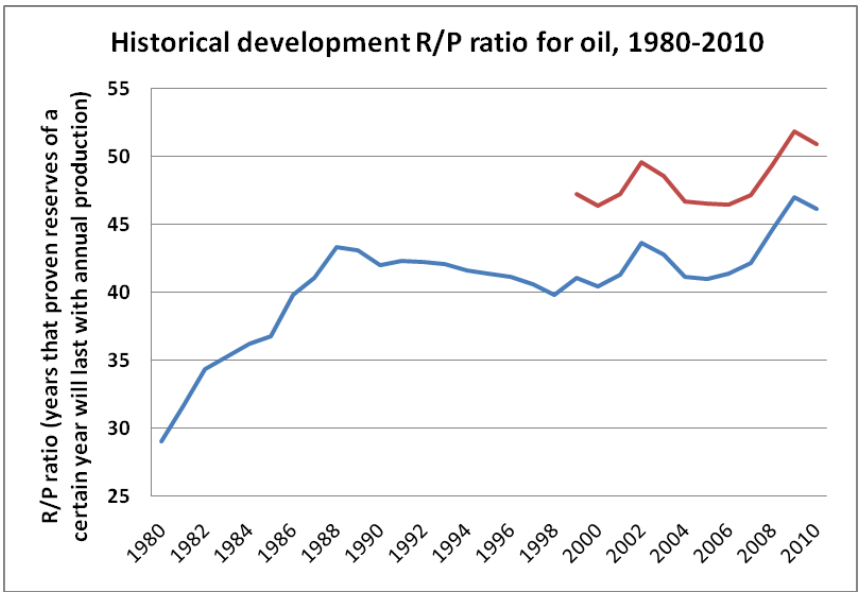

Figure 1. Historical development of the R/P ratio for oil, 1980-2010. The red line shows the jump in total reserves when the Canadian tar sands were added to the statistics in 1999 (given as a separate entry). Source: *BP Statistical Review of World Energy 2011*, June 2011.

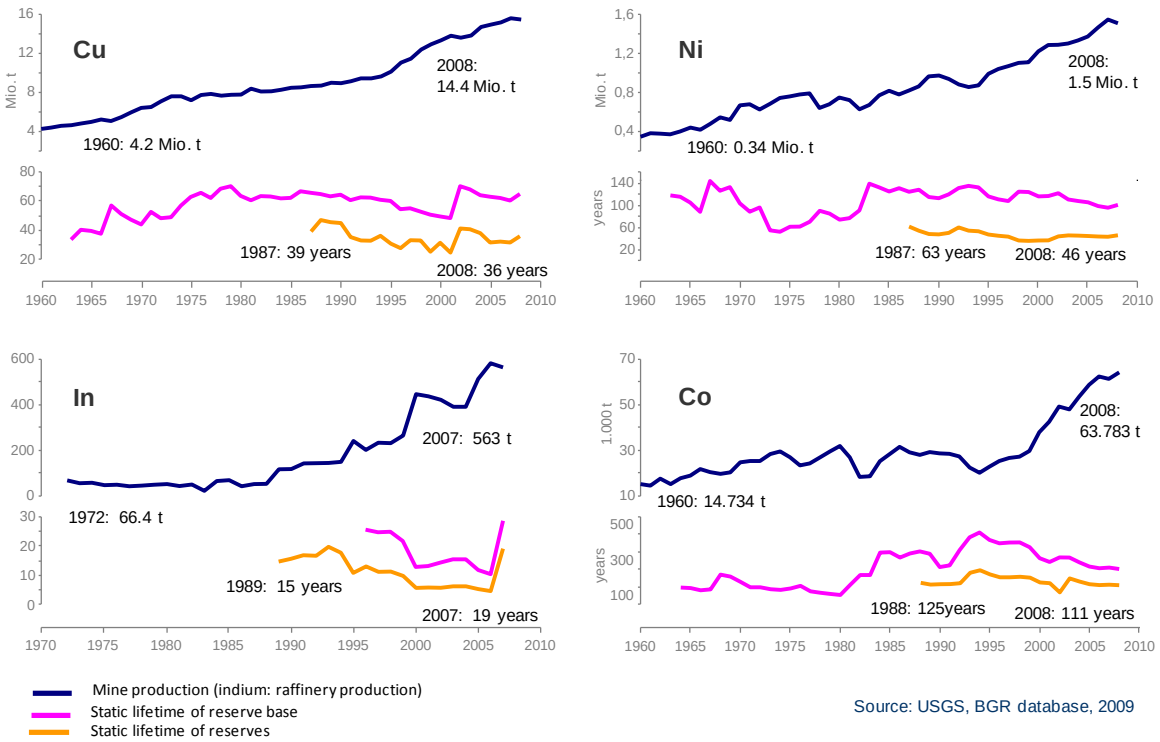

Figure 2. Long-term availability of copper, nickel, indium and cobalt reserves in relation to global production.

Without going into this debate further here, we would like to cite two examples which illustrate the discussion quite well, taken from Marian Radetzki[7]:

- In 1866 a leading British economist, Stanley Jevons, wrote an influential study called *The Coal Question*, forecasting the exhaustion of Great Britain's coal reserves at the then-prevailing rates of consumption, which would force society to either accept a lower welfare growth level or face a crisis caused by a scarcity of coal. He arrived at his conclusion based on the rapid and unprecedented growth of coal consumption (due to the Industrial Revolution) and an estimate of how much coal could be produced, based on the capabilities of that time (e.g. depth of mines, quality of ore deposits, etc.). As is known now, the question of coal depletion never emerged as a problem for Great Britain's economic development. In fact, coal production increased greatly due to improved extraction technologies; and even so, domestic coal was gradually replaced in the second half of the 20th century as it became economically less competitive compared to other energy sources such as oil and gas and to coal imported from other countries where deposits were cheaper to extract.
- The Club of Rome predicted in 1972 that copper reserves would be insufficient to accommodate growing demand, even when taking into account some reserve growth. One of the factors considered explicitly was projections about the amount of copper required to provide every Chinese household with a (copper) telephone line. There are two key observations to be made here. First, copper reserves have been hugely expanded, as the mining of less rich copper ores has become economically profitable due to copper prices, new mining techniques and scientific advances in copper exploration.[8] The second is the aspect of technological leapfrogging: Chinese households have turned out not to be in need of enormous amounts of copper for telephone lines, due to the invention of glass fibre cables and mobile telephones.

These examples illustrate a few elementary observations that are very relevant for the debate about resource security and potential scarcities:

- It is extremely difficult to predict technological progress and innovation, as well as future supply and demand levels.
- Substitution and relative demand reduction will inevitably take place for resources for which supply is constrained.
- Depletion does not play a role in the resource sector in an absolute geological sense. Rather, because resources might become harder to find and to extract, an indirect price impact might influence the economic competitiveness of substitutes and drive resource efficiency.

[7] Marian Radetzki, 'Is Resource Depletion a Threat to Human Progress? Oil and Other Critical Exhaustible Materials', Energy Sustainable Development – A Challenge for the New Century (Energex2002), Mineral and Energy Economy Research Institute, Polish Academy of Sciences, Krakow, 2002. Available online at: http://www.dundee.ac.uk/cepmlp/journal/html/vol10/article10-9.html.

[8] With respect to copper exploration, the concept of plate tectonics led to a new understanding of ore deposit genesis and subsequently resulted in new discoveries.

Concerns about Dominant Producers in the Resource Sector: Fundamental or Not?

Criticality studies focus strongly on situations in which the production of a certain resource is concentrated in only a very limited number of countries.[9] A few comments should be stated about this methodology.

First of all, the question can be raised as to whether the concentration of resource production (or exports) in only a limited number of *companies* should not receive attention equal to that given to production concentration in a few *countries*, in terms of political risk analysis.[10]

Second, market size should be taken into account: for resource markets with small overall volumes and little total production capacity, producer dominance and high price volatility are much more likely. Our discussion of reserve dynamics indicated that companies extracting energy or mineral resources will only invest in the exploration and proving of reserves when commercial circumstances require it and when the economics (e.g. projected profitability) for doing so are right.[11] As a consequence, some cases of highly concentrated reserves or production in certain countries are more fundamental than others.

One key example is oil. Of all energy and mineral resources, the exploration for oil reserves has probably been the most extensive. Consequently, the current predominance of the Middle East in terms of oil reserves is a reality which is extremely unlikely to be overturned by new finds. New reserve additions often include more costly options, such as deep water oil fields, extra-heavy oil deposits or unconventional oil such as tar sands. The geopolitical implication of this is that the world will have to adjust to a major and increasing dominance of the Middle East in the oil market or be willing to pay a premium for diversifying toward production from other sources.

In contrast, the various small 'niche'-like markets for specific technology minerals provide a very different picture. The European Commission report *Critical Raw Materials for the EU* already remarks: "Even the discovery of a single new deposit may have a major impact on global reserves and production of a number of commodities."[12]

An example case is lithium. Lithium is of yet still a rather small market, having a global annual production of circa 24,300 metric tonnes in 2008. Chile has emerged as the leading producer of

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[9] Often measured using the Herfindahl–Hirschman Index (HHI) for company concentration.

[10] These two factors may coincide, but this is not always the case. One resource market that springs to mind is the iron ore market, in which about half of all global production is traded (exported), but in which the largest iron ore companies (the "Big Three": Vale, Rio Tinto and BHP Billiton) control more than 35% of global production and 61% of the world's seaborne trade of iron ore. UNCTAD*, Iron Ore Market 2009-2011 (Abstract)*, 2009. However, it should be noted that such a company concentration does not necessarily imply that there is no economic competition taking place in the market.

[11] In fact, for the country production concentration analysis of small resource markets, over the course of a decade or so one often sees the HH-index suddenly making big drops or jumps, coinciding with the opening or closing of one or more new production facilities at certain locations. Hence, it should be understood that the index gives only a very temporary snapshot. This 'variability' of the HH-index is, however, much smaller for large resource markets (e.g. base metals), in which the impact of one new production facility upon the overall market is much smaller.

[12] European Commission, *Critical Raw Materials for the EU*, Report of the Ad-hoc Working Group on Defining Critical Raw Materials, 30 July 2010, p. 16. Available online at: http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/report-b_en.pdf.

lithium (10,600 tonnes in 2008) and has more than half of all proven lithium reserves.[13] If we look at available lithium *resources* (i.e., known mineral concentrations which are not (yet) proven to be economically extractable, given current prices and technology), Bolivia surpasses Chile as the country with the largest potential for producing lithium. The rapidly rising demand for lithium due to lithium-ion batteries associated with modern electronics and electric vehicles has led to some concern about lithium availability in relation to the potential future dependence upon these countries.[14] However, for a relatively small and developing resource market such as lithium, this dominance in terms of resources, reserves and production is not set in stone. The huge discoveries in Chile and Bolivia and the likely cost-competitiveness of their exploitation make it less attractive for mining companies to invest in global exploration for lithium, but as soon as economic and political conditions provide an incentive, this balance could change substantially.

CASE STUDY: China's Dominance in the Rare-Earth Market

An even more extreme example is the dominance of China in the production of rare earths. The fact that China currently produces more than 95% of the world's rare earths is in no way structural and hence might pose only a very temporary 'threat'. The enormous amount of attention for this issue thus warrants some critical analysis.

The first misnomer is that rare earths are by no means geologically 'rare'; China has only about one-third of the world's proven reserves, though this might be extended in future. Second, since the market is so extremely small, the production coming from a single mine can already make a big difference in the global supply balance. In general, if there are only a few mines in operation, this

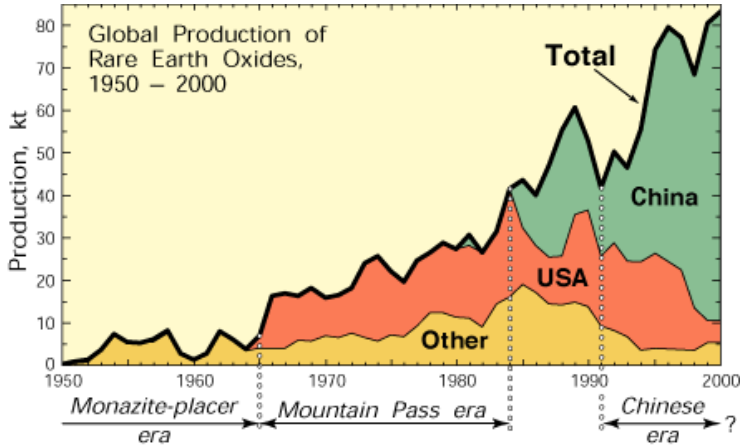

Figure 3. Global rare earth element production from 1950 through 2000.
Source: US Geological Survey, *Rare Earth Elements – Critical Resources for High Technology*, Fact Sheet 087-02, last updated May 2005. Available online at: http://pubs.usgs.gov/fs/2002/fs087-02/.

[13] US Geological Survey, *Mineral Commodity Summary - Lithium*, 2011. Available online at: http://minerals.usgs.gov/minerals/pubs/commodity/lithium/mcs-2011-lithi.pdf.

[14] Two illustrative examples: *A Cleantech Resource Crisis? Will Rare Earth and Lithium Availability Thwart Cleantech Growth?,* CleanTech Insight, January 2010. Available online at: http://www.tremcenter.org/index.php?option=com_attachments&task=download&id=2; William Tahil, *The Trouble With Lithium. Implications of Future PHEV Production for Lithium Demand,* Meridian International Research, December 2006. Available online at: http://tyler.blogware.com/lithium_shortage.pdf.

can easily lead to alarmingly high production concentration statistics. In China, for instance, the Bayan Obo deposit accounts for the majority of its rare-earth reserves.[15] However, this balance might be quick to shift, as it has in the past. In fact, the United States used to have a very dominant position in rare-earth production: the Mountain Pass rare-earth mine in California, which is now being brought in production by Molycorp again, was responsible for more than 70% of the global supply of rare earths from the mid-1960s to the early 1980s (see Figure 3).

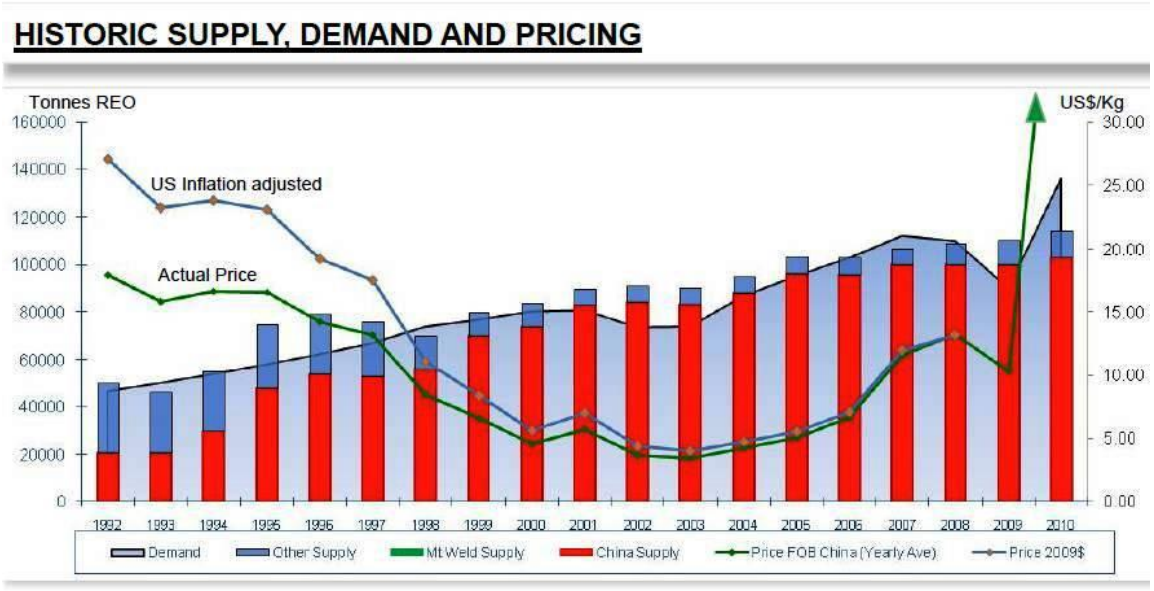

Figure 4. Historic Supply, Demand and Pricing of Rare-Earth Oxides.
Source: Lynas Corporation, 2011. Available online at:
http://www.lynascorp.com/page.asp?category_id=1&page_id=25.

It should be emphasised that China gained its near monopoly because it was able to produce rare earths at a lower cost than the US or other sources, pointing to the important role of the economic factors underlying the developments in the resource sector. In fact, prices had never before been so low, and for about a decade China provided the market with very inexpensive rare earths (see Figure 4 by Lynas Corporation). The lack of environmental legislation and cheap labour made possible the mining of rare earths in China at very low costs. As a consequence, production from the US and a few other sources were undercut by the Chinese, and gradually a near monopoly was reached.

The recent political upheaval surrounding China's control over rare-earth production has two main reasons:

- First, China has limited the export of the rare earths to other countries by means of export quota, causing considerable tightness in the rare-earth market.
- Second, reportedly China halted rare-earth exports to Japan for a brief period, following a dispute between China and Japan over the East China Sea.

[15] European Commission, *Critical Raw Materials for the EU*, Report of the Ad-hoc Working Group on Defining Critical Raw Materials, 30 July 2010, p. 16. Available online at:
http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/report-b_en.pdf.

The apparent willingness to use its control over rare-earth production for political purposes has sparked major concerns worldwide about China's dependency over its rare-earth exports. Second, the export restrictions are creating an unfair competitive advantage for those producers within China, where domestic rare-earth prices can be lower than international prices.[16] It is also seen as an attempt to capture more rents along the value chain, as manufacturers dependent upon rare earths for their products have no choice but to relocate to China if they want to benefit from a steady and affordable supply of rare earths.

However, if such strategic considerations underlie China's actions in the rare-earth sector, it is very doubtful as to whether they will be successful in the longer term. Although in the mineral sector the lead times for bringing alternative sources of supply online can often take 5 to 10 years, in the case of rare earths some mines are already in an advanced stage of pre-production. Apart from the Mountain Pass mine in the US mentioned above, there are several mines in Australia (Mount Weld and possibly Nolans and Dubbo Zirconia) and Canada (Hoidas Lake and Thor Lake) which could very well come on-stream within 5 years, allowing diversification of supplies to take place.[17] Further investments in Vietnam and Mongolia – mainly by Japan – could provide means for diversification in the longer term.

On the technology side, despite the difficulties in the short term of finding substitutes for rare earths for applications such as batteries and magnets, research is being conducted toward improved resource efficiency, conservation and recycling, which might lead to substitutes and a relative decrease in demand in the medium term.[18]

All these processes of diversification and research into substitutes, resource efficiency and recycling options have only been accelerated by increased government support following Chinese interventions in the rare-earth market.

Using Resources as a Strategic Political Tool: Some Considerations on Effect and Effectiveness

With regard to embargoes and politically motivated supply disruptions, commentators often neglect the fact that such policies would be very detrimental to the party issuing the embargo.[19] It would lead to a drop in export revenues and stimulate substitution technologies, resource efficiency and import diversification. The example of the Arab oil embargo in 1973 vividly exemplifies this. Although its impact was widely felt, it also provoked a number of reactions which weakened the position of the countries issuing the embargo. First of all, the oil crisis incentivised major energy efficiency gains in the European energy system, reducing the demand for oil. Second, major

[16] It remains difficult to ascertain the exact price differential, however, as not all contracted prices are publicly available.
[17] See Chapter 5 on 'Supply' in: Oakdene Hollins, *Lanthanide Resources and Alternatives,* May 2010. Available online at: http://www.medallionresources.com/i/pdf/UK%20gov%20commissioned%20REE%20report.pdf.
[18] MIT Technology Review, 'New Magnets Could Solve Our Rare-Earth Problems', 20 January 2011. Available online at: http://www.technologyreview.com/energy/27112/page1/. Oakdene Hollins, *Lanthanide Resources and Alternatives,* May 2010. Available online at: http://www.medallionresources.com/i/pdf/UK%20gov%20commissioned%20REE%20report.pdf.
[19] "Basically, embargo actions do not make economic sense in terms of revenue objectives of producers of critical materials. Economic interest argues for selling at a high price, rather than denying the product altogether. An embargo is therefore likely to be undertaken only for political reasons." Quote taken from: Study Prepared by the Ad Hoc Inter-Agency Group on Critical Imported Materials, National Security Study Memoranda 197 (July 1974). Available online at: http://history.state.gov/historicaldocuments/frus1969-76v31/media/pdf/frus1969-76v31.pdf.

diversification efforts were undertaken and the North Sea emerged as a significant oil-producing region. Third, substitution took place in some sectors where this was possible.[20]

Currently, it seems very unlikely that major oil-exporting countries would issue an embargo similar to the 1973 oil embargo, not least because there is a strong awareness that this would be detrimental to their own long-term interests. Furthermore, during the tight market conditions in the run-up to 2008, significant consumer-producer dialogue took place, and the role of OPEC as a stabilising factor in the oil market through its mitigation of the more extreme price swings during that period was welcomed by many.

Similarly, the export restrictions which have currently been issued in China on rare earths run counter to economic logic, making them difficult to enforce. As the Chinese rare-earth industry is not yet strongly regulated, the smuggling of rare earths out of China is substantial, accounting for up to one-third of Chinese supplies according to some sources.[21]

Finally, on the issue of establishing cartels to control prices and use market power to maximise profits, history has shown that the establishment of a well-functioning cartel is no easy feat. The difficulty in maintaining quota discipline within OPEC – the prime example for any resource sector cartel – is already telling. Different interests among participating members and an inherent free-rider problem make the effective functioning of a cartel in a global market quite difficult.[22] Historically there have been a number of attempts to establish cartels in the mineral (mining) sector, but these have all failed.[23] Concerning natural gas, the establishment of the Gas Exporting Countries Forum (GECF) has received quite some attention, but whether this will develop into a strong coordinating body remains to be seen.[24]

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[20] The concern about oil supplies and energy security in general was a major incentive for the development of nuclear power in the 1970s. As another illustrative example, it was the oil embargo that actually caused France to change its development of high-speed rail towards electric trains rather than gas-turbine driven trains.

[21] China Energy Net (China5e), '稀土出口商揭走私那些事 成熟"产业链"催生暴利', 21 October 2010; Xinhua, 'China Mulls Plans to Curb Rare Earth Smuggling', 14 September 2009.

[22] The free-rider problem consists of the fact that if all cartel members restrict their output, thus ensuring a high market price, there is always a temptation for an individual cartel member to sell more volume to profit from the high market price.

[23] "Cartels – true cartels (combines which regulate amounts marketed) are not the heart of our problem. They have been rare in the minerals field and virtually all unsuccessful because of conflicting producer economic objectives and substitution of other products by consumers. Some producers of a few minerals have attempted to maintain a producer price, but awareness of long-term supply and demand responses has generally deterred large and precipitate price increases." Quote taken from: Study Prepared by the Ad Hoc Inter-Agency Group on Critical Imported Materials, National Security Study Memoranda 197 (1974). Available online at:
http://history.state.gov/historicaldocuments/frus1969-76v31/media/pdf/frus1969-76v31.pdf.
David Humphreys, 'Minerals: Industry History and Fault Lines of Conflict', Polinares Working Paper, September 2010, p. 9: "Perhaps not surprisingly, there was also much talk at the time amongst developing countries of seeking to follow OPEC's example in oil and form producer cartels as a means to force up mineral prices. While associations of producers and exporters were set up during late 1960s and early 1970s for all kinds of commodities including copper, iron ore, bauxite, phosphates, mercury, tungsten and silver, these never had the internal disciplines or the market coverage to give them real political leverage or to have a material impact on market prices." (Crowson 2003).

[24] Timothy Boon von Ochssée, *The Dynamics of Gas Supply Coordination in a New World*, The Hague, Clingendael International Energy Programme, July 2010. Available online at:
http://www.clingendael.nl/publications/2010/20100622_dissertation_CIEP_Tim%20Boon%20von%20Ochssee.pdf.

Concerns about the Economic Impact of a Supply Disruption

Apart from supply risks, the other main factor taken into account in criticality studies is the economic impact of a potential (short-term) supply disruption. It is important to realise that there is no straightforward way or standard methodology of calculating such an impact. Second, it is important to differentiate between the impact of very high prices, making the resource unaffordable for some users, and actual physical scarcity of supplies, leading to the resource being unavailable to some consumers even though they are willing to pay high prices for it.

Furthermore, when looking at the potential impact of a supply disruption, it is necessary to distinguish between energy and mineral resources. The key example, of course, is oil. For a resource so fundamental to the functioning of modern society, a supply disruption has severe consequences, as illustrated by the oil crises of the 1970s. For Europe the impacts of a gas supply disruption were also borne out in 2006 and 2009 due to the dispute over gas prices between Russia and Ukraine, which led to a shortfall of supplies to Europe.[25] For other energy resources, such as coal and uranium, the risk of supply disruptions has been minimal. In the unlikely case of a disruption, the impact would be mitigated by stockpiles (which for both of these resources are easier to keep than oil or gas) and a diversified market of suppliers that might step up production.

For minerals, the impact of a temporary supply disruption is much less clear and immediate. First of all, concerning oil and gas, consumption is concentrated in a few sectors: transport, the petrochemicals industry, power generation and household heating. This is not the case for many minerals, which are much more broadly used throughout the economy. Copper is a prime example of this, with very diversified end-uses. For many minerals the complete value chain leading from the raw material, through various refining, processing, half-product and component stages, into a final product is very complex and globalised.[26] As a consequence, the effect of extreme price spikes or supply shortages on the overall economy is difficult to analyse.[27] In addition, the potential for reducing demand by improving resource efficiency, recycling, substitution and other means cannot be clearly estimated for all these uses in all different sectors of economic activity. In other words, it is the sheer complexity of our economy which makes a clear assessment of the impact very tough.

For other minerals, such as technology-driven minerals (rare earths required for batteries and permanent magnets being a good example), end-uses can be more clearly identified. In these cases, the volumes required are very small but nevertheless typically essential to the manufacturing of products with certain special physical properties.

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[25] In total (via all routes), Russian supplies account for about one-quarter of European gas consumption. Pierre Noël, 'How Dependent is Europe on Russian Gas?', EU Policy Blog, 18 November 2008. Available online at: http://www.energypolicyblog.com/2008/11/18/how-dependent-is-europe-on-russian-gas/.

[26] E.g.: "(…) the fragmentation of the production chain implies that several stages of production are undertaken in different countries and at least half of traded goods are intermediate products (semi-finished, parts and components, etc.) destined to industrial demand." Armando Rungi, *From Export Dependency to Dynamic Comparative Advantages,* POLINARES Working Paper no. 10, September 2010, p. 5. Available online at: http://www.polinares.eu/docs/d1-1/polinares_wp1_export_dependency.pdf.

[27] The earthquake and tsunami disaster in Japan provides another recent example showing how difficult it is to identify the exact effects of a major disruption on the global supply chain: "(..) the regional supply chain network is much more complex than a simple flow of intermediate goods from Japan to China for assembly and export to the US and Europe. Exports of Thai intermediate goods to China grew quadrupled in the past decade and those from Malaysia grew five-fold. Most of these were used in making the same goods for which Japan also supplied components. The impact of disruption to such a complex network is hard to estimate." 'Chart of the week: Japan, supply chain, and earthquake disruption', *Financial Times,* 22 March 2011. In the end, the disruption for global businesses turned out to be less severe than was feared at first.

However, for such 'technology minerals' and end-uses, the impact of a short-term supply disruption or price spike might not be as disastrous as is often portrayed. First of all, there are often significant private company stockpiles of such essential feedstock materials which mitigate the impact of any sudden supply disruption. For example, in the case of China's temporary halt of rare-earth exports to Japan, the real industrial economic impact was actually very limited. At the end of 2010 global company stockpiles of rare earths were considered to be enough to cover approximately one year of worldwide demand[28] and to date not a single factory in Japan has been reported to have stopped production because of insufficient supplies. Second, in the case of a price hike, there is leeway for paying higher prices, as the fraction of the cost of technology minerals relative to the end product is often minimal. If one thinks of bulk materials or energy resources, a quadrupling of prices would have a devastating impact, but these shocks are fairly common for such small markets from a historical perspective.

If we acknowledge that no supply disruption of minerals or other raw materials would have a similarly enormous impact as would a supply disruption of oil, what can we expect to happen in the case of such disruptions?

It is worthwhile to review a few historical studies on the possible impact of supply disruptions for minerals. In 1974, under the Nixon Administration, the report *Critical Imported Materials: Study of Ad Hoc Group Established by NSSM 197/CIEPSM 33* examined 19 major industrial raw materials and found bauxite, platinum and chromium to warrant extra attention. Yet overall, it concluded the following:

"Some risk exists with regard to a few of the other 16 materials examined. Under currently foreseeable circumstances, however, market forces, with all their imperfections, appear adequate to deter price gouging or cartel-like action for all 16 materials. For none of the critical materials would the economic effect of price increases approach that for oil in 1973-74. Our petroleum imports amounted to $7.5 billion in 1973, or 11% of our imports, compared to $0.7 billion (about 1%) for iron ore, the most important critical industrial raw material outside the energy field. If oil prices and the import volume remain constant throughout the year, our oil import bill will increase $16 billion, causing nearly a 25% hike in our overall import cost. A similar price increase for iron ore would raise our overall import cost by only 2%." [29]

Further, the paper on mineral industry history by David Humphreys, written as part of the EU FP7 POLINARES project, mentions:

"Few commodities are really that scarce in nature, and there are few examples that one can point to in history where shortages of minerals have precipitated major economic problems."[30]

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[28] As per discussions at the conference "Rare Earths, Europe and Australia: Trade, Security and Sustainability", held at the Dutch Ministry of Foreign Affairs, (co-)organised by The Hague Centre for Strategic Studies, 1 December 2010.

[29] *Critical Imported Materials: Study of Ad Hoc Group Established by NSSM 197/CIEPSM 33,* US Government (Nixon Administration), July 1974. Available at the US Bureau of Public Affairs, Office of the Historian, "Foreign Relations of the United States, 1969-1976, Volume XXXI, Foreign Economic Policy, 1973-1976", available online at: http://history.state.gov/historicaldocuments/frus1969-76v31.

[30] David Humphreys, "Minerals: Industry History and Fault Lines of Conflict", EU FP7 Polinares Working Paper, September 2010, p. 21. Available online at: http://www.polinares.eu/docs/d1-1/polinares_wp1_history_minerals.pdf.

What about the impact of a supply disruption of a technology mineral that is considered critical? A very interesting case study is provided by cobalt, which was identified as a critical mineral in almost all criticality studies in the 1970s and '80s because of its use in defence-related technologies, such as jet engines and turbines.

CASE STUDY – The Cobalt Crisis in the 1970s

There was a major disruption in the supply of cobalt in the late 1970s, caused by the civil war in the Shaba region of Zaire (now the Democratic Republic of Congo), which caused the halt of circa two-thirds of the world supply of cobalt at that time and a major price spike (see Figure 5).[31] The report *Cobalt: Policy Options for a Strategic Mineral* by the Congressional Budget Office (CBO) of the United States in 1982 provides a fascinating insight in this historical case study:[32]

"From 1977 through 1979, the price per pound of imported cobalt rose from approximately $5.50 to approximately $25.00; spot prices as high as $50.00 per pound were recorded, and cobalt was in short supply. These price increases were fueled by war in the Shaba region of Zaire, which, although only shutting down cobalt production for a short time, caused increases in worldwide private stockpiling. A simultaneous peaking of cobalt use in many Western nations, and the cessation of cobalt sales from the U.S. strategic stockpile (see below), allowed Zaire, the world's primary supplier and acknowledged price setter, to execute this substantial price increase."

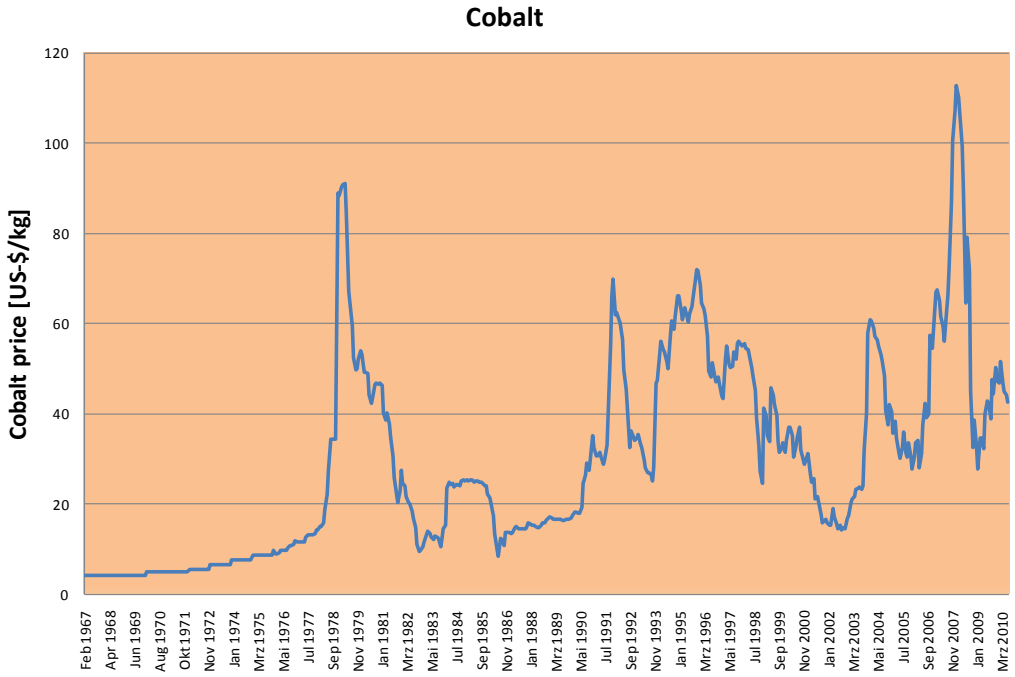

Figure 5. Development of cobalt prices over the last decades (1967-2010) with the sharp price increase in the late '70s caused by the Shaba crisis. Source: BGR, 2011.

[31] Oakdene Hollins, *Material Security: Ensuring Resource Availability for the UK Economy*, March 2008, p. 26.

[32] Congressional Budget Office of the United States, *Cobalt: Policy Options for a Strategic Mineral,* 1982. Available online at: http://www.cbo.gov/ftpdocs/51xx/doc5126/doc29-Entire.pdf.

A couple of crucial observations related to price spikes of technology-driven minerals come to the fore in the analysis presented by the report:

- Demand for technology-related minerals is usually not very price-elastic in the short term, yet high prices can nonetheless often be borne because they make up only a very limited share of the cost of final end products.
- Higher prices will incentivise all kinds of adaptive measures, such as more resource efficiency, substitution and recycling, which will have an impact on the market in the medium- and long term.
- Price hikes can be devastating to specific industrial consumers, but the overall economic impact might actually be very limited.

We elaborate on these points, following the report's structure.

In the time of the cobalt crisis, cobalt-bearing alloys were used in jet engines for aircraft and in gas turbine engines used for electric power generation and gas pipelines. These alloys were uniquely fit for these uses due to their unparalleled high-temperature properties. This caused cobalt demand for such uses to be very insensitive to price changes. A second reason for this price inelasticity was the limited importance of the cost of cobalt metal used in the alloys in comparison to the end products. The CBO report did a quick calculation for a jet engine and noted that in 1982 a military jet engine retailed for $3-4 million. With a cobalt content of about 900 pounds, the cost of cobalt in the engine – even at an extreme price of $100 per pound – would still be less than 3 percent of the engine's overall price.[33]

Given the above background, a very interesting part of the report analyses the reaction of industrial consumers to the supply crisis and accompanying price spike:

"The large and sustained increases in price during the 1977 to 1979 period not unexpectedly reduced the demand for cobalt. A careful review of the recent history of each of these end uses shows how conservation and substitution efforts brought about the adjustments. (…) Efforts to increase the conservation and recycling of cobalt, and the substitution of other materials for it, were all begun during this period."

This analysis is corroborated by other sources that describe the rapid and profound innovation and substitution processes that followed the cobalt supply crisis in 1978:

"Whereas before the crisis 30% of the cobalt supply went into the market of permanent magnets, after the crisis and the innovation of ferrites, the share of cobalt for this application fell to only 10%."[34]

The report furthermore investigates the potential for a new cobalt supply crisis and what might be the impact, given the experience of the recent supply crisis that was just overcome. Here the mitigation effects of inventories and substitution are noted:

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[33] Congressional Budget Office of the United States, *Cobalt: Policy Options for a Strategic Mineral,* 1982, p.9. Available online at: http://www.cbo.gov/ftpdocs/51xx/doc5126/doc29-Entire.pdf.

[34] Wellmer, F.-W., 'Reserves and Resources of the Geosphere, Terms So Often Misunderstood: Is the Life Index of Reserves of Natural Resources a Guide to the Future?' Z. Dt. Ges. Geowiss., 159/4, pp. 575-590. E. Schweitzerbartsche Buchhandlung, Stuttgart, 2008.

"Private inventories (averaging between four and six months of U.S. demand in 1975-1979) would provide an initial buffer." (…) "A major supply shortfall would no doubt be accompanied by extreme price increases, as high as $100 per pound, thus motivating appreciable substitution. (..) Finally, it is the nature of extreme situations that they provide incentives to find alternative approaches that, until the crisis was at hand, had not been considered."

In particular, the impact of price hikes is evaluated:

"Major cobalt price increases, the second potential cobalt market problem, have occurred in the recent past. They led to higher costs for cobalt users, as well as increased costs for substitutes. Such increases can be devastating to particular cobalt users. For the economy as a whole, however, major cobalt price increases are of little significance. If the price of cobalt were to increase to $112 per pound in 1985 (an extreme price increase), and if cobalt imports were to total 25 million pounds in 1985 (perhaps an overestimate, given substitution possibilities), the undiscounted additional payments to cobalt suppliers in that year would be $2.5 billion. This is less than 1 percent of the value of U.S. merchandise imports in 1981 and 5 percent of the 1981 U.S. imports from countries belonging to the Organization of Petroleum Exporting Countries. The inflationary pressures associated with the additional expenditures would be less than 0.1 percent."

This mirrors the conclusion of the Nixon Administration document of 1974 quoted in the previous section: in terms of monetary value, the costs of importing minerals or other non-energy raw materials – even in the case of a severe price hike – would still be relatively small compared to the costs of oil imports, an observation that is not only valid for the US but for almost all countries that are dependent upon a significant share of oil imports (such as the EU, Japan and China).[35]

The report concluded:

"Only a wartime scenario, with shipping and airlanes blocked and a complete cutoff of cobalt imports, would justify a contingency plan for defense needs. Otherwise, even for extreme and highly improbable cutoffs of African cobalt supply, significant plant closings or substantial losses in economic output would not be expected. The aerospace industry would not be forced into major work stoppages. Large price increases could be costly to particular firms, but would not have a significant effect on the economy."

[35] This is related to the fact that the monetary value of the oil market (and other energy resources), in terms of volume multiplied by price, is very high relative to metals and minerals. E.g.: "Higher oil prices have helped the share of fuels reaching 77% of world exports in natural resources. Metal prices have not kept pace with the prices of fuels, even if in absolute terms prices have also risen sharply. As a result, trade of metals fell to a mere 9.6% of the total of exported resources.", Armando Rungi, *From Export Dependency to Dynamic Comparative Advantages,* POLINARES Working Paper no. 10, September 2010, p. 5. Available online at: http://www.polinares.eu/docs/d1-1/polinares_wp1_export_dependency.pdf. The percentages are based upon statistics from UN ComTrade data for the base year 2008 (but roughly similar for 2009): http://comtrade.un.org/db/default.aspx.

Part II: Access to Resources, Prices and Competitiveness

A great deal of concern has risen lately over the link between access to resources, raw material prices and international industrial competitiveness.[36] Here we wish to disentangle some of the major aspects:

- high prices,
- high volatility of prices,
- access and availability, and
- international prices differences and their impact upon competitiveness.

High prices are usually the main factor sparking concern about resource security in general. As we noted in the first briefing paper, however, periods of severely constrained markets are an almost inevitable characteristic of the 'hog cycles' of capital-intensive resource sectors. If high prices are the main concern, it will be necessary to consider the following:

- What prices are we talking about? Spot prices or prices incorporated in long term contracts? Are they the same for every consumer, or do they have an unequal impact? and
- Is the price impact detrimental for a specific industry sector or for the economy in general?

A second concern, which should be distinguished from sustained high prices, is about the volatility of prices. This concern has played up especially in recent years, following the price spike for many resources in the run-up to the economic and financial crisis.

Third, there is the concern about unequal access to resources. In some cases access to resources might be physically restricted, resulting in a *de facto* supply disruption. Generally, however, unequal access to resources will result in price differentials for different countries or companies. Moreover, domestic vs. international price differences – so-called 'dual-pricing' – can be induced by governments through taxation, subsidies and export restrictions.

Finally, there is the concern about how international price differences might impact upon industrial competitiveness.

Pricing and Price Volatility: A 'Disconnect' from Market Fundamentals?

One concern that has been emphasised in the *Raw Materials Initiative* launched by the European Commission, is that resource markets do not only react to the so-called 'market fundamentals' of supply and demand, but are increasingly 'distorted' by influences that do not originate from actual producers and consumers of the resources itself.

[36] "Increasingly, many emerging economies are pursuing industrial strategies aimed at protecting their resource base to generate advantages for their downstream industries. This is apparent in the proliferation of government measures that distort international trade in raw materials. (..) China, Russia, Ukraine, Argentina, South Africa and India are among the key countries involved in applying such measures, while in many cases also benefiting from reduced or duty-free access to the EU market for related finished products, placing many EU industrial sectors at a competitive disadvantage." 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', COM(2008) 699, pp. 4-5. Available online at: http://ec.europa.eu/enterprise/newsroom/cf/document.cfm?action=display&doc_id=894&userservice_id=1.

For oil there already has been an extensive discussion on the 'financialisation' of oil trade and the distinction between 'paper' barrels and 'wet' barrels.[37] Statistics show that as an asset class, commodity markets have increasingly gained the interest of financial investors.[38] Especially in the face of the problems in the global monetary system and increasing risks in the currency exchange markets, investing in commodities is considered by some to be an attractive option. The trade in financial derivatives is in many cases much larger in volume than the physical market (e.g. oil futures vs. physical deliveries).

In principle, trading in resource market derivatives allows those traders with commercial exposure to the market (e.g. actual producers or consumers) to hedge their price risks for future deliveries against counterparties that are willing to take that risk and provide liquidity to the market (so-called 'speculators'). A main concern is that due to the increasing participation of speculative investors in the market, prices might not reflect actual physical supply and demand, causing investments to become out of synch with the market fundamentals.[39] Secondly, there is the perception that this extra investment is exacerbating market cycles and increasing price volatility, as many investors simply follow price swings by only starting to buy raw materials when prices are already on the increase and selling them off when prices drop. However, as discussions over new regulation point out, it is very difficult to distinguish between pure hedgers and speculators. Moreover, both parties are necessary to allow the market to function. The main concern with excessive price volatility is its impact upon consumers and the difficulties that it creates for industry sectors dependent upon the resources as input or output. In particular, extreme price volatility might deter resource companies from investing in new supplies if there is insufficient certainty about future profitability.

Pricing Mechanisms for Resources: Paying the Same Price?

When concerns over high prices arise, it is important to keep in mind which prices are meant, as for almost all energy and mineral resources a spot market exists alongside long-term contracts which have their own price mechanisms. The interaction between spot markets and long-term contracts and the relative importance between the two, however, varies greatly among different resources.[40]

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[37] See presentations on CIEP Oil Day, 1 July 2010: Paul Stevens, 'Supply and Demand Dynamics in the Oil Market'; Jean-Marie Chevalier, 'Report of the Working Group on Oil Price Volatility'; Bassam Fattouh, 'The 2002-2009 Oil Price Cycle: Lessons & Issues'. Available online at: http://www.clingendael.nl/ciep/events/20100701/. Also see: *Interim Report on Crude Oil*, Interagency Task Force on Commodity Markets, July 2008, issued at the request of the US Commodity Futures Trading Commission (CFTC). Available online at: http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/itfinterimreportoncrudeoil0708.pdf. Kenneth Medlock and Amy Myers Jaffe, *Who is in the Oil Futures Market and How Has It Changed?*, Baker Institute for Public Policy, August 2009. Available online at: http://bakerinstitute.org/publications/EF-pub-MedlockJaffeOilFuturesMarket-082609.pdf.

[38] Some reasons for financial investors to become involved in the oil market, for instance: return enhancement, portfolio diversification, inflation hedge, hedge against weak US dollar, financial innovation. Bassam Fattouh, 'The 2002-2009 Oil Price Cycle: Lessons & Issues', slide 27. Presentation at CIEP Oil Day, 1 July 2010. Available online at: http://www.clingendael.nl/ciep/events/20100701/.

[39] Of course, the most exceptional example is gold, where the price is determined much more by the developments in international currency markets and the buying and selling by central banks, rather than by mining sector supply and demand from end-uses in society. However, this issue has also been raised for other more broadly used commodities. E.g. the extraordinary rise in copper prices have led some to debate as to whether the currency instability is leading to something akin to a 'copper standard'. 'Forget Treasures, Is Copper the Future for China?', *Financial Times,* 16 April 2009. Available at: http://ftalphaville.ft.com/blog/2009/04/16/54721/forget-treasuries-is-copper-the-future-for-china/.

[40] For a thorough introduction to the subject of pricing in the metals and minerals sector, see: David Humphreys, 'Pricing and Trading in Metals and Minerals', Chapter 2.2 in: *SME Mining Engineering Handbook*.

This distinction is important to make, as one of the main concerns related to tension over resources is whether everyone is paying the same price – especially relevant when prices become very high.

For resources that have global, open and transparent markets and that are traded on international commodity exchanges such as the New York Mercantile Exchange (NYMEX) and London Metal Exchange (LME), there is something resembling a 'unified global spot price'. This is the case for the largest and most globalised resource markets, such as oil and base metals like copper, nickel, zinc and aluminium. Even though high prices might increase tension in the market, the fact that all major importers will have to deal with the same high price should in principle align their interests and not spark competitiveness concerns.[41]

For other resources, spot markets play a less important role and there might be sector-specific pricing arrangements. In small resource markets such as technology, minerals like rare earths and 'minor metals', the vast majority of supplies are traded directly from producers to individual consumers using long-term contracts. This means that the spot price for such resources might be less relevant for industrial consumers.[42] A second consequence is that the market (and pricing) is much less transparent; it is this lack of data and transparency that also complicates the debate about China and rare earths.

In general, for those markets in which spot pricing and long-term contracts co-exist, a significant price differential will inevitably lead to tension and attempts to renegotiate long-term contracts – historically another recurring theme in resource markets.[43] The recent upheavals in the iron ore pricing system and ongoing discussions on whether natural gas will maintain its oil-indexed pricing system or move towards more spot pricing can be seen as examples on this issue.[44]

Another source of tension related to pricing that can emerge is the perception (valid or not) that some consumers are trying to cut advantageous bilateral deals outside of global transparent markets, giving them a competitive edge.[45] A second point to keep in mind is that it is only for those resources that are produced mainly domestically that producer countries will have the option to try to influence domestic pricing relative to international prices.[46]

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[41] For instance, since almost all major economies are major oil importers (e.g. United States, Europe, China, Japan, Brazil), high oil prices should bring them together rather than cause friction among them as long as market access conditions remain equal. Of course, tension can still emerge, as some countries' economies and societies will be more able to bear a certain high price level than others.

[42] An example mentioned in the first briefing paper is the uranium market, in which the spot market is relatively small (in volume circa one-tenth of the annual uranium demand by nuclear reactors) and most deliveries are arranged through long-term contracts. Cameco, *Uranium 101*, 2011.

[43] For natural gas, due to its dependency on pipeline infrastructure, long-term contracts with oil-indexed prices are prevalent in most regions. In part due to the growing flexibility offered by LNG shipments, linkages to spot pricing have become a more important factor as well. For discussions on the pricing of natural gas, see: Clingendael International Energy Programme (CIEP), *Pricing Natural Gas*, January 2008.

[44] David Humphreys, 'Mineral Pricing Regimes and the Distribution of Rents in the Value Chain', POLINARES Internal Working Document, 2011. Available upon request.

[45] This includes, for instance, the debate about China's perceived preference for bilateral equity oil deals versus buying its oil on the global oil market.

[46] China can serve as a case in point. Due to the rising share of oil imports, China has had no other choice but to adjust its domestic pricing system for oil products, allowing it to better reflect the fluctuations of the international oil price. The same thing is happening for natural gas in China due to the growing role of imported gas (both pipeline and LNG).

International Pricing of Resources and Industrial Competitiveness

Much debate has centred on how price differences among countries might impact international competitiveness. While this is certainly a valid concern, it is worthwhile to place this issue in a nuanced perspective. Although it is clear that relatively cheap access to raw materials can give certain industries a distinct competitive edge in the global market, the exact impact of such an advantage is more complex than it might appear. Some countries with industries which would seem likely to be hampered by very high prices nonetheless seem to compete quite well, while other industries in countries with inexpensive feedstock still find it difficult to grow into global competitive players. For international competitiveness so many factors play a role that it is often difficult to attribute a decisive role of energy and mineral prices: it is only for the most resource-intensive industries that a clear impact can be ascertained. Overall, related to unfair pricing as a topic of concern, the following observations can be made:

- Significant disparities in energy and raw material prices worldwide already exist.
- International price differences have the most impact on those industries that are very energy- or raw material intensive. Industries which require technology minerals are likely to suffer fewer negative effects on competitiveness due to high prices; for them availability is a stronger concern than price.
- High domestic prices can actually make an economy better prepared to deal with price volatility, as these price fluctuations translate into smaller relative or percentage changes and resource efficiency is encouraged.

We will briefly elaborate on these points in the following paragraphs.

Illustrating the large price differences with respect to energy resources are Figures 6 and 7. They list retail prices for gasoline and electricity for households and industry in a selection of different countries. Taking gasoline as an example, the US price level is approximately half (or less) of that of the United Kingdom, Italy, France, Germany or Denmark. Chinese gasoline prices – despite the fact that they are strongly regulated – are higher than in the US. Regarding natural gas and electricity there are wide differences as well. According to the *Key World Energy Statistics 2010* by the International Energy Agency, electricity prices in Japan are twice as high for both households and industry as compared to in the US, and in most European countries they are even higher.[47] The same publication indicates that in the Netherlands natural gas for industry is 2.5 times as expensive as in the US and twice as expensive for households, even though the Netherlands is a gas-exporting country, exporting about half of its annual production.[48]

While such price differences have an impact upon the economy as a whole, they naturally have the most impact upon energy- and raw material-intensive industries. For energy, these are industries such as steel, cement, non-ferrous metals, aluminium, paper and pulp, refining and petrochemicals.[49] This partially overlaps with those industries for which certain raw material

[47] International Energy Agency (IEA), *Key World Energy Statistics 2010*, 2010, pp. 42-43.
[48] The Netherlands produced 70.5 bcm of natural gas in 2010 and net exports amounted to 36.4 bcm. *BP Statistical Review of World Energy 2010*, June 2011.
[49] In its Industrial Technologies Program, the US Department of Energy lists the following energy-intensive industries: aluminium, chemicals, forest products, glass (8-12%), metal casting (5%), mining, petroleum refining and steel (15%). Percentages indicate the share of energy expenditures in the total production cost. Available online at: http://www1.eere.energy.gov/industry/rd/industries.

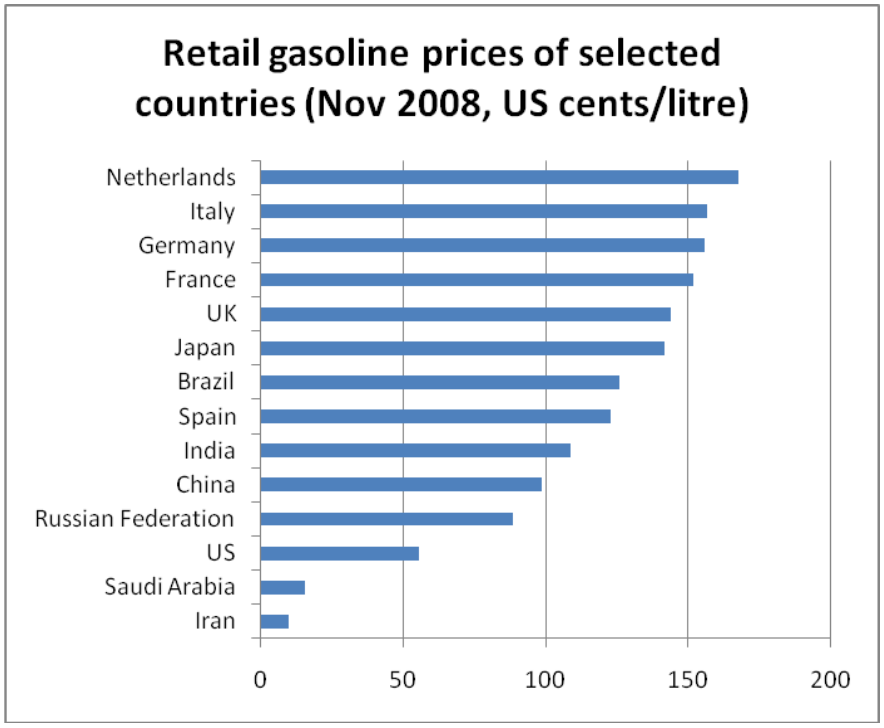

Figure 6. Retail prices of gasoline in 174 countries as of November 2008 (in US cents/litre). Source: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, *International Fuel Prices 2009. 6th Edition — More than 170 Countries*, December 2009, pp. 62-63. Available online at: http://www.eia.gov/emeu/international/IFP-2009-EN.pdf.

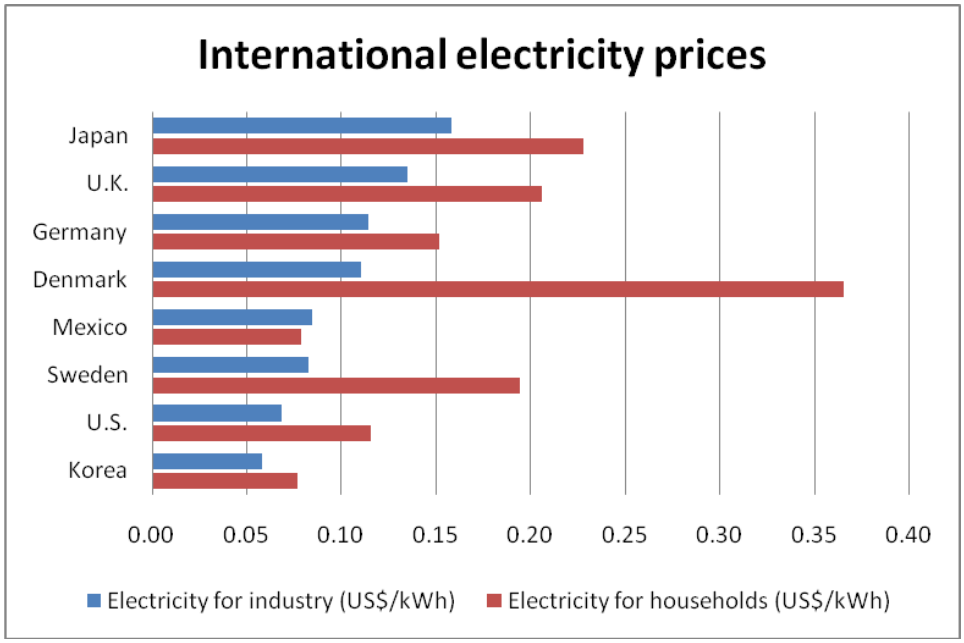

Figure 7. International electricity prices for industry and households in selected countries. Source: International Energy Agency, *Key World Energy Statistics 2010,* pp. 42-43. Available online at: http://www.iea.org/textbase/nppdf/free/2010/key_stats_2010.pdf.

feedstock is a key cost component, such as the steel industry, non-ferrous metals industry, glass and ceramics industry, and the fertiliser and chemical industry. For these industries, competitiveness does depend significantly upon the availability and pricing of energy and raw materials.[50] Of course, specific energy-intensive industries often have special pricing arrangements to enhance their competitiveness, which are not reflected in the generalised statistics shown above.

The impact on competitiveness caused by technology mineral prices is another matter. Taking China and its export restrictions on rare earths as an example, much of the debate has focused on the fact that such export restrictions would lead to lower domestic Chinese prices relative to international prices for rare earths, giving Chinese manufacturing industries using these rare earths an unfair advantage. Yet, as has been mentioned, for industries using technology minerals, the costs of these required raw materials are often only a minor share of the final price. Consequently, price hikes can more easily be borne and in most cases international price differences are not as critical. In fact, availability is much more of a concern than price. This leads to the strong interest in securing a properly functioning global market in which price and availability go together and materials are made available to the consumer willing to pay the most.

Finally, is it worth mentioning that high prices for resources can have positive effects as well, especially in the medium and long term. An interesting effect caused by the differences in energy prices around the world is that it makes some economies more robust in adjusting to price swings or high prices than others. For those economies used to high energy prices and high fuel taxes (such as Europe and Japan), price volatility of energy resources causes less of a percentage change and can more easily be absorbed. Given the major price difference for gasoline as illustrated in Figure 6, it is no coincidence that the average per capita oil consumption is about twice as high in the US as in Europe and there is a significant difference in average vehicle fuel efficiency levels. In fact, the broader implications are even larger: Europe has a highly developed public transport system, giving alternatives for car-based travel, whereas adapting to high oil prices is much harder in the United States. Similarly, for resources such as minerals and metals, domestic high prices might actually give a strong incentive for technology innovation in the field of resource efficiency and recycling, thus increasing societal capacity to deal with constrained primary supplies.

Level Playing Fields: Dual-pricing, Export Restrictions and the WTO

The third main concern which we identified is whether countries or companies are experiencing unfair economic disadvantages. One crucial concern is the manner in which 'normal' economic competition is played out. Is this done following a rule-based system in which all economic actors have more or less equal chances, or are these rules increasingly being sidelined? On this matter, the *Raw Materials Initiative* by the European Commission mentions:

> *"Increasingly, many emerging economies are pursuing industrial strategies aimed at protecting their resource base to generate advantages for their downstream industries. This is apparent in the proliferation of government measures that distort international trade in*

[50] See, for example: Chapter 3 of the EU ETS Review *International Competitiveness, European Commission, Directorate General for Environment*, McKinsey & Co and Ecofys, December 2006. This report includes a thorough economic cost analysis of the most energy-intensive industries, Available online at: http://ww1.mckinsey.com/clientservice/sustainability/pdf/Report_on_International_Competitiveness.pdf.

> *raw materials. (..) China, Russia, Ukraine, Argentina, South Africa and India are among the key countries involved in applying such measures, while in many cases also benefiting from reduced or duty-free access to the EU market for related finished products, placing many EU industrial sectors at a competitive disadvantage."* [51]

Securing level playing fields and making sure that industries in various countries compete on equal footing (and thus promoting global trade) are important World Trade Organization objectives originating from the GATT agreements. Regulation has been aimed toward removing protectionist measures (in particular, import tariffs) and unfair support to domestic industries.

However, trade in natural resources occupies a somewhat special place within the overall governance and regulation on international trade, such as by the World Trade Organization.[52] Whereas most of the WTO rules and previous GATT arrangements focus on the eradication of import tariffs in order to encourage free trade, the particular characteristics of natural resource markets make these rules less relevant.

First of all, for 'importer' countries which do not have certain resources and are dependent upon raw material imports, there is no point in imposing import tariffs, as this will not help to stimulate domestic production. Rather, these countries are interested in obtaining the imports at the lowest price. On the other hand, 'exporter' countries which are in the possession of raw material resources are concerned with balancing the level of production and exports in order to maximise the return on the resources they possess.[53]

Concerning the issue of export restrictions, which have come under renewed scrutiny, a few things are important keep in mind. First, it is generally agreed that it is a matter of a nation's sovereignty to decide the amount of raw materials it wishes to produce, whether there is a huge demand for these resources on the global market or not.[54] Second, export restrictions such as export duties or taxes are generally allowed under the standard WTO rules, and it is only for some countries (such as China) that the use of export restrictions have been made conditional in the respective WTO Accession Protocols (the so-called 'WTO-plus' provisions). In general, export restrictions will induce a price difference between the domestic and international markets: so-called 'dual pricing'.[55]

However, one question worth asking is whether export restrictions are really an effective measure to ensure a competitive edge for one's economy. The key issue here is whether they actually lead to a significant difference in price or availability relative to that of other international competitors. A

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[51] Communication of the Commission to the European Parliament and the Council, 'The Raw Materials Initiative: Meeting Our Critical Needs for Growth and Jobs in Europe', COM(2008) 699, pp. 4-5. Available online at: http://ec.europa.eu/enterprise/newsroom/cf/document.cfm?action=display&doc_id=894&userservice_id=1.

[52] See, for instance, the comments on trade in natural resources and the WTO made by Professor Joost Pauwelyn of the Graduate Institite in Geneva, in the World Trade Report 2010. Available online at: http://www.wto.org/english/res_e/publications_e/wtr10_forum_e/wtr10_29july10_e.htm.

[53] Idem.

[54] However, a decision not to increase production despite strong market demand certainly might lead to significant tension, taking the discussions between large oil importers and OPEC as an example.

[55] For a discussion on WTO regulation and dual-pricing for energy resources, see for instance: Daniel Behn, 'The Effect of Dual Pricing Practices on Trade, the Environment, and Economic Development: Identifying the Winners and the Losers Under the Current WTO Disciplines', Centre for Energy, Petroleum, and Mineral Law and Policy, Tulane University, 17 December 2007. Available online at: http://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID1151553_code704306.pdf?abstractid=1151553&mirid=3.

study on the economic impact of export restrictions by the OECD describes the basic concern in the case of the steel industry:

> *"Domestic consumers pay less, and international consumers pay more. This gap between domestic and international prices provides domestic consumers of the materials (in this case, steel producers) with an advantage in international competition. If the gap is significant, and the material represents a sizable portion of the total cost of raw materials, the advantage can be potentially decisive."*[56]

However, it is once again important to note that this argument only holds true for those industries for which the raw material constitutes a significant price component. As an illustration of this, some observations about the WTO cases against China on export restrictions are given below:

- Export restrictions usually take the form of export duties. China is an unusual case in that it is liable for WTO cases filed against it concerning export duties; this is only so because China agreed to extra regulation limiting their use in its Accession Protocol to the WTO.[57]
- The first WTO case filed against China did not deal with rare earths at all, but rather with bulk commodities like bauxite, magnesium, coke, fluorspar, manganese, silicon metal, silicon carbide, yellow phosphorus and zinc (important for aluminium and steel industry). In this first WTO case, the impact on industrial competitiveness does not seem to have been the leading consideration, given that some of these materials are subject to import tariffs.[58]
- In trying to shape the value chain, some other measures related to trade and industry (such as localisation requirements or non-trade barriers) might actually be much more effective and influential than offering inexpensive energy and mineral resources.

In fact, an historical analysis by the US International Trade Commission on export restrictions mentions that:

> *"With respect to economic effects, when a country imposes an export control, it typically has the intended effect of lowering the domestic price of the restricted product in the short*

[56] OECD, Chapter 3: 'Export Barriers and the Steel Industry', Alan H. Pric e and D. Scott Nance, p. 84. Available online at: http://scrapcoalition.com/apps/stories/articlefiles/154-Economic%20Impact%20of%20Export%20Restrictions%20--%20Chapter%203.pdf.

[57] Idem, p. 86: "The WTO rules do not impose disciplines on one major type of export restrictions, though: export duties. To the contrary, GATT Article VIII explicitly exempts export duties from the requirements described above. Unlike import duties, export duties are not generally subject to binding agreements among WTO members. However, China for example agreed to limit export duties on certain identified products." (WTO, 2001).

[58] "However, the list of targeted products does not suggest that the EC and the United States have focused their challenge on those raw materials that pose the greatest problems for downstream industries (the intention suggested in the Commission's Raw Materials Initiative). Take silicon metal as an example. China currently imposes a 15 per cent export tariff on silicon metal, while the EC imposes a 49 per cent anti-dumping duty and the United States imposes a 139.49 per cent anti-dumping duty on their respective imports of silicon metal from China. It would seem counterintuitive for the EC and the United States to argue that a 15 per cent export duty is unfairly driving up prices, while at the same time driving up prices themselves even further by imposing much high anti-dumping duties. If access to cheaper raw materials were really the main consideration, the EU could simply start by suspending its anti-dumping duties on silicon metal, which would be a much quicker remedy than initiating WTO proceedings that can take several years to yield results." Arnoud Willems and Sven De Knop, 'The EC and US WTO Challenge to China's Export Restrictions: Will It Increase Their Downstream Industries' Competitiveness?', *International Trade Law and Regulation*, vol. 15 , issue 6 , ISSN 1357-3136 (2009), pp. 171-175. Available online at: http://wenku.baidu.com/view/23a2ea225901020207409c67.html.

> *run because of increased supply in the domestic market. In the long run, however, export controls may have unintended and undesirable effects."*[59]

What the study noted is that low (subsidised) prices might actually have a detrimental effect on resource efficiency and lower the pace of technological improvements, thus undermining the long-term competitiveness of the industries involved.[60]

CASE STUDY: Middle East Petrochemicals Industry

To place in perspective the discussion about competitive advantages for industries in China based on the cheap domestic supply of rare earths, we turn to another case study that attracts little attention but is worth mentioning in this regard: the role of oil and gas as feedstocks in the petrochemicals industry.

According to a document by DG Enterprise of the EU,

> *"Energy and gas-as-feedstock costs play an important role in the chemical industry as a whole, representing between 15% and 60% of manufacturing costs for most products. The vital importance of electricity for chlorine products and natural gas for fertilizers are just two examples. (…) Much of the primary energy is imported into the EU as are many of the raw materials for the industry, especially for basic chemicals. This tends to lead to certain input cost disadvantages. (…) Non-tariff-barriers or measures, and in particular double-pricing of raw materials and feedstocks, distort trade. The latter is of particular concern to the petrochemical industry for whom feedstock double-pricing in certain developing countries causes unfair competition."*[61]

For the petrochemicals industry in the Middle East, the cost advantage of its inexpensive feedstock has been a major benefit for its development, in addition to strong government support and sufficient funds being available for investment. In comparison to global price averages, which have at times reached US$6.50/MBtu, the Saudi petrochemicals conglomerate SABIC only needs to pay US$0.75/Mbtu, according to some sources.[62] As a result, there has been an enormous expansion over the past two decades, with SABIC becoming a world player in the petrochemicals business.[63]

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[59] 'Export Controls: An Overview of Their Use, Economic Effects, and Treatment in the Global Trading System', Joanna Bonarriva, Michelle Koscielski and Edward Wilson. Office of Industries, US International Trade Commission, August 2009. Available online at: http://www.usitc.gov/publications/332/working_papers/ID-23.pdf.

[60] Two illustrative examples: "In 1994, the aim to control inflation by employing an export tax on palm oil in Indonesia had a modest effect controlling inflation but at the major cost of developing economic inefficiency in the industry that consequently undermined its long-term competitiveness." And: "Between 1988-95, an export tax on raw cotton was imposed in Pakistan to promote the downstream yarn industry. This policy succeeded as a short-term subsidy to the yarn industry, but later led to reduced investment in new technology in the yarn industry that consequently inhibited its long-term growth." Joanna Bonarriva, Michelle Koscielski, and Edward Wilson, *Export Controls: An Overview Of Their Use, Economic Effects, And Treatment In The Global Trading System*, Office of Industries, US International Trade Commission, August 2009, p. 10.

[61] European Commission, DG Enterprise, Chemicals REACH White Paper – background communication, 'An Industrial Competitiveness Policy for the European Chemical Industry: an example', 2010. Available online at: http://ec.europa.eu/enterprise/sectors/chemicals/documents/reach/archives/white-paper/background/communication/index_en.htm.

[62] "While global petrochemical rivals such as BASF and Dow Chemical struggle with fluctuating feedstock prices, Saudi Arabia supplies heavily subsidised feedstock, which means higher profits for Sabic. It pays only 75 cents per million British thermal unit for its gas, compared with a global average of $6.50." *Financial Times,* 'Sabic Sees Growth at Home and Abroad', 4 April 2011.

[63] Patrick Rooney, 'Factors That Influence The Petrochemical Industry in The Middle East', *Middle East Economic Survey*, Vol. XLVIII, No. 23, 6 June 2005. Available online at: http://87-85.netway.com.cy/postedarticles/oped/v48n23-5OD01.htm

Compared to the debate about China and rare earths, two things are striking. First of all, the petrochemical industry is a major industrial sector in Europe carrying a much greater economic weight than industries directly involved in processing rare earths. Second, the impact of the price advantage is much more important in this sector, given that the feedstock material is a much larger cost component of the final product than in the case of rare-earth-based products such as permanent magnets or batteries.

So why is this case not generating much public complaint about uneven playing fields? Interestingly, at a political level much attention *has* been given to this topic. In fact, the issue of the 'dual pricing' of natural gas feedstocks for the petrochemicals industry was a major point of contention during the negotiations on Saudi Arabia's accession to the World Trade Organization.

In this discussion, Saudi Arabia argued that its pricing system was a WTO-compatible investment incentive on several grounds: first, the natural gas was primarily associated gas from oil fields that had been previously flared. Second, exporting the gas would require major infrastructure investments including liquefaction facilities, storage and export terminals, such that charging lower domestic prices relative to export prices was reasonable. Third, the domestic price of US$0.75/MBtu was available to both Saudi and non-Saudi users, consistent with the WTO national treatment principle.[64]

In the end, Europe dropped its opposition during the negotiations and allowed Saudi Arabia to continue this practice while becoming a WTO member in 2005.[65]

(accessed on 4 March 2011). Also see: 'Moving energy-intensive industries to the Gulf', *McKinsey Quarterly,* February 2007. Available onlinet at: http://www.mckinseyquarterly.com/Moving_energy-intensive_industries_to_the_Gulf_1921 (accessed 21 March 2011).

[64] Khan H. Zahid, 'The 'Feedstock Issue: Another WTO Win for Kingdom', *Arab News*, 30 January 2006. Available online at: http://archive.arabnews.com/?page=6&section=0&article=77072&d=30&m=1&y=2006.

[65] One European commentary noted the following: "The EU has attacked these [dual-pricing] practices for a long time, but it failed to have them eliminated in its bilateral WTO accession treaties with both countries [i.e., Russia and Saudi Arabia]: in 2003, the EU concluded an agreement with Saudi Arabia and in 2004 one with Russia. Initially, the issue looked as though it might have a positive outcome with Saudi Arabia, i.e., a commitment undertaken by Saudi Arabia to eliminate dual pricing. However, in the negotiations with Russia, the EU did not insist on such elimination. As a consequence Saudi Arabia withdrew its original commitment in the final WTO accession negotiations. This means that both countries can continue to practise a dual-pricing system. The EU's lack of enthusiasm to combat dual-pricing practices in the context of WTO accession can only be explained in political and geopolitical terms. WTO membership of Russia and Saudi Arabia was considered more important than solving the petrochemical industry's problems with dual pricing." For a more elaborate discussion, see: Reinhard Quick, 'Export Taxes and Dual Pricing: How Can Trade Distortive Government Practices be Tackled?', Chapter 18 in: *Global Challenges at the Intersection of Trade, Energy and the Environment*, Edited by Joost Pauwelyn, The Centre for Trade and Economic Integration at the Graduate Institute of International and Development Studies in Geneva, 2010, p. 195.

Part III: Confidence in Global Markets – Entering A New Era?

The previous sections have elaborated upon a number of concerns related to resource security. In particular, we have discussed the issue of economic competitiveness quite thoroughly. With some of the major concerns now better in perspective, we will examine some other issues that have been brought forward. In particular we discuss the claim that we are witnessing a fundamental change in the way resource markets operate and a shift away from the earlier 'ordinary' resource sector business cycles. Regarding the characteristics and functioning of the global energy and mineral markets, we will attempt to disentangle the general anxiety that is sometimes voiced and analyse the underlying concerns.

The 'China Factor': A Departure from 'Normal' Resource Demand Cycles?

One of the main questions currently being asked is whether the massive and rapid demand growth from large emerging market economies such as China and India has distorted 'ordinary' business cycles in the resource markets and has led us into a new era of resource scarcity: the so-called 'China factor'.[66] As shown by a quotation we introduced earlier from the 1974 Nixon Administration document, this concern is hardly a new one: *"The recent tight supply situation for energy, food and many raw materials has also prompted a more general concern – that we may be passing from an era of abundant supplies into one of constant shortages*."[67]

As for the current market cycle, how this will unfold is difficult to predict with certainty. Foreseeing the development of such cycles is no easy feat, and even those within the industry will occasionally fail to do so correctly.[68] Major determining elements are whether China will sustain its rapid economic growth and whether the large investment projects in the resource sector taking place now will be realised successfully and in a timely manner.

Yet overall, it is important to keep in mind that 'hog cycles' are an inherent characteristic of energy and mineral resource-extractive industries. Political attention for the topic of access to resources has often fluctuated in parallel with prices and tight market conditions. It will be helpful to keep sight of the cyclical nature of some of the problems encountered and try to manage these 'hog cycles' rather than fight them. One thing is for certain: the current situation will not last forever..

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[66] As per discussion at EU FP7 POLINARES project meeting in Brussels, March 2011. Also: "The Paley Commission as well as the Club of Rome underestimated the mineral wealth of our globe and humans' force to invent new technologies for extracting and for using these minerals. With the beginning of the 21st century and the Chinese growth in demand causing historic price hikes and delivery shortages the discussion about the finiteness of mineral resources is back on the table." (..) "However, in real terms, prices have fallen continuously until 2003. With the China factor, we have entered a new era. The extent to which the current high raw materials prices represent a permanent departure from the old price structure is almost impossible to predict at present." Quoted from: Dirk Rosenau-Tornowa, Peter Buchholz, Axel Riemann and Markus Wagner, "Assessing the Long-term Supply Risks for Mineral Raw Materials: A Combined Evaluation of Past and Future Trends", *Resources Policy* vol. 34 (2009), pp. 161-175.

[67] Quote taken from *Critical Imported Materials: Study of Ad Hoc Group Established by NSSM 197/CIEPSM 33,* US Government (Nixon Administration), July 1974. Available at the US Bureau of Public Affairs, Office of the Historian, 'Foreign Relations of the United States, 1969-1976, Volume XXXI, Foreign Economic Policy, 1973-1976', available online at: http://history.state.gov/historicaldocuments/frus1969-76v31.

[68] One can think of the enormous investments in LNG regasification terminals in the US, while its need for imports actually decreased due to the unconventional gas 'revolution'.

Challenges to a Functioning Global Market: Non-Economic Behaviour

In the course of the discussions above, we have seen that many problems can be overcome in a well-functioning market – that is, a market in which supplies are sold to the buyer willing to pay the most. In this case, price incentives cause a host of reactions that can solve a disruption of supplies. However, in a situation where countries and economic actors are dependent upon the proper functioning of a global market, it is essential that all market participants operate on the basis of the same economic principles.

Consequently, one of the most serious causes for concern that has been analysed is the non-economic (or non-market conform) behaviour of actors in the market.[69] Unfortunately, ample current and historical evidence suggests that non-economic behaviour does in fact occur regularly – especially in crisis situations.

First of all, during crisis situations government policy tends to be driven by national interests, and in many cases this disrupts the functioning of the global market. A prime example is the practice of issuing an export ban for certain products as soon as a local shortage occurs or is feared. For example, Russia instigated a wheat export ban after a period of serious droughts in 2010. While this had the effect of lowering domestic prices, it triggered fear in other countries of a global food shortage.[70] Another example, with only a very limited external impact due to the small quantities involved, is the case of a Chinese diesel export ban in May 2011 at the time of power outages and concerns about a shortage of diesel to fuel additional power generators.[71] From a global perspective, when a supply problem occurs, such reactions only aggravate the situation.

A second concern is that the market behaviour of state-owned enterprises in the resource sector is not guided by economic principles alone but rather by their ties to the government. For this reason investments in the resource sector by state-owned firms are closely watched – something that we will elaborate on the next section. Giving priority to domestic needs above profit-maximising strategies is quite common in domestic markets in which energy or raw material prices are subsidised (i.e., lower than the international level).[72] For instance, it is well-known that domestic Chinese refiners have to follow government directives, even if this means selling on the domestic market at a loss because of regulated Chinese oil product prices, whereas they might make a profit on the international market. A different example is Russia, which has a strongly regulated domestic gas market. According to Gazprom, the average price charged for gas exported to Europe is 3.1 times as high as the price for domestic Russian consumers. This is duly reflected in its revenue profile: in terms of volume, Gazprom sells 55% of its gas production on the domestic Russian market

[69] It is important here to distinguish between non-economic behaviour of market participants and the ways in which governments can try to support domestic industries, either directly or indirectly by dual-pricing or export restrictions, or by providing 'cheap' financing below market rates. We discuss the latter issues in other sections.
[70] 'Russia Grain Export Ban Sparks Price Fears', *Financial Times,* 5 August 2010.
[71] "China will halt diesel exports to guarantee domestic supply of the fuel as electricity outages continue to put pressure on the country's power supplies", but "domestic refiners are reluctant to sell diesel in China to make losses when exports can produce profits." Zhou Yan, 'Power Crisis Forces Halt to Diesel Exports', *China Daily,* 14 May 2011. Available online at: http://www.chinadaily.com.cn/china/2011-05/14/content_12510090.htm.
[72] For a discussion of the energy subsidisation issue, see: *Analysis of the Scope of Energy Subsidies and Suggestions for the G-20 initiative*, joint report by the IEA, OPEC, OECD and World Bank, 16 June 2010. Available online at: http://www.iea.org/weo/docs/G20_Subsidy_Joint_Report.pdf.

even though that generates only 28% of its gas sales revenues. Inversely, the 31% percent in volume that it sells to Europe provides 51% of its sales revenues.[73] Clearly, in cases such as these, tensions are apt to emerge between the state-owned firms and the government, as the companies often cannot satisfy both government demands and profit-maximising objectives. As long as these practices concern domestic production and consumption, the impact on global markets might still be limited. Yet the real concern in this matter is when control over resource production and possible non-economic behaviour extends to (international) projects that could potentially supply the global market.

This bring us to a third identified concern, namely that some countries seek to bypass global markets and secure their resources on a bilateral basis, causing resources to be 'withheld' from the global market. The concern surrounding equity oil projects by Chinese NOCs provides an example of this. As the report *Overseas Investments by Chinese National Oil Companies* by the International Energy Agency observes:

> *"Much commentary regarding the overseas activity of China's national oil companies (NOCs) has presumed that the firms are acting under instructions and in close co-ordination with the Chinese government. Some experts have also expressed concerns that the activities of NOCs could result in reduced and more-expensive supplies to other oil-importing nations."*[74]

Yet the argument about resources being 'withheld' from the global market and other consumers is not valid, at least not directly. If the oil that China produces through its own equity oil projects is sent back to China for domestic consumption, this oil does not need to be bought on the global oil market, thus alleviating the pressure on the market. Nonetheless, there are some reasons for concern: this behaviour is making markets less liquid and deep, and thus less flexible. Second, there might be price differences between such bilateral deals and internationally-traded oil. Finally, such activities are making the overall market less transparent and might spark competitiveness concerns.

There is more to the story, however. First, the size of bilateral trade might be very small in comparison to the global market. This point holds true in particular for oil. The IEA estimates that Chinese NOCs produced about 1.36 million barrels per day (mb/d) in equity oil projects, which would amount to 36 percent of China's crude oil imports if – hypothetically – all equity oil were to be shipped back to China. A second important point is that in practice the equity oil does not get shipped back to China but instead appears to be mostly sold on local or international markets, as far as scarce available data indicates.[75]

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[73] Gazprom natural gas sales in terms of volume in 2010: Russia 262.1 bcm (54.6%), CIS+Baltic States 70.2 bcm (14.6%), Europe 148.1 bcm (30.8%). Average gas sales prices in RUB per 1000 cubic metres: Russia 2345.5, CIS + Baltic States 6416.5, Europe 7420.7. Consequently, sales revenues in RUB amount to: Russia 615 bn (28%), CIS and Baltic States 450 bn (21%), Europe 1099 bn (51%). Gazprom in *Questions and Answers*, Chapter 8, 'Gazprom in Foreign Markets', pp. 53-56, 2011. Available online at: http://eng.gazpromquestions.ru/fileadmin/files/2011/view_version_eng_22062011.pdf.

[74] Julie Jiang and Jonathan Sinton, *Overseas Investments By Chinese National Oil Companies: Assessing the Drivers and Impacts,* International Energy Agency Information Paper, February 2011. Available online at: http://www.iea.org/papers/2011/overseas_china.pdf. Also see: Erica Strecker-Downs, 'Who's Afraid of China's Oil Companies?', Chapter 4 in: *Energy Security: Economics, Politics, Strategy, and Implications,* Brookings Institution Press, 2010. Available online at: http://www.brookings.edu/papers/2010/07_china_oil_downs.aspx.

[75] The figure can be compared to the total domestic oil production of 4.1 million barrels per day and imports of about 3.8 million barrels per day. The statistics mentioned are reflecting data for the first quarter of 2010. Julie Jiang and Jonathan

Taking a Stand on Resource Sector Investments: Some Considerations

An integral part of the debate on resource security is that of resource sector investments. As mentioned in the previous section, investments by foreign state-owned entities generate particular attention. We will discuss here investments in developing as well as developed countries.

First of all, there is a general anxiety regarding investments in resource-rich countries by emerging economies, especially China. Perhaps the best-known example is the debate about Chinese activities and investments in Africa,[76] but similar attention is given to Central Asia, the Middle East and Latin America.[77] The two main concerns often voiced are that the growing economic relations with China are increasing its political clout and, furthermore, that this might undermine the governance objectives of Western countries. The latter comes to the fore especially with countries which are having troubled relations with the West such as Iran, Myanmar and Sudan.

With regard to the first concern, two things are worth considering. One is that China's deepening trade relations with resource-exporting countries will indeed increase its economic importance for them, and this in turn will inevitably create more political leverage for China vis-à-vis other trading partners. Yet at a fundamental level this is the consequence of China's growing economy and the expansion of global trade. Since China's economic growth is based predominantly upon manufacturing, heavy industry and infrastructure construction, it is very resource-intensive in both energy and minerals, resulting in its massive demand for natural resources. An essential question to consider in the light of this debate is what position Western countries wish to take towards Chinese investments in the resource sector. What is their thinking about this issue, and how do Western countries see their own role? Do they want China to invest or not? It could be argued that in fact it would be better if China were to invest in the resource sector and make sure the necessary financing is invested to bring projects and future supplies online. Not doing so only exacerbates already tight markets.

The second issue is that the relationships that have developed between China and Iran, Myanmar, Sudan and Angola are sometimes eyed with suspicion and portrayed as being part of a Chinese strategy to counter Western influence in these countries. However, analysts have also noted this behaviour might have been prompted by other than just strategic considerations: as latecomers, Chinese companies have had a difficult time in carving out a position for themselves in international resource markets, and these countries – precisely because of their sometimes troubled relations with the West – offered China an opportunity for relatively advantageous deals.[78]

Sinton, *Overseas Investments By Chinese National Oil Companies: Assessing the Drivers and Impacts,* International Energy Agency Information Paper, February 2011, p. 17. Available online at: http://www.iea.org/papers/2011/overseas_china.pdf.

[76] See, for instance: Bas Percival, Benjamin Valk and Lucia van Geuns*, Gambling in Sub-Saharan Africa: Energy Security through the Prism of Sino-African Relations*, Clingendael Energy Paper, July 2009. Available online at: http://www.clingendael.nl/publications/2009/20090710_ciep_energy_report.pdf. Alex Vines, Lillian Wong, Markus Weimer and Indira Campos, *Thirst for African Oil: Asian National Oil Companies in Nigeria and Angola*, Chatham House Report, August 2009. Available online at: http://www.chathamhouse.org/sites/default/files/r0809_africanoil.pdf. For an overview of the major topics of discussions, see: China in Africa Programme, Center for Stategic and International Studies (CSIS). Available online at: http://csis.org/program/china-africa. Stephanie Hanson, *China, Africa, and Oil,* Council on Foreign Relations*,* 6 June 2008. Available online at: http://www.cfr.org/china/china-africa-oil/p9557. Arthur Waldron (Ed.), *China in Africa*, Jamestown Foundation, 2008.

[77] E.g. *China Analysis: The New Great Game in Central Asia,* European Council on Foreign Relations, September 2011.

[78] See, for example: Erica Strecker Downs, 'The Fact and Fiction of Sino-Africa Energy Relations', *China Security*, Summer 2007. Available online at: http://www.brookings.edu/articles/2007/summer_china_downs.aspx.

Of a different order are resource sector investments in developed countries: these sometimes become politicised. Generally, investment law stipulates that government approval must be sought for a proposed investment or take-over as soon as the monetary value of the deal exceeds a certain threshold. In many countries this is done through some kind of foreign investment review authority.[79] In many cases the political upheaval surrounding such proposed investments keeps them from materialising. Some of the most famous cases are:

- China Minmetals Corporation's bid for the Canadian mining company Noranda (2004-2005), a major producer of nickel, zinc and copper. Even before government approval was sought, the Canadian government indicated that human rights concerns would be taken into account in evaluating the bid. This concerned alleged 'forced labour' by prisoners – not, by the way, taking place at Minmetals (or one of its subsidiaries), but at one of its suppliers. After a prolonged period of difficult negotiations the exclusive negotiating period expired and the bid was abandoned.[80]
- The bid by the China National Offshore Oil Company, CNOOC, for the American oil company Unocal (in 2005). This proposed bid faced very strong public opposition, and before it was formally submitted for government approval, the bid was dropped. We will address this case in more detail later on.
- Speculation on a potential bid from Gazprom for British gas supplier Centrica in 2006, which led to a heated discussion in British (and European) media. The Blair government indicated that it would not make objections to a potential deal.[81] In the end no formal bid was submitted.
- Bid by China Minmetals for Oz Minerals in Australia. This bid was at first rejected by the Australian government due to national security concerns. The specific reason cited was that one of the mining assets – the Prominent Hill copper-gold mine – was located too near to a weapons-testing ground. After the deal was revised and several assets (among them the Prominent Hill mine) were excluded, the bid was approved and executed in 2009.[82]
- A proposed US$19.5bn deal by Chinese state-owned aluminium producer Chinalco to increase its stake in the mining giant Rio Tinto to 18 percent in February 2009. This caused a significant debate in Australian media and politics.[83] The Australian Foreign Investment Review Board (FIRB), extended the period it required to review the bid, and after a

[79] E.g. Australia has a Foreign Investment Review Board (FIRB), http://www.firb.gov.au; Canada had a Foreign Investment Review Agency (FIRA) which was established in 1973 but was renamed Investment Canada in 1985. In the US there is a Committee on Foreign Investment in the United States (CFIUS) established by president Ford in 1975.

[80] This case, and especially its judicial and legal aspects, are very thoroughly documented in: Aaron A. Dhir, 'Of Takeovers, Foreign Investment and Human Rights: Unpacking the Noranda-Minmetals Conundrum' (April 11, 2011). *Banking & Finance Law Review*, Vol. 22, pp. 77-104, 2006.

[81] "Tony Blair has ruled out any possibility that UK ministers might actively seek to block a future bid by Russia's Gazprom for Centrica, the gas supplier. The Prime Minister believes that Britain must stick firmly by its commitment to liberalise European markets. (…) In recent months, Department of Trade and Industry officials have responded to Gazprom's expression of interest in Centrica by examining whether ministers could legislate to block a bid in order to protect the security of UK energy supplies." Quote taken from: 'Blair rules out blocking Gazprom Centrica bid', *Financial Times,* 25 April 2006.

[82] 'Australia Blocks Minmetals-Oz Deal', *Forbes*, 27 March 2009. Available online at: http://www.forbes.com/2009/03/27/oz-minmetals-rejected-markets-commodities-australia.html. 'China Minmetals, OZ Minerals ink $1.21b takeover deal', *China Daily,* 15 April 2009. Available online at: http://www.chinadaily.com.cn/bizchina/2009-04/15/content_7681109.htm.

[83] Some Australian politicians gave the following reactions: "If the Chinalco deal with Rio Tinto goes ahead the Communist bosses in Beijing will exert control over the management of Rio Tinto's Australian mineral resources," (Bob Brown, leader of Australia's Green political party, quoted by Reuters). "The Australian government would never be allowed to buy a mine in China, so why would we allow the Chinese government to buy and control a key strategic asset in our country?" (Barnaby Joyce, senatorial leader of the opposition National Party, quoted by media reports). Mark Scott, 'Controversy Swirls Around Rio Tinto-Chinalco Deal', Business Week, March 17, 2009. Available online at: http://www.businessweek.com/blogs/europeinsight/archives/2009/03/controversy_swi.html.

> protracted process the deal finally collapsed as market circumstances and Rio Tinto's financial outlook had changed. Apart from the public debate, the deal was further complicated by a fierce dispute between Chinese steel mills and the world's leading iron ore producers, of which Rio Tinto is one.[84] After the deal collapsed, more debate followed, as four Rio Tinto employees were arrested and convicted in China of espionage and bribery charges related to the iron ore pricing issue.[85]

These cases indicate that proposed resource sector investments can sometimes run into significant political opposition. However, it is not only Chinese investment that comes under political scrutiny. In 2010, BHP Billiton's bid for PotashCorp in Canada did not receive government approval in the face of strong national opposition from the Saskatchewan province where PotashCorp is located.[86] In an interim decision, the Minister of Industry Tony Clement indicated that he was not satisfied that the proposed transaction was "likely to be of net benefit to Canada".[87]

It is interesting to see how these proposed investments are evaluated. In the case of Canada, under the Investment Canada Act, the ministry of the federal government has "the two-fold function of promoting foreign investment and reviewing investments to ensure that they are of 'net benefit' to Canada". Of course, here the whole question hangs on the explanation of "net benefit".[88] Especially for those countries that are large resource exporters, such as Canada and Australia, there a number of different aspects to balance.[89] For them, the resource extraction sector is a large part of their economy and the exports make up an important part of their economic revenues. China has often become a major export destination as the largest global growth market for raw materials. Yet what the political consequences should be of these intensifying economic ties is still much debated. This holds for Canada,[90] but even more so for Australia whose geographical location links this debate to its broader stance towards China in foreign policy and security issues.[91]

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[84] On the iron ore pricing dispute, see: David Humphreys, 'Mineral Pricing Regimes and the Distribution of Rents in the Value Chain', POLINARES Internal Document, 2011. Available upon request.

[85] 'China formally arrests Rio Tinto employees', *Reuters,* 12 August 2009. 'Rio Tinto executives "admit bribery" at China trial', *BBC News,* 22 March 2010.

[86] Ian Austen, 'Canada Blocks BHP's Purchase of Potash', *New York Times*, 3 Novemer 2010. Available online at: http://www.nytimes.com/2010/11/04/business/global/04potash.html.

[87] 'Canada rejects BHP bid for Potash', *Financial Times, 3 November 2010.*

[88] According to the Canadian government (http://www.ic.gc.ca/eic/site/ica-lic.nsf/eng/h_lk00007.html#benefit), this entails the following: "In determining whether an investment is of 'net benefit', the Minister will consider the following factors: (a) the effect on the level of economic activity in Canada, on employment; on resource processing; on the utilization of parts and services produced in Canada and on exports from Canada; (b) the degree and significance of participation by Canadians in the Canadian business or new Canadian business and in any industry or industries in Canada; (c) the effect of the investment on productivity, industrial efficiency, technological development, product innovation and product variety in Canada; (d) the effect of the investment on competition within any industry in Canada; (e) the compatibility of the investment with national industrial, economic and cultural policies; and (f) the contribution of the investment to Canada's ability to compete in world markets."

[89] For the debate in Australia on investment policy and Chinese investments, see for instance: Andrew Shearer and Mark Thirlwell, 'Is the Foreign Investment Review Board Acting Fairly?', Lowy Institute, December 2008. Available online at: http://www.ipa.org.au/library/publication/1229471411_document_thirwell_updated.pdf. Malcolm Cook and Mark Thirlwell, *The Changing Global Financial Environment: Implications for Foreign Investment in Australia and China – Conference Outcomes Report*, Lowy Institute, July 2008. John Larum, Chinese Perspectives on Investing in Australia, Lowy Institute, June 2011. Both available online at: http://www.lowyinstitute.org/.

[90] Lauren McKeon, 'The Dragon and the Polar Bear', *Up Here Business*, January 2010. Available online at: http://www.upherebusiness.ca/node/400. Wenran Jiang, *Chinese Industry and Foreign Economic Policy: Lessons for Canada*, Canadian International Council, China Papers No. 14, July 2010. Available online at: http://www.opencanada.org/wp-content/uploads/2011/05/Chinese-Industry-and-Foreign-Economic-Policy-Wenran-Jiang.pdf.

[91] For the broader political debate in Australia about China's rise, see: Dr Malcolm Cook, *Building on Strong Foundations: The Future of the China-Australia Relationship – Conference Outcomes Report,* Lowy Institute, July 2007. Hugh White, 'Power Shift:

Finally, the Unocal case is very instructive, if only for the arguments which have been put forward in opposition to the deal:

> *"Opponents of the CNOOC acquisition focused on a number of distinct arguments. First, they argued that, given high oil prices and tight supplies, ownership of key global energy assets by a Chinese state-owned firm would put global energy sources at risk, as CNOOC might hoard Unocal's oil and gas reserves for China's exclusive use, taking important supplies off the global market. Since the United States' national and energy security depended on secure supplies of oil and gas, a sale to CNOOC would compromise US national security interests. Second, opponents argued that the proposed CNOOC acquisition was an attempt by the Chinese government to control critical oil and gas supplies, and such supplies and the accompanying revenues would strengthen the Chinese government and state. Third, opponents argued that preferential loans to CNOOC by Chinese state-owned banks and CNOOC's state-owned parent put US companies at a competitive disadvantage. Fourth, opponents argued that a CNOOC acquisition of Unocal would potentially facilitate the transfer of sensitive technologies to China. Fifth, opponents maintained that, since the Chinese would never allow a US company to acquire a major Chinese oil company, the United States should block the transaction on reciprocity grounds*."[92]

A particularly interesting aspect of the case is how these perceived national security concerns can run counter to – and override – shareholder interests.[93] At the time of the controversy, Fu Chengyu, CEO and Chairman of CNOOC, wrote an opinion piece in the Wall Street Journal in an attempt to allay fears about the proposed take-over, mentioning how the Asian assets of Unocal (70 percent of its asset base) and their vicinity to the Asian consumer markets were some of the key factors making the bid for Unocal by CNOOC a sound business decision.[94] However, the outcome of the politicised debate was that the Unocal shareholders had to accept a lower bid than the proposal from CNOOC, and the company was taken over by Chevron.[95]

Australia's Future between Washington and Beijing', *Quarterly Essay* 39, 2010; Greg Sheridan, 'Distorted Vision of Future US-China Relations', *The Australian,* 11 September 2010. Available online at: http://www.theaustralian.com.au/news/opinion/distorted-vision-of-future-us-china-relations/story-e6frg6zo-1225917582189. Hugh White, 'As China rises we must look beyond U.S. alliance', *The Australian*, 13 September 2010. Available online at: http://www.theaustralian.com.au/national-affairs/opinion/as-china-rises-we-must-look-beyond-the-us-alliance/story-e6frgd0x-1225919850496. Peter Drysdale, 'China and the Challenge to American Power?', *East Asia Forum*, 13 September 2010. Available online at: http://www.eastasiaforum.org/2010/09/13/china-and-the-challenge-to-american-power-weekly-editorial/.

[92] Edward M. Graham and David M. Marchick (Eds.), *U.S. National Securuty and Foreign Direct Investment*, Institute for International Economics, May 2006, p. 130. Available online at: http://labhi.staff.umm.ac.id/files/2010/12/U.S.-National-Security.pdf. This report includes a very thorough description of the CNOOC-Unocal debate.

[93] Alan Reynolds, 'Unocal Shareholder Rights', *CATO Institute*, 14 July 2005. Available online at: http://www.cato.org/pub_display.php?pub_id=3994.

[94] Fu Chengyu, 'Why is America Worried?', *Wall Street Journal*, 6 July 2005. Available online at: http://www.chinadaily.com.cn/english/doc/2005-07/06/content_457657.htm.

[95] "Even in a worst-case scenario, the global supply available for the United States would not be materially affected. In short, there does not appear to have been a national security or economic interest case against CNOOC's proposed takeover of Unocal. (..) Unocal shareholders and the board of directors turned out to be secondary players. (…) Unocal shareholders were forced to accept a lower bid. *The CNOOC Case*, pp. 51-52, Chapter 5 in: G.C. Hufbauer, Y. Wong and K. Sheth, *US-China Trade Disputes: Rising Tide, Rising Stakes,* International Institute for International Economics, August 2006. Available online at: http://www.piie.com/publications/chapters_preview/3942/05iie3942.pdf.

Part IV: Thinking about Policy Responses to Resource Security Issues

First of all, when viewing the debate from a historical perspective, it is interesting to observe that there is a strong historical continuity in the policy solutions proposed in response to perceived resource security risks.

The US reports issued in the '70s and '80s listed the following main options for countering the concerns about high import dependencies from instable (or distrusted) countries; these are not very different from policies which are currently being considered in the European Union and the United States:[96]

1. promoting domestic production,
2. creating or expanding government-controlled stockpiles,
3. incentivising economic (company-held) stockpiles,
4. diversifying supplies, and
5. investing in research and development (to improve mining, processing, recycling, conservation, substitution and resource efficiency). –

To this list of concrete policy measures we add one key global issue: ensuring the proper functioning of global resource markets. This rather broad and overarching objective ties in to the discussion about the 'Washington Consensus' which has focused on trade liberalisation and global market integration, allowing for the free flow of resources and foreign direct investment.

Policy Responses Might Exacerbate Problems : Strategies for Stockpiling

In the debate on resource security there is often a strong focus on those resources which show high import dependency percentages, as this is the main precondition for being vulnerable to either accidental or intentional supply disruptions. Yet we would like to make the case that it is not sensible to see high import dependencies as a problem in itself. Importing raw materials which can be produced most cost-effectively abroad (relative to domestic production) can provide domestic industries with competitively-priced feedstock, and high import dependencies do not necessarily lead to problems.

Moreover, rising concerns over such high import dependencies of raw materials deemed vulnerable to a supply disruption sometimes trigger reflex responses by governments. In particular, proposals are often made regarding the first two options that are listed above: to either start stockpiling or to look for ways to promote domestic production – these being the most primary ways to address the concern. For example, in the debate on China and rare earths this is exactly what is being proposed in the United States: to include rare earths in a national security stockpile and provide loan guarantees for companies which want to mine and process rare-earth elements domestically.[97]

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[96] See: Chapter 5, Policy Options in: US Congressional Budget Office, *Strategic Critical Nonfuel Minerals: Problems and Policy Alternatives*, 1983. Available online at: http://www.cbo.gov/ftpdocs/50xx/doc5043/doc15-Entire.pdf (accessed 16 September 2010); Congressional Budget Office of the United States, *Cobalt: Policy Options for a Strategic Mineral,* 1982. Available online at: http://www.cbo.gov/ftpdocs/51xx/doc5126/doc29-Entire.pdf; National Security Study Memorandums (NSSM), *Critical Imported Materials: Study of Ad Hoc Group Established by NSSM 197/CIEPSM 33,* US Government (Nixon Administration), 1974. Available at the U.S. Bureau of Public Affairs, Office of the Historian, "Foreign Relations of the United States, 1969-1976, Volume XXXI, Foreign Economic Policy, 1973–1976", available online at: http://history.state.gov/historicaldocuments/frus1969-76v31.

[97] "And a bill introduced in March in the House by Representative Mike Coffman, Republican of Colorado, calls for the creation of a national security stockpile and for government loan guarantees for companies that want to mine and process

Yet it should be realised that these two measures are also the most disruptive, as they have the largest and most direct impact upon a market. Since they can impact upon the broader functioning of the market they should be carefully considered and preferably only very cautiously applied. In particular, stockpile policies can actually exacerbate problems and distort the market even more in tight market conditions.[98] This is especially so since stockpiling options are usually only considered when tight markets and high prices have already become a reality – not in advance – and hence the stockpiling itself would only contribute to further tight markets and price spikes.[99]

A second issue is that government-controlled stockpiles create the problem of how to manage them. Decisions will need to be made on which materials to stockpile, in what quantities and form, and how to time acquisitions and sales. By definition, decisions on buying and disposing of stockpile inventories distort normal market functioning. This can potentially hamper the proper functioning of the market and in some cases even further politicise the market. This problem has been recognised as well by historical government studies on resource security policy options.[100]

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rare earth elements in the United States. Similar legislation is being drafted in the Senate." Keith Bradsher, Challenging China in Rare Earth Mining, *New York Times,* 21 April, 2010. Available online at: http://www.nytimes.com/2010/04/22/business/energy-environment/22rare.html?pagewanted=all.

[98] This has been recognised by the EC Communication 'Tackling the Challenges in Commodity Markets and on Raw Materials', in which it was remarked: "Some of these [policy] reactions may exacerbate the tightness of supply." EC Communication 'Tackling the Challenges in Commodity Markets and on Raw Materials', COM(2011) 25 final, 2 February 2011, p. 6. Available online at: http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/communication_en.pdf.

[99] In fact, also without government-led purchases, price spikes are a quite common feature of mineral markets. In the situation of tight markets, price hikes will often have the tendency to reinforce themselves, as those holding inventories will be inclined to wait with selling until prices reach an even higher level. Moreover, outside investors might join – speculating on further price increases. The resulting price spikes are commonly observed, especially in the smaller resource markets such as tantalum, tungsten and other technology minerals.

[100] For instance, the National Security Study Memorandums (NSSM), *Critical Imported Materials: Study of Ad Hoc Group Established by NSSM 197/CIEPSM 33,* **,** US Government (Nixon Administration), 1974, p. 904, includes the statement: "Government stocks, if promptly releasable, could serve to deter price gouging and cartel-like action and provide long-term protection against the risk of interruption of supply for platinum and chromium. (…) But the distinction between price gouging and normal price movements will be a hard one for the government to make." A case illustrating the political sensitivities of stockpile management is the recent decision by the OECD countries and International Energy Agency on 23 June 2011 to release oil emergency stocks in the wake of the 'Arab Spring' turmoil and Libyan revolt. For a discussion on this issue see: Thijs van de Graaf, 'The Dangers of An Interventionist Oil Market Policy', *EU Energy Policy Blog,* 1 July 2011. Available online at: http://www.energypolicyblog.com/2011/07/01/the-dangers-of-an-interventionist-oil-market-policy/. An excerpt: "The Western oil-consuming nations have traditionally treaded very carefully with these buffer stocks, which were long considered the 'oil market equivalent of a nuclear weapon' as Javier Blas wrote in the Financial Times on June 23. These stocks were never intended to be used as a tool to manipulate the price of crude oil. Instead, they were designed as a last-resort lifeline to be used only in the most extreme circumstances, such as in the case of a severe disruption of oil supplies due to a terrorist attack. The fact that the emergency supplies were not used during major market disturbances such as the Islamic Revolution, the second Gulf War, or the oil price shock of 2008 illustrates the prudence with which the IEA has handled these reserves. (…) Today it appears as though the IEA has switched to a new doctrine. For the first time in history, the agency has used its strategic petroleum reserves in a preventive way, not because there is an actual oil supply shortage, but because it believes that such a shortage is imminent. The upcoming summer driving season, the reconstruction of Japan and the end of the maintenance period for many European refineries will push oil demand up in the coming weeks. The IEA has not waited for the shortage to happen, but it has made a bold move to anticipate it. According to some observers, the decision of last week's Thursday may be the prelude of a more interventionist oil market policy, in which the Western countries will use their buffer stocks to adjust the price of oil." The decision increased tension to the producer-consumer dialogue between the OECD and OPEC: "There was no need for the oil release, OPEC Secretary General Abdalla El-Badri said at that time. 'I hope the IEA will refrain from using this practice,' he said on June 27. 'Stocks are supposed to be for emergency use only, not commercial activity.'" 'New IEA Chief Says No Need for Another Oil Stockpile Release', *Bloomberg,* 8 September 2011. Available online at: http://www.bloomberg.com/news/2011-09-07/new-iea-chief-says-no-need-for-another-oil-stockpile-release.html.

In the past the disposal of materials that were stockpiled, especially of Cold War-era stockpiles, has sometimes had a significant influence on mineral markets, for instance in the case of tungsten.[101] Of course, if used appropriately and in countercyclical fashion, government stockpiles can also help to balance markets. In the early 1960s some of the stockpiled materials in the United States were considered to be in excess, while at the same time tight market conditions were observed in some mineral markets. The government ordered the sale of limited amounts of cadmium, and later also of antimony, lead, zinc and copper, which helped to bring down prices.[102]

Governments have sometimes attempted to limit the impact of stockpile sales upon the market. For instance, in a case slightly different from strategic stockpile sales, the United States and Russian Federation agreed in 1993 on a treaty regulating the sale of highly-enriched uranium (HEU), following the agreement to dismantle part of their nuclear weapons arsenal. This was done in order not to disturb the uranium markets too much, since uncontrolled sales could have easily caused a glut on the uranium market, bringing 'ordinary' uranium producers into financial problems.[103]

Because of the interference of strategic government stockpiling with market functioning, many argue for simply encouraging commercial stockpiling by the industry – the third option on the list introduced earlier.[104] This can be done by various measures, for instance by creating fiscal incentives for industry to maintain larger stockpiles. This removes the inherently complicated issue of stockpile management by the government, while still creating a buffer for supply disruptions. A second advantage is that promoting industry stocks is considered a less costly option than maintaining stockpiles through government agencies.[105] Of course, the only drawback is that governments

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[101] "Government stockpiles have played an important role in tungsten supply and demand over the years. During the Cold War, large quantities of tungsten materials were stockpiled in the United States and Soviet Union. From 1992 until 2004, tungsten materials were released from former Soviet stockpiles and exported to Western markets. Sales of tungsten materials from the U.S. government's National Defense Stockpile began in 1999 and continue today." Kim B. Shedd, 'Tungsten', US Geological Survey, *Geotimes*, February 2006. Available online at: http://minerals.usgs.gov/mineralofthemonth/tungsten.pdf.

[102] "Thus it can be said that the national stockpile materials served as a economic stabilizer during this period". Committee on Assessing the Need for a Defense Stockpile, US National Research Council of the National Academies, *Managing Materials for a Twenty-first Century Military*, 2008, p. 138.

[103] "This agreement [the US HEU Agreement of 1993] provided a major source of new supply – the equivalent of one major mine. Since new supplies of this magnitude can be disruptive in the uranium market, Cameco placed a high priority on ensuring this material was marketed in the Western world market in a disciplined fashion and sought participation in the marketing of the natural feed component. (…) In 1994, the United States Enrichment Corporation (USEC) as agent for the US government, and Russia, signed an agreement whereby USEC would purchase the enrichment component of the LEU upon delivery to the US. In 1999, Cameco and two other Western companies, AREVA and NUKEM, Inc. concluded an agreement with Russia in which they have the option to purchase the majority of the natural feed component of LEU. This agreement is officially called the UF6 Feed Component Implementing Contract. In November 2001, the Western companies agreed to exercise a portion of their options to bring predictability to the program – predictable supply to the Western market and predictable revenue to the Russians." Cameco, *Uranium 101,* updated 2011. Available online at: http://www.cameco.com/uranium_101/markets/.

[104] "Stockpiling of strategic minerals by the federal government became a common practice after 1939, and the practice was sharply increased after World War II. (…) The mineral industry has often been critical of the government's stockpiling policy, since sudden large purchases or sales from the stockpile can have drastic artificial effects on the price and demand for a commodity. Economists generally tend to favour private-sector management of inventories." Howard L. Hartman, Chapter 1.2 'Elements of Mining' in: *SME Mining Engineering Handbook*, 2nd Edition, Vol. 1, 1992, p. 25. Also see: Michael Shafer, *Mineral Myths*, Foreign Policy vol. 47, 1982, pp. 163-165.

[105] "These forms of government incentives for larger industrial inventories of the problem materials would be less costly than a government economic stockpile and avoid government involvement in difficult decisions on timing of acquisitions and releases. But the government would have limited control over the purposes for which inventories were used, particularly price speculation as opposed to protection against disruption." National Security Study Memorandums (NSSM), *Critical Imported Materials: Study of Ad Hoc Group Established by NSSM 197/CIEPSM 33* **,** US Government (Nixon Administration), 1974, p. 904.

cannot order companies to release stocks in the case of high prices, so markets will still remain vulnerable to market participants and investors which wish to speculate on further price increases and retain commodity stocks for that purpose.

Challenges to Increasing Domestic Production

Promoting domestic production is even a more complicated matter. Although this might appear as the most fundamental solution to combat high import dependencies and related risks, this is often practically infeasible because of either geological or economic reasons. When geological resources are not available, neither is this option. Yet even for those raw materials where domestic production is technically possible, costs are sometimes prohibitively high. If extraction and production is more expensive than international imports, promoting domestic production would in fact necessitate some form of subsidies. Given the fact that this would only achieve an effect if sustained for a prolonged period of say several decades, the costs quickly run out of hand, even if the cost difference with imports is only small.

After the major historical cobalt crisis described earlier, the US government considered subsidising domestic production. Yet for its thoughtful considerations it is worthwhile quoting at length the conclusions from the report that emerged in the wake of this crisis, analysing the option of 'subsidising domestic production':

"When prices were high in 1980, proposals were made to subsidize the domestic production of cobalt. It was estimated that up to a dozen years of domestic cobalt production of six million pounds per year (37.5 percent of 1980 primary cobalt demand) would be achievable. Domestic mine production could alleviate world cobalt market tightness in the event of a supply shortfall, thereby reducing the need for adjustment by cobalt users. Domestic mine production could also deter major price increases to the degree that it responded to them with increased output.

Benefits from domestic production would have to be weighed against costs incurred. According to the mining companies with the best prospects, a floor price would have to be set in the $25 range and guaranteed for at least ten years. Twenty-five dollars per pound is significantly above today's cobalt price ($12.50 per pound), and only marginally below the peak price of 1980. It is also considerably above most price projections for the 1980s. Table 10 shows what the annual costs of such a subsidy would be at different market prices. Although these costs are not large, ranging up to $132 million a year (assuming production of six million pounds per year), they must be seen as a form of insurance against a hazard that is not likely to occur. If cobalt prices remained at $12.50, and if cobalt domestic production was subsidized for ten years at $25 per pound, the present value cost of this subsidy (assuming a 2 percent discount rate) would be $673 million. This would do no more than to put domestic production in place; it would not guarantee supplies for U.S. consumers, nor would it provide for defense needs after the ten-year period. Since only the most extreme case of cobalt supply disruption would incur significant costs, the highly unlikely probability of the extreme case makes domestic mine subsidization appear, like economic stockpiling, to be an expensive insurance policy."[106]

[106] Section 'Subsidization of Domestic Mine Production' in Chapter 5: 'Policy Options' in: Congressional Budget Office of the United States, *Cobalt: Policy Options for a Strategic Mineral,* 1982, pp. 31-32. Available online at: http://www.cbo.gov/ftpdocs/51xx/doc5126/doc29-Entire.pdf.

The US report *Strategic Critical Nonfuel Minerals: Problems and Policy Alternatives* from 1983, which analysed a range of raw materials, came to similar overall conclusions. It noted that subsidised domestic producers would quickly cease production as soon as government purchase contracts would expire if production was not cost-competitive and that subsidisation of domestic mineral production would be a rather costly risk insurance policy.[107]

Of course, there might be other aspects that hamper domestic production apart from costs.[108] Removing obstacles such as undue regulatory complexity are always sensible actions to take. Insofar as environmental legislation is restricting potential extractive operations, it will be necessary to carefully weigh the various interests and government objectives in different fields to come to a balanced decision on the matter.[109]

'No-Lose' Options: Diversifying Supplies, Promoting Resource Efficiency and Recycling

Finally, there are some 'sure-fire' options that are always worthwhile pursuing, including the last few options on the list introduced earlier: diversifying supplies and promoting resource efficiency and recycling.

Diversification of supplies can sometimes be achieved without incurring extra costs, in which case it is clearly a sensible 'no-lose' strategy to follow. Yet diversification can be difficult to achieve when economic logic would point to securing more supplies from the lowest cost provider. The key question again is what premium are governments and companies willing to pay in order to reduce a dependency upon predominant producers; just as an insurance fee, the costs should be measured against the risks and potential impact of any problem, whether accidental or intentional.

As for promoting resource efficiency and recycling, this is another 'no-lose' option, as it will lower the relative dependency upon imported primary materials. As mentioned earlier in this paper, high prices will be a natural incentive for this and can in fact make an economy or industry sector more robust to withstand supply disruptions. Governments can sometimes play an important role – not necessarily by subsidising or influencing the economics, but in the case of recycling of metals for instance, by providing a regulatory framework on waste management which makes more efficient material recovery and recycling possible. For major base metals, such as iron, copper, aluminium and lead, recycling is well-established and a major component of supply with recycling input rates

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[107] "Nor is it likely that productive capacity would remain in place after government purchases were suspended unless it could operate at competitive prices. (…) Nevertheless, there might be cases when competitive production capacity could be created with the help of some initial public financing. If the required federal subsidy was a low percentage of the market price, it might be preferable to bear this cost than to incur the expense of a three-year stockpile. But, this case would most often apply in metal industries that already have substantial domestic excess capacity and that pose the smallest security risks." (…) "It is difficult to justify production subsidy programs unless most of the cost is warranted as an efficient method of insuring the country against the risks of supply shortages." Section 'Subsidization of Domestic Production' in Chapter 5, 'Policy Options' in: US Congressional Budget Office, *Strategic Critical Nonfuel Minerals: Problems and Policy Alternatives*, 1983, pp. 69-72. Available online at: http://www.cbo.gov/ftpdocs/50xx/doc5043/doc15-Entire.pdf (accessed 16 September 2010).

[108] In this respect, it is interesting to read the comments by the European Association of Mining Industries, Metal Ores & Industrial Minerals (Euromines) submitted as part of the DG Environment Stakeholder Consultation on the Resource Efficiency Roadmap, undated. Available online at: http://ec.europa.eu/environment/resource_efficiency/pdf/Euromines.pdf.

[109] The environmental impact of domestic production is a key issue in the debate around the growing exploitation of shale gas in the United States and oil sands in Canada.

between 25 and 75 percent (i.e., share of secondary sources in total primary consumption).[110] Yet especially for smaller technology minerals, recycling is often still minimal – mostly because economies of scale have not been reached, recovery from discarded products is complicated and prices are not high enough to make recycling commercially attractive.[111] History shows that often it takes a major price spike or supply crisis to incentivise a breakthrough and establish recycling systems.[112] Yet recent concerns over the sustainability of our rising demand for resources have put a renewed focus on improving resource efficiency and developing recycling techniques, such as e-waste collection and urban mining.[113] Taking end-of-life recycling considerations into account at the product design stage can further greatly enhance the scope for recycling.

Government support can play a role in promoting these trends, and these are partly already being undertaken, such as the European Union *flagship initiative for a resource-efficient Europe* under the Europe 2020 strategy.[114] Taking a broader viewpoint, there is a strong case to be made for support for R&D investments in the development of more advanced technologies related to energy and mineral resources in the extraction stage, processing stages and resource efficiency in end-uses.

As we have seen in the analysis of this paper, high prices and constrained supply often are main drivers for technological innovation. Regarding the extractive industry, exploration technologies for both energy and mineral resources have become much more advanced, as have the recovery techniques.[115] Similarly, periods of high prices have incentivised enormous technological progress in the field of resource efficiency, substitution and recycling. Taking the lead in the development of such advanced technologies is never a bad strategy. Since tight markets are bound to return in these cyclical industries, being resource efficient and having advanced extractive or resource efficient

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[110] There are various concepts for measuring recycling in various ways/stages: there is the *end-of-life (EOL) recycling rate*, which indicates what percentage of all the metal in discarded products is being recycled as a secondary source of supply; second, there is the *recycling input rate* (or *recycled content*) which is the fraction of recycled metal from new and old scrap in relation to the total metal input, i.e. which percentage of metal input originates from recycled material. The latter *recycled input rate* for iron is estimated to be between 28-52 percent, copper 20-37 percent, aluminium 34-36 percent, lead 42-63 percent. A detailed discussion can be found in Chapter 3 'Defining Recycling Rates' and Appendices C and D 'Review of (Non-)Ferrous Metal Recycling Statistics' in: United Nations Environment Programme (UNEP), *The Recycling Rates of Metals*, 2011. Available online at: http://www.unep.org/resourcepanel/Portals/24102/PDFs/Metals_Recycling_Rates_110412-1.pdf.

[111] "(R)ates tend to reflect the degree to which materials are used in large amounts in easily recoverable applications (e. g., lead in batteries, steel in auto- mobiles), or where high value is present (e. g., gold in electronics). In contrast, where materials are used in small quantities in complex products (e. g., tantalum in electronics), or where the economic value is at present not very high, recycling is technically much more challenging." United Nations Environment Programme (UNEP), *The Recycling Rates of Metals*, 2011, p. 18. Also, for instance: James Kanter, 'Fancy Batteries in Electric Cars Pose Recycling Challenges', *New York Times*, 30 August 2011. Available online at: http://www.nytimes.com/2011/08/31/business/energy-environment/fancy-batteries-in-electric-cars-pose-recycling-challenges.html?pagewanted=all.

[112] Various case studies are described in: Oakdene Hollins*, Material Security: Ensuring Resource Availability for the UK Economy*, March 2008.

[113] International Institute for Sustainable Development, 'UNEP and European Commission Launch Metal Recycling and Decoupling Reports', 26 May 2011. Available online at: http://uncsd.iisd.org/news/unep-and-european-commission-launch-metal-recycling-and-decoupling-reports/. United Nations Environment Programme (UNEP), *Decoupling Natural Resource Use and Environmental Impacts from Economic Growth*, 2011. Available online at: http://www.unep.org/resourcepanel/decoupling/files/pdf/Decoupling_Report_English.pdf.

[114] See: http://ec.europa.eu/resource-efficient-europe/.

[115] One can think of 3-D seismic imaging, horizontal and 3-D drilling, deep sea drilling, enhanced oil and gas recovery techniques, unconventional oil & gas production methods, etc. On the mineral side, continuous technical improvements have made the mining of increasingly less rich ore bodies possible and profitable. Moreover, there is a strong interest for 'clean' or 'green' mining techniques that minimise the environmental impact. See, for instance the so-called 'Green Mining Initiative (GMI)' by National Resources Canada (online information available at: http://www.nrcan.gc.ca/mms-smm/nmw-smc/gmi-gmi-eng.htm): "GMI is a research program to find improved ways to protect and remediate the environment, and to find better alternatives to existing technologies for mineral extraction, mineral processing and environmental reclamation. The focus has been placed on four main research pillars: footprint reduction, innovation in waste management, ecosystem risk management and mine closure and rehabilitation."

technologies that can be marketed will have double benefits. Not only will the economy and specific industrial sectors be better prepared to deal with such market conditions, but there will also be export opportunities, as global interest in such technologies will rise.

The Larger Challenge: Ensuring a Global Flow of Energy and Minerals

The fundamental question which has been looming in this discussion is how global resource markets will develop in future. As we have seen in the course of discussions above, economies and markets are able to overcome many problems as long as they function well. Yet ensuring the proper functioning of global markets is one of the most complex goals to address.

Achieving it is too large of a goal for any single country to tackle by itself. This challenge touches upon very essential questions about the position and strength of global governance in the international political and economic system. To open up global markets and allow for the free flow of resources and foreign direct investment has in fact been one of the major objectives of the Washington Consensus – and the current questions relate to how this 'consensus' might evolve. [116]

A few key prerequisites for proper market functioning are transparency, level playing fields and fair market rules which are reasonably well enforced. Although these aspects remain ideals and are clearly not completely attained, a sufficient basis of these conditions provides the necessary trust and confidence in the global markets to rely on them and participate in them. In particular, they should address the concern about unequal access and unequal economic opportunities by providing transparency of prices, trade flows and investment conditions. Perception of unfair treatment or unequal opportunities can already lead to political tension, regardless of the actual situation.

The World Trade Organization provides a broad overarching regulatory system aimed at creating a reasonably fair playing field for international trade, which we have discussed earlier. On transparency, some initiatives are the Joint Organisations Data Initiative for oil (JODI) by the International Energy Forum and the Extractive Industries Transparency Initiative (EITI).[117] Another exemplary initiative has been the Energy Charter Treaty (ECT) that aims to establish shared global rules on energy trade, transit and investments. Progress in these fields has been difficult, but at least there has been a certain momentum in this direction. Other important roles are played by the international commodity exchange platforms via which international trade is taking place.

One of the key questions still open is whether globalisation and global trade in resources will continue to grow in its current form, as it has done for the past couple of decades. According to some, the current system of globalised trade has been made possible by the strong role of the United States as its guarantor, and a shift towards a different global system might be occurring.[118] Yet what the consequences will be for global trade in energy and mineral resources remains the major question to be addressed.[119]

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[116] On this discussion, see: Coby van der Linde, 'Energy in a Changing World', Inaugural lecture, Clingendael Energy Paper No. 11, 2005. Available online at: http://www.clingendael.nl/publications/2006/20060308_ciep_paper_vanderlinde.pdf.

[117] See: http://www.jodidata.org/ and http://eiti.org/.

[118] See, for instance: The New Global Economic Order, Chapter 1 in: Robert Gilpin, Global Political Economy, 2001. Available online at: http://press.princeton.edu/chapters/s7093.pdf; and Introductory Chapter 'The Fragile Global Economy' in: Robert Gilpin, 'The Challenge of Global Capitalism, 2000'. Available online at: http://press.princeton.edu/chapters/i6778.pdf.

[119] This question is the central issue which is extensively analysed in the EU POLINARES Project; see: www.polinares.eu.

Conclusion

There appears to be a sense of alarmism surrounding the debate on resource security, caused in part by misconceptions regarding the functioning of resource markets. With the analysis presented in this paper, we have tried to address the main concerns and provide a balanced approach to resource security issues.

First of all, it is important to note the historical parallels that exist between earlier periods of tight resource markets and contemporary concerns over access, prices and resource availability. Political attention for resource security has fluctuated largely in line with price developments; awareness of this historical context can provide a source of nuance and reflection. In fact, as noted in the first briefing paper *Critical Thinking about Critical Minerals: Assessing Risks Related to Resource Security*, periods of severely constrained markets are an almost inevitable characteristic of the 'hog cycles' of capital-intensive resource sectors.[120]

The analysis in this paper suggests that we tend to overestimate our own vulnerability. Past experiences with supply disruptions and price spikes should give us a bit more confidence that we are actually able to deal with these problems when they come up. This holds true in particular for the technology minerals that are identified by criticality studies.

The first briefing paper provided a critical analysis of 'criticality' studies that has been elaborated upon in this second briefing paper. The short-lists of 'critical minerals' which are presented by these studies consist mainly of 'technology minerals' whose special properties are often in demand by specific high-tech applications.

We argue that the supply risks associated with these technology minerals appear to be exaggerated. The markets for such technology minerals are often quite small in terms of total tonnage and number of producing mines, causing concentration levels in a producer country (or company) that seem very alarming but that are in fact not so fundamental and can be easily overcome through diversification in the medium term. Moreover, severe price spikes are quite common in such speciality mineral markets, as demand for a specific mineral often expands suddenly due to some technological innovation or new application. Yet price increases of technology minerals usually translate into very limited price increases of the end-products in which they are used, as they often constitute only a small share of the overall cost. Such price increases can easily be borne by consumers in many cases, causing little detrimental economic effect. Moreover, high prices have traditionally spurred innovation in substitution and resource efficiency that have mitigated the tight supply situations. In-depth case studies on China and rare earths and on the cobalt crisis of the 1970s have served to illustrate these points in this paper.

In the first part of this paper we furthermore addressed some common misconceptions concerning resource markets. In particular we discussed the fear of resource depletion and the dynamic nature of reserve statistics. These concerns, too, have a long history: fears of running out of coal already surfaced during the Industrial Revolution in Great Britain but never materialised.

[120] See: *Critical Thinking about Critical Minerals. Assessing Risks Related to Resource Security,* 2011, CIEP-BGR Joint Briefing Paper, 2011. Available online at: www.clingendael.nl/ciep.

Part II of this paper analysed a set of concerns related to prices, pricing and competitiveness. We briefly discussed issues such as price volatility, pricing mechanisms, the impact of international prices differences on economic competitiveness, and governance on such issues provided by the World Trade Organization.

Among other observations, we have argued that the impact upon industrial competitiveness caused by international price differences for energy and mineral resources often seems exaggerated, especially in the face of the considerable disparity in prices which already exists globally. Only in the case of very energy- or mineral-intensive industries is this likely to have a decisive effect. However, for other industries, including those using technology minerals, availability is a stronger concern than price and the impact of high prices is less likely to be crucial for production and competitiveness. To a certain degree, high resource prices can even have positive effects by making economies more robust in withstanding price shocks while incentivising resource efficiency, substitution and recycling.

In Part III, we have looked into the assertion that resource markets have now entered a fundamentally different era due to the enormous demand growth coming from emerging markets, especially China. Apart from the impact of such demand growth, there has been a growing concern about the activities of state-owned enterprises in resource markets worldwide and apprehension about the investments which are being made in resource-rich countries. In general, there seems to be a tendency to interpret resource sector developments largely in strategic terms, whereas the economic factors that drive many market developments are often underestimated.

Our analysis suggests that concerns about the potential non-economic behaviour of state-owned companies in the resource sector certainly have validity, yet they should also be seen in proper perspective: state-owned companies and governments are separate entities, and their diverging interests regularly cause tensions between them. Furthermore, state-owned enterprises largely participate in the same global markets as all other companies, also with the objective of maximising profits. At this moment, bilateral flows do not seem to undermine the functioning of global resource markets. Considering oil, for instance, the complaint about Chinese equity oil projects which divert oil away from the market by means of bilateral deals does not seems warranted. The relevant volumes are only marginal, and supplies that are shipped back to China for internal consumption do not need to be bought on the international oil market, thus alleviating demand pressure there.

Resource sector investments often give rise to political concerns. Yet taking China as an example, it should also be acknowledged that given its massive demand for resources, expanding resource sector investments overseas is a legitimate and understandable strategy. It does not seem very sensible to see such investments as threatening in themselves, as in principle they will expand supply. Moreover, proposed investments in industrialised countries such as the United States, Canada or Europe often become politicised mainly because of perceptions.

Finally, we provided a discussion on policy measures in response to resource security concerns in Part IV. A first observation is that during the past half century proposed solutions have not changed much: promoting domestic production, creating strategic stockpiles, incentivising industry-held stockpiles, diversifying supplies, investing in R&D for resource sector technologies, and promoting

resource efficiency and recycling. Some of these measures, such as government-controlled stockpiling and subsidised production, can be quite disruptive to the market and might exacerbate problems, so they should be carefully considered and cautiously applied.

Furthermore, we argue that measures guarding against supply disruptions can best be seen as an insurance policy, in which costs are measured against the potential risks and impact. Analysis of historical cases show that both the risk of a supply disruption and its economic impact are sometimes overemphasised. Regarding policy solutions, diversification of supplies is of course a 'no-lose' strategy when it can be pursued profitably. As soon as extra costs are involved, the diversification result has to be weighed against the price premium. Other 'no-lose' options are promoting resource efficiency and recycling, and resource sector technology development in general. Resource efficiency, conservation, recycling and substitution are all incentivised by high prices, yet government involvement – including other means than direct financial support – can be effective in achieving progress in these fields. Improving resource efficiency makes an economy – and the specific industries which are part of it – better prepared in cases of supply disruption or high prices. Moreover, the development of new technologies in the extractive, processing, recycling or end-use stages, which either improve resource efficiency or provide more supplies, can yield commercial opportunities in future. Interest in such technologies will inevitably rise as soon as tight markets and high prices return.

The final question taken into consideration is how to ensure the proper functioning of global resource markets, as this is the fundamental long-term challenge. As we have seen through various examples, markets and economies are able to withstand quite severe price spikes and supply disruptions. Moreover, the concern that we are moving towards an era with more strategic interference in markets is not a new one. Of course, the possibility that resource markets will fundamentally change in character in the long run cannot be excluded; this topic is addressed in more detail in the EU POLINARES project.[121] Yet hopefully the cases and analysis presented in this paper can help to find a balanced approach towards resource security in future.

[121] For more information see: www.polinares.eu.