

# **HM GOVERNMENT HORIZON SCANNING PROGRAMME**

## **RESOURCE NATIONALISM**

A HORIZON SCANNING RESEARCH PAPER  
BY THE  
RESOURCES DEMAND AND SUPPLY RESOURCE NATIONALISM  
COMMUNITY OF INTEREST

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NOTE TO THE READER: THIS ANALYSIS WAS COMPLETED IN 2013 AND HAS NOT BEEN UPDATED WITH MORE RECENT DATA BUT SENSITIVE INFORMATION, SUCH AS POLICY IMPLICATIONS HAVE BEEN REMOVED

## INTRODUCTION

1. This paper explores the issue of resource nationalism, particularly in relation to energy and metal and mineral supplies, and the potential implications for the UK.

## WHAT IS RESOURCE NATIONALISM?

2. There is no fixed definition of resource nationalism. It can encompass nationalisation and expropriation of foreign companies, export restrictions, cartel pricing behaviour or high taxation. In this paper we define resource nationalism as anti-competitive behaviour designed to restrict the international supply of a natural resource.
3. There is concern about resource nationalism driven by three main factors:
  - a. **Population growth.** The world's population is forecast to grow from 6.9 billion in 2010 to 8.3 billion in 2030 and 9.1 billion in 2050<sup>1</sup>, and within this there are expected to be more than 3 billion extra middle class consumers by 2030<sup>2</sup>. Rising demand causes prices to rise, which can incentivise governments to try to capture a share of increased profits.
  - b. **Uneven worldwide distribution of resources.** In some cases both physical reserves and production are concentrated in a small number of locations, which presents an increased risk to market supply.
  - c. **Governance issues.** At a national level, if the wealth from resource exploitation benefits only a minority of businesses or individuals, it may result in unrest or conflict, jeopardising future investment and production. At an international level, the increasing influence of emerging economies may alter global governance structures or shift the power distribution within existing institutions, thus making the resolution of resource trade disputes more uncertain.
4. Annex A sets out the incentives to engage in resource nationalism and considers the disadvantages of doing so. Since no country is fully self-sufficient, no country is immune to the impacts of retaliation by other countries. China, once self-sufficient, only domestically produced 37% of its aluminium, 29% of its iron, and 26% of its copper requirements in 2011<sup>3</sup>. China's import dependency means it is a price taker for these metals, despite being a significant producer in its own right.

## KEY RESOURCES

5. For the UK, energy and metal and minerals supply represent two potentially key areas of risk in terms of resource nationalism.
6. **Energy**
  - a. In terms of energy, our analysis suggests that whilst resource nationalism does and will continue to affect supply and prices, the major risks to the UK economy are already factored into the UK Government's policy approach. Annex B sets out an analysis of oil, coal and gas, and concludes that, for the fossil fuels considered, the proportion produced by the three largest producers is not above the threshold considered to be critical for the purposes of this analysis<sup>4</sup>. The production concentration<sup>5</sup> and import dependence<sup>6</sup> is lower than those found

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<sup>1</sup> UN Population Division - World Urbanization Prospects: The 2009 Revision Population Database

<sup>2</sup> McKinsey Report, Resource Revolution: Meeting the World's Energy, Materials, Food and Water Needs, November 2011

<sup>3</sup> Chatham House Resources Futures 2012

<sup>4</sup> Threshold: top 3 producers account for 70% of global production.

<sup>5</sup> Dependence on fossil fuels is the ratio of total net imports to total demand

<sup>6</sup> Import dependency for oil and gas is forecast to rise through to 2030 while coal is forecast to fall. See annex B

for the minerals and materials considered below. For example, while forecasts suggest rising dependence, 2012 UK gross import dependence for oil and gas is 36% and 39% respectively, the figure is 100%<sup>7</sup> for niobium and tantalum. Figure 1 below shows the top 3 producers share of global production, possibilities for substitution and UK net import dependency for fossil fuels.

Fossil fuel	Top-3 producers share of global production	Substitutability	UK net import dependency 2012
Oil	35.6%	Low (short-term) Low (medium-term)	36%
Gas	42.7%	Low (short-term), Medium (medium-term)	49%
Coal	67.1%	Low (short-term), Medium (medium-term)	69%

Figure 1: Fossil fuel market analysis<sup>8</sup>

- b. While the coal market appears relatively concentrated, this is distorted by Chinese production (47.5%), which is all used for consumption in China. Import dependency is also high but forecasts show the UK will consume less coal over time. Overall, the threat of resource nationalism even for coal appears low.

## 7. Minerals and materials

- a. There are numerous studies that have attempted to assess which critical minerals and materials are at risk of disruption to supply<sup>9</sup>. The most relevant<sup>10</sup> of these for the UK is a recent study assessing critical materials for the EU<sup>11</sup> which identified 14 critical metals ('the EU 14 metals'). This takes account of both supply risks and the economic importance of a range of raw materials. The list of materials considered critical is consistent with other studies in the literature.
- b. Factors influencing supply risk included the concentration of worldwide production, the political and economic stability of producing countries and the potential for substitution, including substitution by recycled raw materials. The report includes consideration of materials which are by-products of other metals; these have more complex markets and technological requirements for extraction<sup>12</sup>. The analysis for the economic importance of the EU 14 metals was relatively basic - attributing to each metal the value added of the economic sector that uses the metal as an input. We identify this as an area for further research.
- c. The traditional demarcation between resource importers and exporters can be misleading. Processing hubs are embedded in intricate global supply chains which add another layer of complexity. For example, many multinational car companies use Thailand as a manufacturing hub importing refined materials from Japan and South Korea. Although there have been no cases reported, resource nationalism from processing hub countries appears an underexplored area in the literature, explained in part by the difficulty of disentangling individual supply chains. Similarly, a large share of global resource trade now passes through a limited number of ports and shipping channels. However, although concentration

<sup>7</sup> British Geological Survey Mineral profiles: Niobium-Tantalum 2011

<sup>8</sup> Sourced from [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/136390/production\\_projections.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/136390/production_projections.pdf) And [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/208565/coal.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/208565/coal.pdf)

<sup>9</sup> For example: US Department of Energy: 2010 Critical Materials Strategy; Defra: A review of resource risks to business and an assessment of future viability; Defra & BIS: Resource Security Action Plan: making the most of valuable materials, SEPA: Raw Materials critical to the Scottish Economy 2011; Science and technology committee: Strategically important metals 2010-12, British Geological Survey: Risk List 2012.

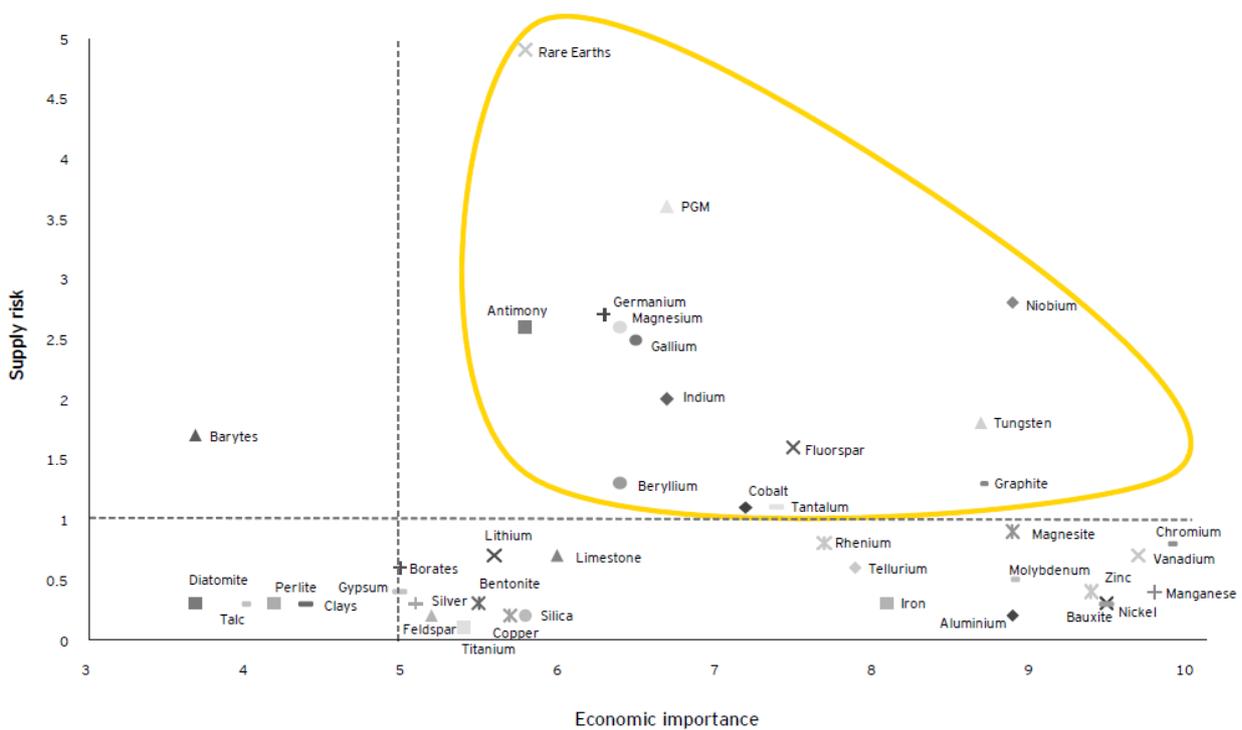
<sup>10</sup> E.g. The UK Minerals centre for sustainable mineral development endorses the EU report

<sup>11</sup> [http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/report-b\\_en.pdf](http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/report-b_en.pdf) This report has since been updated: [http://ec.europa.eu/enterprise/policies/raw-materials/critical/index\\_en.htm](http://ec.europa.eu/enterprise/policies/raw-materials/critical/index_en.htm)

<sup>12</sup> Typical by-product metals are germanium, Indium and gallium which are extracted in addition to the carrier metal. For example gallium is found in bauxite (aluminium ores)

of supply routes is highlighted as an issue for energy and food markets it appears less of a concern for metals and minerals<sup>13</sup>.

- d. Figure 2 shows the economic importance and supply risk of the 41 metals and materials considered in EU 14 metals report. The critical 14 are circled in yellow.
- e. Whilst one of the criteria used to assess the materials in Figure 2 was the potential for substitution by other inputs, it is very difficult to predict the impact of innovation and changing technology that could, in the future, make any one of the materials obsolete. While none of the EU 14 metals are physically scarce, disruptions to supply, current or expected, may incentivise innovation and/or exploration which would reduce exposure to supply risks in the future.



Source: Critical raw materials for the EU: report of the Ad-Hoc Working Group on defining critical raw materials, European Commission, June 2010.

Figure 2: Importance and supply risk of metals and minerals considered in the EU 14 metals report

- f. It is useful to contextualise the size of the global markets for the EU 14 metals. The ICMM<sup>14</sup> (2012) lists typical volumes of annual metal production; the pie chart at Annex C illustrates that although considered important, the EU 14 metals account for a relatively small proportion of the total value of the global metals and minerals market. New emerging demands can therefore be met by the opening of a small number of new mines, although, like many infrastructure projects requiring major planning and management, there may be significant lead times associated with this.

## 8. Section Conclusion

- a. Our analysis suggests that the risk to the UK of resource nationalism for fossil fuels is relatively limited and is factored into current government policy. The remainder of this paper therefore focuses on metals and minerals, in particular the EU 14 metals identified in Figure 2.

<sup>13</sup> Chatham House: Resources Futures 2012

<sup>14</sup> International Council on Mining and Metals

## WHICH COUNTRIES ARE KEY TO SUPPLY?

9. Intuitively, resource nationalism is likely to have a greater effect on global terms of trade when production is concentrated in few countries.
10. Figure 3 shows the market share of the largest producer<sup>15</sup> of each of the 14 critical metals and minerals<sup>16,17</sup>. Including the 3 largest producers sees the concentration rise to over 70% for all the materials in graph 1 except Cobalt (see Annex D). China dominates production for the majority of these materials. Although production is highly concentrated, this does not necessarily suggest that future production possibilities will be similarly geographically concentrated. Based on reserve data, there are additional countries that might become more important producers in the future<sup>18</sup>, although more generally reserves tend to be more geographically dispersed (See Annex D)<sup>19</sup>. New supply sources could help limit the impact of resource nationalism in strategic metals, such as the US re-opening rare earth mines in California in 2010<sup>20</sup> in response to Chinese export restrictions. There are, however, potential obstacles for green-field projects given planning restrictions and other project management requirements that can result in considerable lead times.

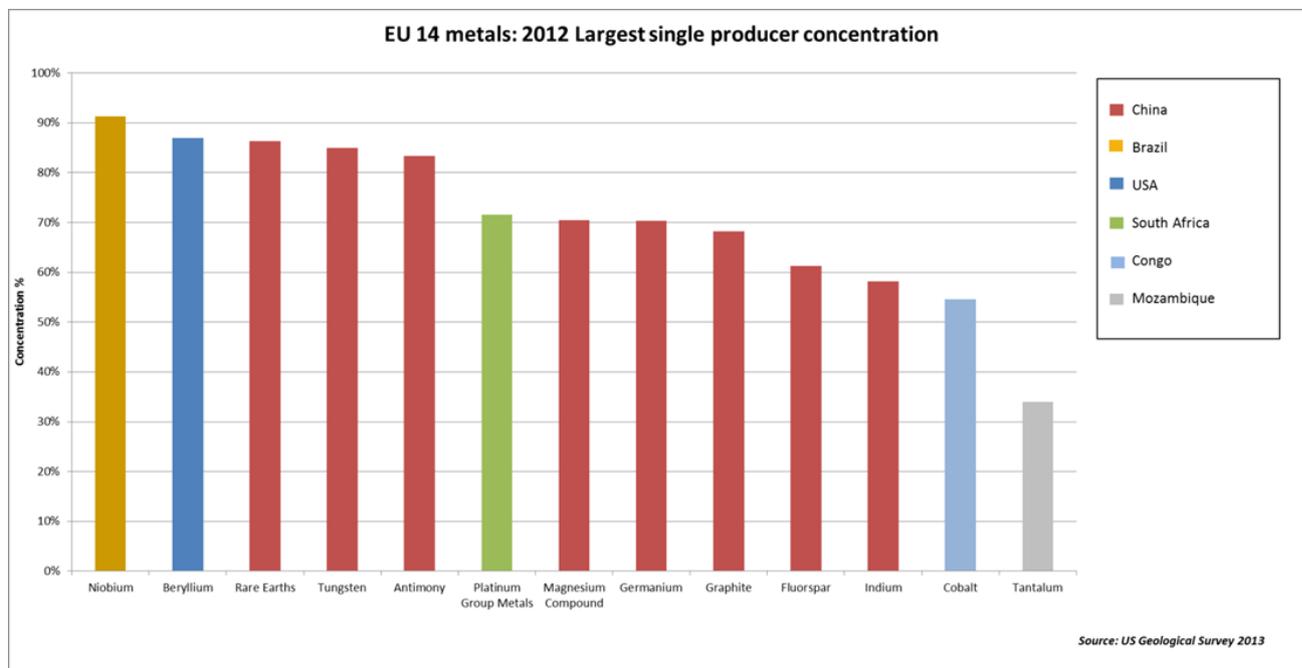


Figure 3: EU 14 metals, 2012 largest single producer concentration.

11. Countries may increase their economic power by acting as a cartel; OPEC is the most obvious example of this. There is some evidence that regional groups are trying to formulate natural resource strategies in a collective manner such as the South American Union of Nations and the African Union. Russia and South Africa are also reported to have attended talks about the formation of a cartel in the platinum group metals market (PGM)<sup>21</sup>. The rise of regional blocks is well reported in the geopolitical literature. Regional blocks are increasingly intervening in the

<sup>15</sup> Processing hubs are out of scope for this paper but have been identified as important. See Chatham House 2012: Resources Futures p23

<sup>16</sup> Except Gallium for which there is no Data

<sup>17</sup> Taken from the 2013 US Geological Survey

<sup>18</sup> Russia (antimony, magnesium compound), Bolivia (antimony), Australia (cobalt, tantalum), Cuba (cobalt), Mexico (fluorspar), India (graphite), North Korea (magnesium), Brazil (tantalum)

<sup>19</sup> There are inherent uncertainties in the calculation of reserves and their quality for strategic metals

<sup>20</sup> <http://www.wired.com/wiredscience/2012/05/rare-earth-mining-rises-again/>

<sup>21</sup> <http://www.pressdisplay.com/pressdisplay/viewer.aspx> & <http://mq.co.za/article/2013-04-05-00-russia-sa-plan-an-opec-for-platinum>

management of natural resources with the objective of maintaining collective resource security, reducing regional competition in the access to resources and minimising local scale resource driven conflicts. For example, both the Union of South American Nations and the 50 members of the Committee of the Intelligence and Security Services of Africa have met in the last year to discuss how to protect the sovereignty of their natural resources<sup>22</sup>. Collective action amongst key exporters, in already concentrated markets, could exacerbate the impacts of resource nationalism on prices and supply chains, although the difficulty in creating, sustaining and coordinating cartels and supra-national organisations mitigates this.

12. While individual countries have sovereign rights to natural resources, there is concern about resource production concentration at company level. Three producers control over 60% of platinum production<sup>23</sup>; three companies control approximately 85% of niobium production<sup>24</sup>; and six companies control 90% of antimony production for example<sup>25</sup>. There appears to be relatively little centralised evidence on company concentration in minerals and metals markets, which is a key evidence gap.
13. Section Conclusion: Supply risk in key minerals and metals – There are significant monopolistic production structures in EU 14 metals: Brazil for niobium, USA for beryllium, China<sup>26</sup> and South Africa for platinum group metals and Congo for Cobalt. In these markets, countries have the ability to affect global prices for raw materials and have most to gain from resource nationalism. In addition there may be an issue with market concentration at the firm level, although evidence on this is difficult to obtain. Despite few cases, there is therefore potential for key producers (firms or countries) to act in a co-ordinated manner to manipulate global prices.

## PAST EXPERIENCE AND INSTITUTIONAL FRAMEWORKS

14. Export restrictions and levying taxes are the most common form of resource nationalism. These include quantitative export restrictions (quotas), export taxes and mandatory minimum export prices. Other forms include outright nationalisation (e.g. Argentina taking 51% stake in YPF<sup>27</sup> from Repsol in 2012<sup>28</sup>), royalties and 'land acquisition'. Recent land acquisitions by China have received significant media coverage, however it is estimated that China has a controlling stake in less than 1% of the global mining industry outside its own country<sup>29</sup>.
15. An OECD study analysing 21 metals and minerals<sup>30</sup> found that incidents of exports restrictions were imposed on 8 of the EU 14 metals. The data shows there have been 39 isolated incidents of export restrictions for these metals between 1999 and 2009<sup>31</sup>. Of the 39 reported incidents, China is responsible for 33 of them, particularly in the markets for tungsten and REE's<sup>32</sup>. There were only two incidents of export bans and this was in scrap metals markets.
16. Following export quotas and an increase in taxation on REE's in China (on environmental grounds) in 2008, non-Chinese rare earth processors paid 31% more for rare earth raw materials than their Chinese counterparts<sup>33</sup>. However, REE's are used in such small quantities

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<sup>22</sup> See e.g. <http://www.eclac.org/cgi-bin/getProd.asp?xml=/prensa/noticias/comunicados/6/49976/P49976.xml&xsl=/prensa/tpl-i/p6f.xsl&base=/prensa/tpl-i/top-bottom.xsl> & <http://www.issafrica.org/iss-today/securing-africas-natural-resources-to-avoid-conflict>

<sup>23</sup> Chatham House 2012, Resources Futures p112

<sup>24</sup> <http://tanb.org/niobium>

<sup>25</sup> <http://www.mining.com/web/antimony-market-to-remain-volatile-while-china-restructures-for-the-future/>

<sup>26</sup> For rare earths, tungsten, antimony, magnesium compound, germanium, graphite and fluorspar

<sup>27</sup> Yacimientos Petrolíferos Fiscales

<sup>28</sup> Chatham House Resources Futures 2012

<sup>29</sup> Chatham House Resources Futures 2012

<sup>30</sup> Chromium, platinum, tantalum, manganese, vanadium, molybdenum, rhenium, lithium, tungsten, rare earths, antimony, indium, cobalt, silver, titanium, copper and nickel

<sup>31</sup> OECD 2009 Export restrictions on strategic raw materials and their impact on trade and global supply

<sup>32</sup> Rare Earth Elements

<sup>33</sup> OECD 2009 Export restrictions on strategic raw materials and their impact on trade and global supply

that it had limited impact on prices of final goods. Based on a brief literature search there appears to be few documented cases of export restrictions on metals affecting global prices.

17. There is evidence to suggest that even in markets which are heavily concentrated, market forces and government reaction can mitigate the effects of resource nationalism over the medium term. After continued Chinese export restrictions for REEs in June 2010, the price spike helped incentivise other nations including the USA to invest in mining capacity. Such an increase in supply has led to the expectation that price falls could occur in the future.

## 18. Institutional frameworks

- a. UK Government has worked internationally and through the EU to tackle market barriers, and ensure a level playing field for business; for example through free trade and open markets with fair access to resources, particularly in relation to export restrictions and stockpiling.
- b. Within the framework of the EU's raw materials trade strategy, several actions have been pursued including (i) the inclusion of rules on export restrictions in all bilateral Free Trade Agreement negotiations<sup>34</sup>, (ii) the launch of a World Trade Organisation (WTO) panel, jointly with the USA and Mexico, on some export restrictions imposed by China<sup>35</sup>, and (iii) the tackling of individual barriers to raw materials trade through the Market Access partnership.
- c. There is however no duty to notify any international body of export restrictions nor are such restrictions included in WTO disciplines, although article XI of the GATT<sup>36</sup> does stipulate there is a general prohibition on quantitative restrictions. It does not include taxation, duties or other charges. The UK has however supported and reinforced existing and emerging rules based institutional systems and instruments that provide for the necessary stewardship of critical raw materials. The UK is also engaged with the European Commission work that is currently investigating resource nationalism in the context of the WTO and Free Trade Agreement (FTA) negotiations.

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<sup>34</sup> The EU-Korea Free Trade Agreement (FTA) includes the prohibition of duties, taxes or other fees on exportation, and the upcoming EU-Singapore FTA includes the prohibition of duties, taxes or measures of an equivalent effect on exportation. The EU and Central America, and Colombia/Peru trade agreements include a prohibition of export duties or taxes, with some minor exceptions. WTO accession Tajikistan: a commitment was secured on the prohibition of export duties or taxes, except for a list of products with bound rates

<sup>35</sup> The WTO challenge to China's export restrictions on a number of key raw materials (bauxite, coke, fluorspar, magnesium, manganese, silicon carbide, silicon metal, yellow phosphorus and zinc) was launched in November 2009. The action reflected EU industries long standing concerns on export restrictions which China had applied on key raw materials. In July 2010, the WTO ruled against China's export restrictions finding that they were not justified on environmental grounds and should be removed. China appealed but on 30 January 2012 the WTO appellate body confirmed the ruling. The EU expects China to adhere to the ruling not only with regard to the raw materials covered by the dispute but also with regard to rare earth metals and other raw materials. A second WTO case was launched in 2012 against export restrictions applied by China on another set of products (rare earths, tungsten and molybdenum).

<sup>36</sup> General Agreement on Tariffs and Trade

## ANNEX A: WHY DO COUNTRIES ENAGE IN RESOURCE NATIONALISM

1. Engaging in resource nationalism is a strategic decision by a country weighing up the costs and benefits.
2. **Benefits**
  - a. The benefits depend on the policy adopted, but the underlying motive is to increase or maintain national access to resources and/or to the revenues that flow from them in the long term; motivations can also be ideological, environmental, social or political. In oil markets the most common motivation for resource nationalism appears to be motivated by rent maximisation, especially when oil prices rise<sup>37</sup>. Export restrictions on minerals have been used for national security purposes (mainly in the case of uranium), to combat corruption and human rights<sup>38</sup> violations, and to protect the environment<sup>39</sup>.
  - b. Levying windfall taxes at various stages of mine and project development or compulsory nationalisation (E.g. Argentina taking a controlling stake in Repsol in 2012<sup>40</sup>), can raise government revenue. This is particularly prominent in Africa where countries are typically resource rich and cash poor<sup>41</sup>.
  - c. Taxes levied on exports can generate competitive advantage for domestic firms and makes resource rich countries particularly attractive for downstream processing industries, which produce higher value added goods.
3. **Costs**
  - a. No country however is fully self-sufficient. China, despite having the largest mining industry in the world, is increasingly dependent on imports for most metals, and much of its energy. Only 37% of China's aluminium, 29% of iron, and 26% of copper requirements in 2011 was produced domestically, for example<sup>42</sup>. China potentially has much more to lose, if other countries retaliate than it could gain by itself playing the resource nationalist game<sup>43</sup>. No country is therefore immune from the potentially deleterious effects of retaliation by other countries in other key resources. There is evidence of this in the market for Chromite where South Africa considered reducing exports in response to China's export restrictions in 2007 in a tit-for-tat like manner<sup>44</sup>.
  - b. Instability in minerals and metals markets caused by resource nationalism increases the risks of investment by foreign mining and processing companies. Resource nationalism can therefore have a negative impact on foreign investment in the long run, as firms take into account any potential policy changes when modelling the economics of future projects in host countries.
  - c. Rising raw material prices following the adoption of resource nationalism can make mines and reserves in other countries commercially viable which, through competition, can drive down prices in the medium term. This is predicted in the market for REE's.

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<sup>37</sup> Luciani (2011) Global oil supplies: the impact of resource nationalism and political instability.

<sup>38</sup> Such as the extensive export controls for rough diamonds, and restrictions on the export of tin, tantalum and tungsten that have recently been introduced by countries in the Great Lakes region of Africa to rein in the trade of conflict minerals from the Democratic Republic of Congo.

<sup>39</sup> Chatham House Resources Futures 2012

<sup>40</sup> Chatham House Resources Futures 2012

<sup>41</sup> <http://whoswholegal.com/news/features/article/29397/>

<sup>42</sup> Chatham House Resources Futures 2012

<sup>43</sup> <http://rukor.org/china-in-a-world-of-resource-nationalism/>

<sup>44</sup> OECD 2009 Export restrictions on strategic raw materials and their impact on trade and global supply

## ANNEX B: ANALYSIS ON COAL, OIL GAS AND BIOENERGY

Fossil fuel	Top-3 producers share of global production	Substitutability	UK net import dependency 2012
Oil	35.6%	Low (short-term) Low (medium-term)	36%
Gas	42.7%	Low (short-term), Medium (medium-term)	49%
Coal	67.1%	Low (short-term), Medium (medium-term)	69%

Figure 5: Summary of data on oil, gas and coal for 2012.

- Oil.** Oil supply is relatively widely spread worldwide with the largest producers in 2012 being Saudi Arabia (13.3%), Russia (12.8%) and the US (9.6%) and 26 different countries producing more than 1% of global production. Regional shares of production are not projected to change dramatically and the IEA suggest that in 2020 the top 3 producers will supply about 35% (see figure 6). OPEC's share is projected to remain just over 40%. If OPEC is considered as a single producer, the top-3 producers share (in 2012) rises to 65.5%. UK net import dependency stood at 36% in 2012, although this figure is inflated by abnormally high levels of planned and unplanned outages in the North Sea so the 2011 figure of 28% is more representative for current levels of dependency. However, as North Sea production declines, UK import dependence will rise. UK oil import dependency is forecast to be relatively flat until 2017 and then rise continually thereafter, exceeding 50% by 2023 and exceeding 60% by 2027.

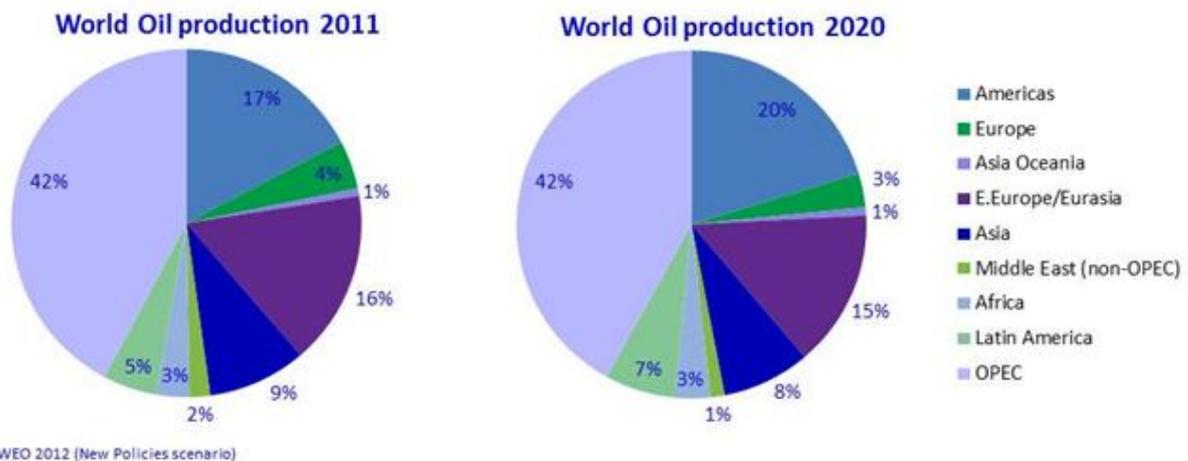


Figure 6: Distribution of world oil production in 2011 and projected distribution in 2020

- Gas.** Production is relatively dispersed with the US producing 20.4%, Russia 17.6%, Iran 4.6% and 29 different countries producing more than 1% of global production. This is expected to remain similar out to 2020 with no region having a greater than 25% share of production (see figure 7). 2012 import dependence is 49% and this is forecast to rise as UK gas production continues to decline, exceeding 50% in 2019, exceeding 60% by 2022 and exceeding 70% by 2026. Although UK import dependency is expected to increase over time, there is demand side flexibility through switching between gas and coal generation. However, over time the scope for such switching will reduce as coal capacity closes due to European Emissions Directives (LCPD, IED) and increasing carbon prices. In the longer term, the development of coal and gas plants with carbon capture and storage could introduce additional demand side flexibility in fossil fuel generation.

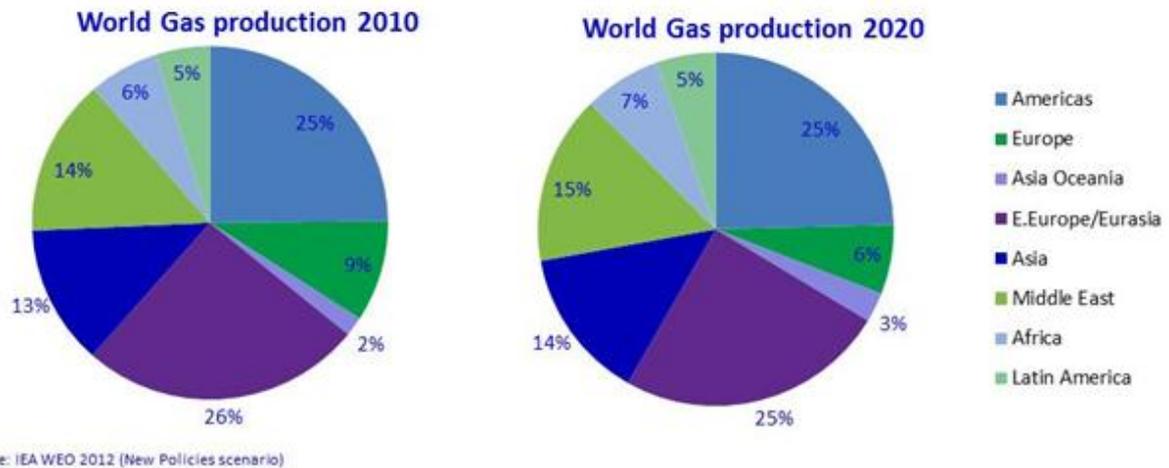


Figure 7: Distribution of world gas production in 2010 and projected distribution in 2020

3. **Coal.** The concentration of supply is heavily influenced by Chinese production (47.5%), however China consumes all of its production and does not export into the global market. Of non-Chinese production, the largest 3 producers accounted for 49%. Forecasts predict that coal supply is relatively abundant compared to demand and that the UK will consume significantly less coal over time. The threat of resource nationalism therefore seems low.
4. **Bio-energy.** Analysis for the UK Bioenergy Strategy<sup>45</sup> suggests that by 2050 bioenergy could contribute approximately 12% of UK primary energy. Bioenergy policy will increase demand for biomass imports<sup>46</sup> but it is expected that international bioenergy production will be widely dispersed across the world, with regions such as Latin America and China having a significant role alongside North America and the EU<sup>47</sup>. Given this diversity of supply, resource nationalism issues appear limited.

<sup>45</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48337/5142-bioenergy-strategy-.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48337/5142-bioenergy-strategy-.pdf)

<sup>46</sup> <http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=eqqYsG%2BkXwY%3D&tabid=82>

<sup>47</sup> UK bioenergy strategy

## ANNEX C: THE MARKET FOR METALS AND MINERALS BY PERCENTAGE OF THE TOTAL VALUE OF THE GLOBAL MARKET 2012

1. The EU 14 metals are 'bundled up' in 'others' which accounts for only 15% of value of the global metals markets and platinum group metals (PGM's) account for only 2%.

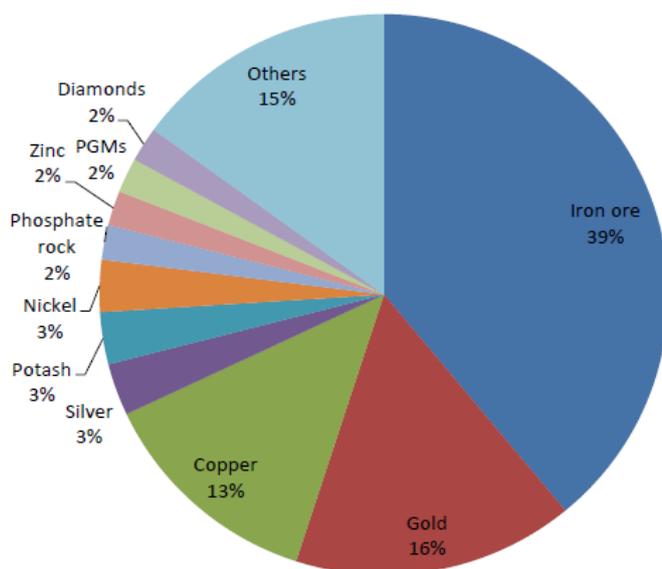
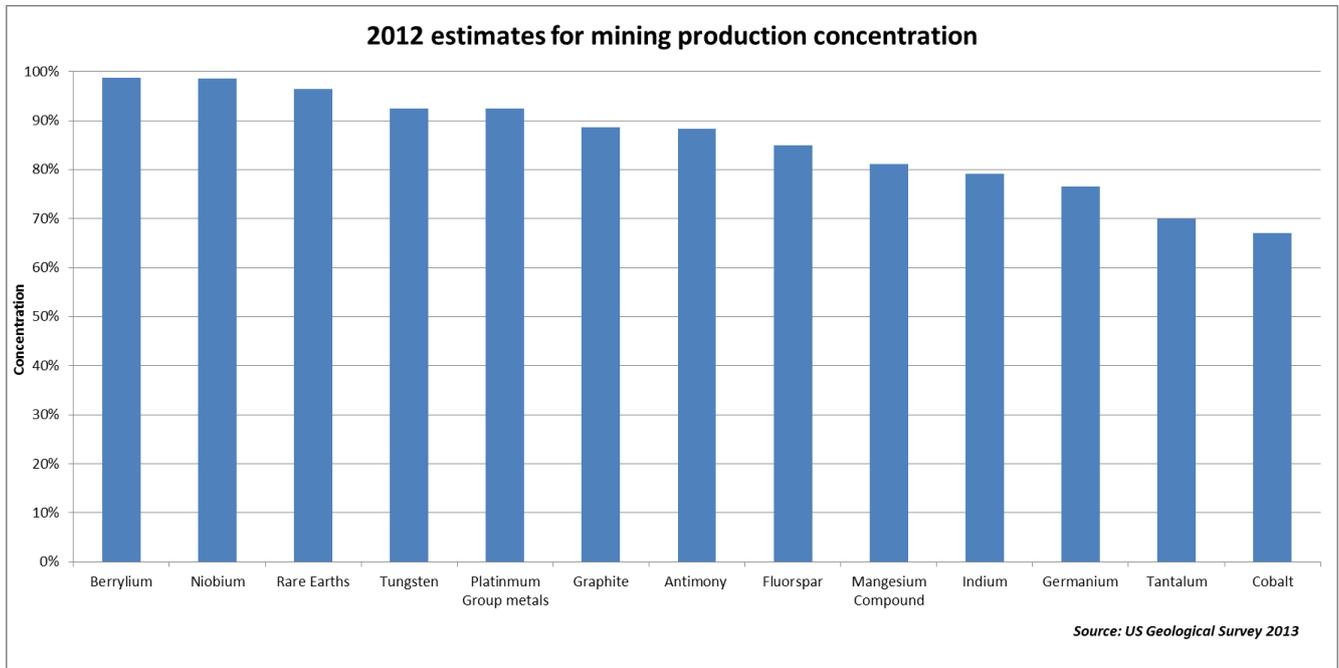


Figure 2 The market for metals and minerals by percentage of the value of the market

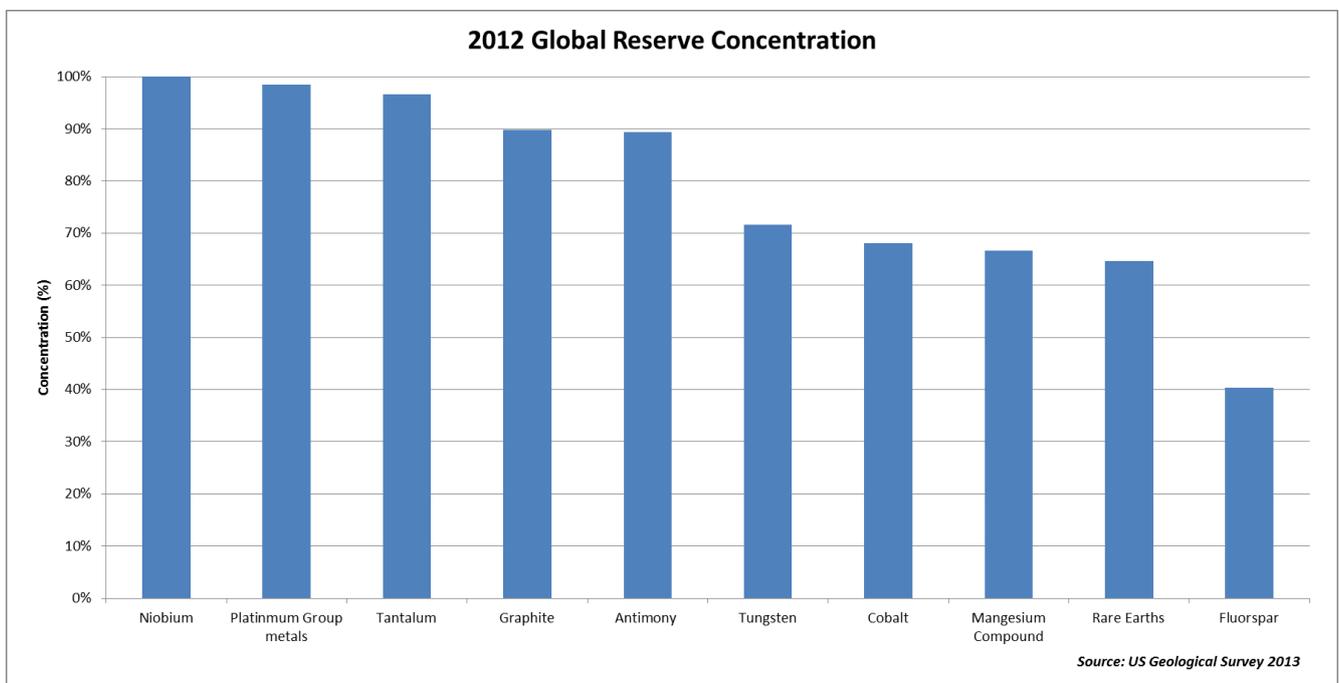
Source: ICMM, 2012

## ANNEX D: US GEOLOGICAL SURVEY 2013 GLOBAL PRODUCTION AND RESERVES OF CRITICAL METALS

- The graph below represents the share of total 2012 estimated production which is accounted for by the 3 largest production countries for the critical metals.



- The graph below represents the share of the total global reserves which is accounted for by the 3 largest reserves countries for the critical metals<sup>48</sup>.



<sup>48</sup> Note there is no data available for Germanium, Tantalum and Cobalt.

## ANNEX E: DEFRA/BIS RESOURCE SECURITY ACTION PLAN – SECTORS WHICH HAVE THE CRITICAL 14 METALS AS AN INPUT

- The graph below is extracted from the UK's Resource Security Action Plan. It identifies sectors which use each critical metal as an input and assigns a percentage of total use of the metal to that sector.

