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# Material Security and Policy Instruments to Aid Substitution and Recovery

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*Print on recycled paper*

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# 1 Material Security

Material security - the access to raw materials for military and economic sufficiency - has received increasing press coverage recently. Some of this has related to geopolitical concerns of monopoly supply of substances (largely rare metals) critical to high tech and military hardware<sup>1</sup>. Some reporting has related to the “green paradox”: the specialist materials that we require for some of the major categories of green products sometimes are themselves produced by potentially highly polluting and carbon intensive industries<sup>2</sup>. Other concerns have been around the lack of substitutability of these materials<sup>3</sup>. Rare earth metals, which qualify in all of the above categories, are under particular investigation due to their strategic importance in electric vehicles<sup>4</sup>. However the material security issue is being addressed more widely, as a parallel to peak oil concerns, in case the world may be “running out” of such non-renewable metals and minerals. To an extent this is a re-run of the “Limits to Growth” debate of the 1970s, which was proved incorrect in predicting resource shortages, but with the added dimensions of geopolitics and environmental sustainability. Geopolitics because metals and minerals supply is dominated often by just a few companies or countries (often China); environmental issues as increased demand has led to greater impacts, often in countries with weak governance structures.

Our overview of the materials security of metals in 2008<sup>5</sup> concluded that assumptions of scarcity based on reserve and reserve base figures were likely to be incorrect, as these are usually found to be underestimates and do not reliably predict material shortages. The historical trend in commodities generally is to become cheaper in real terms, although this can be consistent with long term scarcity if extraction technology improves at a faster rate than resource discoveries decline. However the environmental impact of metals extraction and refining is of substantial concern: increased demand for metals, the increased resource intensity of processing as lower quality ore grades are used; and the movement of the metals extractive industries to countries with poor governance and regulatory controls (including on carbon emissions) all mean that environmental concerns should limit primary ore extraction before scarcity issues have any impact.

Metals already are a major source of environmental pollution. This is both as capital intensive processing plants such as the Norilsk nickel and platinum group metals smelters in Russia, which is one of the world’s largest point source emitters of acidic gases; and also low capital intensity operations such as artisanal gold mining in Brazil which is a major source of mercury pollution from the extraction process.

It is therefore important to introduce resource efficiency measures that maximise the circulation of existing products and materials within the economy in order to minimise the topping up by primary resources. Many existing policy measures can be used familiar to those promoting product lifetime optimisation, remanufacture,

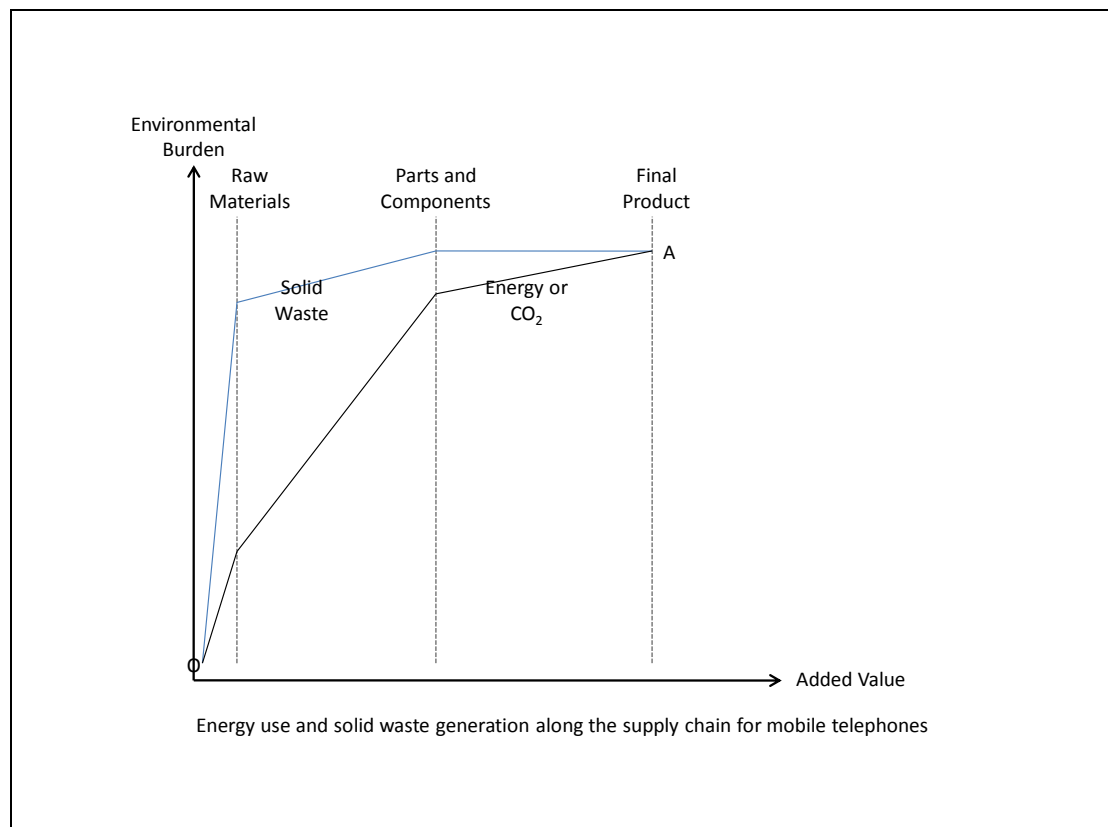
reuse and recycling, alongside measures which incorporate such environmental externalities into (usually) imported products. It is also necessary to discourage dissipation of these resources back into the environment at low levels that make re-extraction difficult. Producer responsibility measures, effective design can assist the latter.

It is useful to illustrate the issues involved. Platinum requires 600,000 kg of material to be processed to produce 1kg of material<sup>6</sup>. Whilst the use of platinum in catalytic converters reduces acidic gas emissions, it comes at a penalty in terms of carbon emissions and total material resources when virgin material is used. Recycling of platinum from converters is carried out, but losses occur from the catalytic converter in use and when the used car is exported outside of the EU to a developing country (which occurs with about 20% of cars). Since the use of catalytic converters is increasing, it has been calculated that over 75% of the use of platinum in the EU comes from virgin materials. Substitutes exist, but are also similarly rare and expensive. There are also some issues of ultimate resource availability: global uptake of catalytic converters would require about 25% of the world's minable resources of platinum group metals. Resource efficiency proposals include collection systems from developing countries, perhaps using bounties; ensuring converter collection from scrapped cars.

Similarly with copper metal, there are ultimate resource limits of which to be aware, in this case that there is insufficient minable copper in the world to allow the world population of 2100 to have the same copper-intensive lifestyle of the USA, of around 170kg per person. However, inferior substitutes exist, mainly aluminium, one of the world's commonest metals. Copper is already assiduously collected as a scrap metal, but legislation such as the WEEE Directive should help in preventing dispersion of the small amounts in electrical goods into landfill. With another metal (gold), the enactment of the WEEE Directive has been instrumental in reducing one European smelter's supply of virgin ore from 90% to 50%.

Although metals extraction and production is increasingly being located in resource rich developing countries, these capture relatively little of the added value of the final product compared to a disproportionate amount of the associated environmental impact, as the analysis below for a mobile phone demonstrates. The energy infrastructure is often inefficient and therefore production, although economic, may be at a higher carbon intensity than in developed countries. Hence the movement of countries such as China to higher added value products is understandable. Such approaches are may be more difficult to copy in other countries lacking the industrial infrastructure whose economies are purely resource-based.

Figure 1: Cumulative environmental burden and added value for mobile phones



Source: Clift, R., Wright, L., "Relationship between environmental impacts and added value along the supply chain" *Technological Forecasting and Social Change*, Vol 65, pp281-295, 2000

In summary, the arguments for policy instruments to minimise the use of virgin metals into the UK rest upon:

- strategic concerns to minimise exposure to monopolistic practices from countries and companies
- minimisation of the increasing environmental impact from primary extraction and processing that is carried out in the less regulated world economy, which will become critical sooner than resource scarcity.

It is on this latter point that this paper will now focus. Metals are increasingly imported from countries that sit outside of carbon trading schemes or other systems to incorporate negative environmental externalities into the price of their products. The issue is therefore very similar to carbon leakage concerns – the movement of carbon-intensive industries to outside of such tightly controlled regulatory systems due to increased competitiveness. The concerns are also consistent with analyses based on the carbon impact of consumption in the UK, which demonstrate the substantial carbon impact embodied in imported goods<sup>7</sup>. We will therefore use carbon as a proxy for general environmental concerns in this next section, with "low carbon" defining products made within regulatory systems that incentivise carbon reduction.

## 2 Policy Instruments for Minimising Imported Metals Use

General principles of green taxation would seek to apply taxes and incentives as close to the environmental problem as possible. Global sectoral agreements on carbon emissions, as mentioned in the Green Fiscal Commission report, are a possible way in which this might occur. However the difficulty of achieving this must be considered very great. Other options include:

### 2.1 *Border tax adjustments (BTAs)*

Taxation of materials and products as they cross into countries with more stringent environmental standards is under consideration by both the EU and USA, due to competitiveness concerns around energy intensive industries. In the short run such taxes will increase the price of these materials. In the long run they should incentivise companies to supply low carbon products and countries to invest in low carbon energy generation provided that the tax is high enough.

Some considerable work has been done by researchers around this issue from the perspective of both its effectiveness and its legality as regards WTO rules<sup>8</sup>. The general conclusions from this research are:

- BTAs are consistent with climate policy and incentivise a global low carbon economy.
- BTAs have untested legality with respect to WTO rules, but may be acceptable. Weakening of the BTA principle (for example by taxing only the carbon that would have been emitted had it been manufactured in the low carbon economy) make it more likely to be acceptable to the WTO, but do not incentivise carbon reduction as much.

In addition, BTAs are more likely to be acceptable under WTO rules when they are applied to countries which are not compliant with existing international climate agreements, and less likely to be found valid against countries already complying, albeit (in case of developing countries and Kyoto) without binding targets.

The impact of introducing BTAs would generally to penalise exporting developing countries such as China and India whose industrial economies are more carbon intensive. It would however be a substantial incentive to move to a low carbon economy in order to retain export markets. Such countries already receive subsidies on low carbon investment through the Clean Development Mechanism, and one option might be to recycle such BTAs as additional assistance. Modelling by World

Bank researchers indicated an approximate 26% tariff on Chinese exports, leading to a 20% decline from that country.

From a metals perspective, China in particular has already taken a dominant position in many metals, for example rare earths, lead, zirconium, antimony, in part due to geological good fortune, but also due to lower cost production caused by low labour costs, and frequent absence of good environmental and health and safety practices, mainly at the expense of Western producers. Hence the introduction of BTAs could be a rebalancing towards companies with better environmental controls residing in countries with lower carbon energy mixes. Pre-announcement of BTAs, and a focus on materials or products already subject to export quotas might make such taxes more politically acceptable.

One issue restricting the current consideration of BTAs is the practical difficulties of implementation. For example what is the basis for estimation of the tax and can a consistent methodology be agreed? What about low carbon world class factories located within a high carbon electricity generating infrastructure? Suggestions worthy of further examination include:

- use of reporting data from the implementation of the REACH regulations as materials enter the EU
- use of simplified carbon footprinting of products to internationally agreed standards and which use standard embodied carbon data from internationally used databases as defaults
- prioritisation of the most damaging materials / products on which to start.

## **2.2 Export rebates**

Export rebates, which allow exporting companies in low carbon countries to recover the carbon taxes paid in production, are more likely to be more acceptable under WTO rules it is believed, but do not incentivise a global low carbon economy as effectively as BTAs.

## **2.3 General sustainable product incentives**

If environmental taxes cannot be levied on imported virgin materials in order to incentivise increased use of alternative approaches with lower environmental impact, then more indirect taxes and incentives may have to be used. These include:

- a. Recycled content obligations (when reuse could be regarded as 100% recycled content) or minimum recycling rates (already implemented with metals in packaging and through producer responsibility measures for some products).
- b. VAT reduction on green products, such as those with longer functional lives, containing lower impact materials or produced in a more

sustainable manner. Practical examples might include products with the European Ecolabel; domestic appliances that are both A+ energy rated and have a ten year guarantee;

Non-taxation approaches by government could include the introduction of individual producer responsibility on products that possess high levels of embodied carbon combined with dissipation of these constituent materials into the environment at the end of their functional lives. Procurement specifications for the public and private sector developed via voluntary agreements. Other initiatives that could be led by business include the voluntary greening of the supply chain, and the design of products to prevent dispersal and enable easy recovery of resource-intensive metals. Initiatives by innovation funders might include the development of substitutes for insecure or resource intensive materials; being aware of the pollution displacement that is possible with “green” technologies; and developing technologies that can economically mine dissipated sources of insecure materials.

### 3 Conclusions

Material security policies may be a necessary precaution for military and monopolistic reasons. Environmental concerns will become critical sooner than concerns over long term shortages. Virgin metal production is carbon intensive and certain metal types already cause substantial regional and sectoral pollution problems, usually outside of the UK / EU. Border tax adjustments are a logical approach that could strongly incentivise low carbon production, although developing countries will require substantial assistance to respond to this challenge, some of which they are already receiving.

Environmental impacts are reduced by circulating resource-intensive materials such as metals around the economy whilst minimising dissipation to the environment. Materials recycling can be incentivised, but also alternative strategies based on optimising product lifetimes, with associated business models. Government policy measures relevant to consumers include individual producer responsibility or variable VAT rates. Businesses can help through better design and voluntary greening of supply chains. Innovation funders must beware of the possible displacement of pollution that result from green technologies, but could pursue substitution of insecure metals and the ability to mine dissipated sources of such materials.

Nicholas Morley  
8<sup>th</sup> December 2009

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