OAKDENE HOLLINS
RESEARCH & CONSULTING

Mind the Gap

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Resource Security Strategies in an Uncertain World

Critical materials, Circular economy, Substitution, New technologies, Raw materials policy

Oakdene Hollins believes that lack of evidence in key areas and inaction will lead to continuing uncertainty and risk over critical raw materials. This note outlines key factors and developments and suggests actions to address.

The last two years have seen much debate on how to categorise the resources of "critical" importance to a particular business or country. However in a world of diverse interests and timescale considerations, a broad consensus seems to have emerged on which resources are critical, including rare earth elements from China and various other "minor" metals. Further studies are in the pipeline including, notably, the EU revision of its list of critical raw materials.

The key policy and business strategy question now being asked is:

What do we do in response to supply constraints for critical raw materials?

Many governments and companies are pursuing policies to mitigate their materials risks. Six main areas are important, aimed at addressing different concerns:

1. Data collection and dissemination
2. Primary production
3. Resource efficiency strategies (includes recycling)
4. Design and innovation (includes substitution)
5. Trade and international co-operation
6. Procurement and stockpiling

Data Collection and Dissemination

For some metals there are surprisingly large evidence gaps regarding production, trade, use and even pricing. Without accurate and reliable information, it is almost impossible for governments and businesses to make appropriate decisions:

- For example with tellurium, an important material for thin film photovoltaic solar, official data only identifies the origin of around a quarter of world production. On behalf of the International Copper Study Group, Oakdene Hollins has conducted a survey of copper refineries of their tellurium production to fill this data gap. Other materials remain unquantified and regular supply-demand studies are useful.
- To support decision-making on recycling, data is required on the volumes of critical raw materials available for recycling. Oakdene Hollins is working with the UK Government, as part of their Resource Security Action Plan, to model the flows of critical raw materials within electronics products in the UK economy. Other product categories should be considered for research e.g. aerospace and automotive.
- Small and medium sized enterprises in particular may be unaware of materials risks or of possible actions to mitigate them. Action is needed to target and point them to useful information.

Primary Production

Investors have been quick to spot the need and potential profit of new mines, with numerous exploration and development projects underway. There is a growing demand for base metals - for infrastructure in emerging markets and minor metals in electronics and clean technologies - but longevity of products means that these metals will not be available for recycling until far in the future. Thus new demand is likely to continue to drive commodities markets for many years.

Some stakeholders view new primary production to be an "elephant in the room", because of potential environmental and land-use impacts. There is a recognised need to ensure that the highest environmental standards are upheld in order to minimise the consequences of mining and refining. China has started closing down many of its small, illegal and highly polluting mines; however the environmental impact of mining is an issue throughout the whole world. Further research, development, demonstration and implementation are necessary for suitable technologies that can alleviate stakeholder concerns with respect to new and existing facilities.

However opportunities are not limited purely to new mining projects. Existing reserves, mines, facilities, urban mines and spoils offer significant potential. For example, our research has shown that, across the world, there are major base metal smelting and refining operations ignoring the potential to recover valuable by-product metals such as gallium, germanium and indium. More speculative opportunities include revisiting old mines and refining sites, which might now be considered to be high grade deposits by conventional standards, or contain valuable by-products.

Contrary to popular belief, the world is not running out of critical materials, however better geological mapping appears necessary for some of these metals, which have only recently seen a growing number of new and important applications.

Resource Efficiency Strategies

Resource efficiency has been widely touted as a solution to Europe's combined challenges of resource security, environmental protection and business competitiveness. These are legitimate and lofty aims, but lack specific focus on practical actions that avoid blind alleys.

- Quick-wins lie in post-industrial waste streams such as scrap from photovoltaic solar panel manufacture or superalloy turnings from aircraft engine production. Companies such as Rolls-Royce can attest to the role that better resource management control has made to conservation of scarce materials such as rhenium.
- The packaging industry has been vocal on the cost and quality of secondary raw materials. There are genuine resource security concerns with respect to Middle Eastern oil for plastics, magnesium from China in aluminium cans and tin from East Asia in steel cans. Substitution is possible between packaging formats, and increasing both recycling rates and recycled content can mitigate materials risks.
- For products such as electronics, appropriate solutions are still needed. The very low recycling rate of metals such as beryllium, tantalum and rare earths continue to pose a challenge. New innovative technologies for electronics dismantling, separation and recycling need to be developed.
- The benefits of reuse and remanufacture should be promoted as it offers the potential to considerably extend the lifetimes of products and conserve raw materials that are often currently difficult to recover. Repair of these products generates significant levels of skilled employment in Europe. Effective standards, such as PAS141, can underwrite and reward legitimate operators. Reuse and remanufacturing are poorly understood at a policy level.

Design and Innovation

Design and innovation, whether by eco-design to better enable recycling and remanufacture, or the substitution of one insecure material with another material or compound, offer significant scope to mitigate resource risks to business. These strategies are particularly important where genuine supply limitations have been identified, such as heavy rare earth elements for automotive or rhenium for the aerospace industry.

For rare earth elements, considerable activity is underway in the automotive industry to replace permanent magnet-based motors within hybrid and electric vehicles. This motivation is based on both a combination of security of supply and cost. The relative cost compared to vehicles with internal combustion engines, is key for their successful uptake on the mass-market.

Substitution needs to be considered on a case-by-case basis: For some materials it may be possible to reduce the use of a particular metal or replace it completely. However, the use of a particular critical material can confer exceptional performance that may justify the associated supply risks and additional cost incurred. System substitution is also possible, such as by replacing permanent magnet-based motors with superconductor motors, geared systems or alternative magnetic materials. Continued, but targeted, investment in basic and applied sciences, and support for the development to market is needed to meet these challenges.

Trade and international co-operation

With resource nationalism on the rise, strategic alliances are now on the agenda of many foreign ministries. The role of international partnerships has been exemplified by transatlantic and trilateral conferences on raw materials involving the governments and companies of the European Union, United States and Japan. This has helped facilitate collaborative discussion and exchange of knowledge on the subject of raw materials.

However, following the lodging of raw materials disputes at the World Trade Organisation, the opposite approach seems to have been taken against China. It remains to be seen if these appeals will be successful and what impact they might have on international relations.

Procurement and stockpiling

Western governments have generally not pursued stockpiling as a resource policy, the notable exception being the small US Defense Strategic Stockpile. There are good reasons for this: the prominence of free market economic ideologies, but also the difficulty of timing sales and purchases without distorting world markets.

On the other hand, Japan has long been a proponent of materials stockpiling for specific metals, but it is worth noting that the onus does not all fall on the Japanese government. Private stockpiling by major companies constitutes 18 days' worth of domestic demand of the total 60 day stockpiling target, illustrating that a mixed approach may offer benefits.

Action on raw materials risks has traditionally taken a back seat to short-term cost savings. Like governments, private businesses can stockpile, but an alternative is to secure their supply chain through off-take agreements and joint ventures with junior mining projects. These strategies have been successfully pursued by Toyota and Sumitomo amongst others.

Recommended Actions

To conclude, there are numerous risk mitigation strategies available, but ultimately a combination of actions is required by both governments and businesses:

Type	Recommended Action
Data Collection & Dissemination	• Collect better data on the production, use, trade and prices of minor metals
	• Conduct research on product, material flows in the economy, and supply chains
	• Publish regular studies on supply, demand, prices and outlook for critical metals
	• Disseminate information on material risks and mitigation solutions to SMEs
Primary Production	• Encourage the development of new mines and refineries in Europe
	• Ensure the enforcement of appropriate mining environmental standards
	• Support RD&D to lower the environmental impact of mining and refining
	• Assist in the allocation of funding to exploration and development projects
	• Raise awareness of valuable by-product metals in mining/refining waste streams
	• Revisit the geological potential of old mines and refineries
	• Improve geological mapping for critical metals
Resource Efficiency	• Investigate recycling potentials for post-industrial waste streams
	• Increase the recycling rates and recycled content of packaging
	• Improve collection rates of packaging and WEEE
	• Promote the benefits of reuse and remanufacturing
	• Support the uptake and certification of reuse standards such as PAS141
Design & Innovation	• Promote eco-design practices to better allow disassembly, recycling and reuse
	• Support RD&D for the development of recycling technologies for CRMs in WEEE
	• Continue RD&D for substitution of supply constrained materials
International co-operation	• Continue to collaborate internationally to exchange knowledge
Stockpiling & Procurement	• Consider long-term incentives and risk in procurement decisions
	• Explore possibilities to secure materials supply chain

Background to this report:

This summary report has been produced based upon the results and insights gained from research for various public and private sector clients such as the European Commission, UK government and private companies. Oakdene Hollins' research has covered all stages of the supply chain including exploration, mining, refining, use and recycling.

Examples of our work include:

- Product supply chain risk analyses, such as for retailers
- Strategic commodity studies for major mining companies
- Evaluation of by-product metals from mining and refining
- Waste management and recovery technologies
- Advice on clean-technologies
- Materials criticality studies

For additional information please contact:
Peter Willis, Senior Economist
Add: Oakdene Hollins, Pembroke Court, 22-28 Cambridge Street, Aylesbury, UK, HP20 1RS
Tel: +44 (0)1296 423915 Fax: +44 (0)1296 330351
Email: peter.willis@oakdenehollins.co.uk Web: www.oakdenehollins.co.uk