CRITICALITY OF MINERAL RAW MATERIALS AND SUSTAINABILITY ASSESSMENT

Expert Workshop on Security of Supply and Scarcity of Raw Materials
Ranco, Italy, 13-14 November 2012
Some features of „criticality“

- Criticality is a relative concept
- Criticality has at least two dimensions
  - Some sort of risk – generally risk of supply interruptions
  - Some sort of impact – generally economic
- At least two dimensions are connected by a logical „AND“
- Raw materials are not critical in themselves, they are critical to somebody (for some reason or set of reasons) at some point in time
  - Countries or group of countries
  - Parts of countries
  - Sectors
  - Companies
- Instrument to highlight current issues and inform policy or business decisions
Defining “critical” raw materials for the EU

Three reasons why some materials may be considered critical:
- “first, they have a significant economic importance for key sectors,
- second, the EU is faced with high supply risks […]
- and third, there is currently a lack of substitutes.”

Need to define metrics for each in order to determine criticality.

Indicators from “Critical raw materials for the EU” (Ad-hoc working group on defining critical raw materials, 2010)
Some data limitations encountered during the 2010 EU exercise

- Production statistics differentiated by quality
  - Specially relevant for industrial minerals
- Life cycle data
  - Only cradle to gate possible
  - Data not available for all raw materials in the assessment
- Trade statistics
  - Detail, completeness and correctness of reported data
  - Relevant for import dependence and availability of secondary raw materials
- Recycling indicators
  - Quality of data and assumptions varies widely
  - Most complete current source: UNEP report (but heavy reliance on extrapolations and expert judgment)
## EU methodology

### What it does

- Provide transparent estimates for the relative ranking both in supply risk and economic importance
- Give relative ranking at one point in time (snapshot)
- Compare raw materials on the basis of their economic benefit to society
  - Considers all uses of a raw material
- Explicitly acknowledge contribution of secondary raw materials to supply
- Emphasizes the importance of substitution

### What it doesn’t

- Provide a view into the future beyond the lifetime of the indicators used
- Consider the effect of market size (e.g. scale of problem and rate of change of indicators)
- Explicitly consider the interdependence between different metal markets (both on the supply and the demand side)

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See also Buijs, Sievers and Tercero Espinoza: Limits to the critical raw materials approach, Waste and Resource Management 2012 (in press)
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<td>U.S. consumption (value)</td>
<td>Depletion times (reserves)</td>
<td>Basic availability</td>
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<td>Substitutability</td>
<td>Companion metal fraction</td>
<td>Competing technology demand</td>
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<td>U.S. import dependence</td>
<td>Policy potential index</td>
<td>Political, regulatory and social factors</td>
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<td>Ratio of world reserves to production</td>
<td>Human development index</td>
<td>Co-dependence on other markets</td>
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<td>Ratio of world reserve base to production</td>
<td>WGI: Political stability</td>
<td>Producer diversity</td>
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<td>World by-product production</td>
<td>Global supply concentration</td>
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<td>U.S. secondary production</td>
<td>Substitute perf. and avail.</td>
<td>Substitutability</td>
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<td>Limitations to expanding world supply</td>
<td>Consumption DE vs. world</td>
<td>Global consumption levels</td>
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<td>Concentration of supply</td>
<td>Change in the above</td>
<td>Lack of substitutability</td>
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<td>Political risk related to major suppliers</td>
<td>Change in imports</td>
<td>Global warming potential</td>
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<td>Likelihood of rapid demand growth</td>
<td>Sensitivity of value chains</td>
<td>Total material/ environmental requirement</td>
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<td>Demand from emerging technologies</td>
<td>Physical scarcity</td>
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<td>Substitutability</td>
<td>Monopoly supply</td>
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LCA cradle-to-gate: “human health” and “ecosystems”...
# Criticality and sustainability assessment

## Definition of critical raw materials
- Security of supply
  - Political
  - Economical
  - Social
  - Environmental
- Economic or policy importance of metals and minerals

## Sustainability assessment by LCA
- Non-renewable use of resources
  - Depletion of abiotic resources
- Several other impact categories
Defining supply risk: The EU approach

Material properties are **not included**!

Risk from **concentrated primary production** in countries with
- Poor governance
- Low environmental standards

- Risk-reducing filter
  - Recycling
- Risk-reducing filter
  - Substitutability

Supply risk
Acknowledging the contribution and potential of recycling

Growth through larger, more affluent population
Saturation when?

Demand

today minus lifetime of products

today

minimum gap to be filled by primary resources today

theoretical recycling potential

time

Example: Cobalt

- EU completely dependent on imports (≈ 20% of world production)
- ≈ 2/3 of cobalt products produced in Europe are sold outside of Europe
- ≈ 20% of cobalt demand worldwide is for battery production (Li-ion for electronic devices)
  - but these are not produced in the EU!

Based on data from Eurometaux for the report Critical Raw Materials for the EU (2010); see also Tercero Espinoza (2011) / POLINARES Project (http://www.polinares.eu/docs/events/polinares_events_tw2_minerals_supply_chain_bottlenecks.pdf)
Market size (tonnes, 2010) of EU CRM

Market size is a factor in:

- Overall environmental impact
- Magnitude of investment necessary to increase supply
- Rate of change of indicators, e.g.
  - Concentration of supply
  - Distribution of end uses
- Limitations to expanding supply of co- and by-products
  - And impact of these

Data from “Critical raw materials for the EU” (2010), World Mining Data (2012), USGS Mineral Commodity Summaries (2012)
Speed of change in indicators: Can we keep up? How long-lived should results be?

Based on production data courtesy of BGR, World Governance Index: http://info.worldbank.org/governance/wgi/sc_country.asp
Some items for a wish list

- Substitutability mapping and monitoring
  - USGS publishes useful assessment, but necessarily vague
- Environmental impact data for all materials at similar quality
- Environmental impacts tied to geography
- Global recycling rates (not extrapolations) – see next slide
- Production statistics differentiated by quality
- More detailed trade statistics
Wish list: Dynamic substance flow analysis

Modeling work for the International Copper Association (publication in preparation by Glöser, Soulier and Tercero Espinoza)
Wish list: Capturing the dynamics of raw materials markets

Preliminary results from the project “Value from Waste” (part of the ERA-NET AERTOs)
Linking LCA to criticality

- Where can criticality ideas be included in LCA? Should they be included at all?
- Where can LCA thinking be included in criticality assessments?
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Dr. Luis A. Tercero Espinoza
Coordinator of Business Unit Systemic Risks
Fraunhofer Institute for Systems and Innovation Research ISI
Competence Center Sustainability and Infrastructure Systems
Breslauer Str. 48, 76139 Karlsruhe, Germany

luis.tercero@isi.fraunhofer.de
Tel: +49 721 6809-401
Fax: +49 721 6809-135

www.isi.fraunhofer.de