Rare Metals as bottlenecks in the supply chain of low-carbon energy technologies
Brussels, 16 December 2010
World Metal Price

6.08.2010 accident in a small size Cu-mine, Chile
The Raw Materials Initiative

Integrated strategy
- based on three pillars
- support by R&D and innovation

- Ensuring access to raw materials from International Markets under the same conditions as other industrial competitors

- Right framework conditions within the EU in order to foster sustainable supply from European sources

- Boosting resource efficiency and recycling to reduce the EU's consumption of primary raw materials
Define critical raw materials
Methodology

- 41 raw materials analysed
- Time horizon: 10 years
- A pragmatic approach
- Three main aggregated **indicators**
  - economic importance
  - supply risks
  - environmental country risks
<table>
<thead>
<tr>
<th>41 raw materials analysed</th>
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</thead>
<tbody>
<tr>
<td>Aluminum</td>
</tr>
<tr>
<td>Bentonite</td>
</tr>
<tr>
<td>Clays (incl. kaolin)</td>
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<tr>
<td>Feldspar</td>
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<tr>
<td>Graphite</td>
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<tr>
<td>Limestone</td>
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<tr>
<td>Manganese</td>
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<tr>
<td>Perlite</td>
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<tr>
<td>Rare earths (REE)</td>
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<tr>
<td>Silver</td>
</tr>
<tr>
<td>Tellurium</td>
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<tr>
<td>Tungsten</td>
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<tr>
<td>Zinc</td>
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<tr>
<td>Antimony</td>
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<tr>
<td>Beryllium</td>
</tr>
<tr>
<td>Cobalt</td>
</tr>
<tr>
<td>Fluorspar</td>
</tr>
<tr>
<td>Gypsum</td>
</tr>
<tr>
<td>Lithium</td>
</tr>
<tr>
<td>Molybdenum</td>
</tr>
<tr>
<td>Platinum Group Metals (PGMs)</td>
</tr>
<tr>
<td>Rhenium</td>
</tr>
<tr>
<td>Talc</td>
</tr>
<tr>
<td>Titanium</td>
</tr>
<tr>
<td>Vanadium</td>
</tr>
<tr>
<td>Barytes</td>
</tr>
<tr>
<td>Borates</td>
</tr>
<tr>
<td>Copper</td>
</tr>
<tr>
<td>Gallium</td>
</tr>
<tr>
<td>Indium</td>
</tr>
<tr>
<td>Magnesite</td>
</tr>
<tr>
<td>Nickel</td>
</tr>
<tr>
<td>Silica sand</td>
</tr>
<tr>
<td>Tantalum</td>
</tr>
<tr>
<td>Bauxite</td>
</tr>
<tr>
<td>Chromium</td>
</tr>
<tr>
<td>Diatomite</td>
</tr>
<tr>
<td>Germanium</td>
</tr>
<tr>
<td>Iron ore</td>
</tr>
<tr>
<td>Magnesium</td>
</tr>
<tr>
<td>Niobium</td>
</tr>
</tbody>
</table>
Economic importance

Importance for economic value chain and emerging (key) technologies

- **Renewable energy:**
  solar cells, wind turbines

- **Energy efficiency:**
  hybrid and electric cars, LED lighting, batteries

- **Electronics:**
  flat screens, mobile phones

- **Aerospace:**
  light weight alloys
## Emerging technologies

<table>
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<tbody>
<tr>
<td>Gallium</td>
<td>152</td>
<td>28</td>
<td>603</td>
<td>0.18</td>
<td>3.97</td>
<td>22</td>
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<tr>
<td>Indium</td>
<td>581</td>
<td>234</td>
<td>1.911</td>
<td>0.40</td>
<td>3.29</td>
<td>8.2</td>
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<tr>
<td>Germanium</td>
<td>100</td>
<td>28</td>
<td>220</td>
<td>0.28</td>
<td>2.20</td>
<td>7.9</td>
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<tr>
<td>Neodymium</td>
<td>16.800</td>
<td>4.000</td>
<td>27.900</td>
<td>0.23</td>
<td>1.66</td>
<td>7.2</td>
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<tr>
<td>Platinum</td>
<td>255</td>
<td>very small</td>
<td>345</td>
<td>0</td>
<td>1.35</td>
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<tr>
<td>Tantalum</td>
<td>1.384</td>
<td>551</td>
<td>1.410</td>
<td>0.40</td>
<td>1.02</td>
<td>2.5</td>
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<tr>
<td>Silver</td>
<td>19.051</td>
<td>5.342</td>
<td>15.823</td>
<td>0.28</td>
<td>0.83</td>
<td>2.9</td>
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<tr>
<td>Cobalt</td>
<td>62.279</td>
<td>12.820</td>
<td>26.860</td>
<td>0.21</td>
<td>0.43</td>
<td>2.1</td>
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<tr>
<td>Palladium</td>
<td>267</td>
<td>23</td>
<td>77</td>
<td>0.09</td>
<td>0.29</td>
<td>3.2</td>
</tr>
<tr>
<td>Titanium</td>
<td>7.211.000</td>
<td>15.397</td>
<td>58.148</td>
<td>0.08</td>
<td>0.29</td>
<td>3.6</td>
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<tr>
<td>Copper</td>
<td>15.093.000</td>
<td>1.410.000</td>
<td>3.696.070</td>
<td>0.09</td>
<td>0.24</td>
<td>2.7</td>
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</tbody>
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### Emerging technologies

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Emerging technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>Antimony-Tin-Oxide (~ In-Sn-O), micro capacitors</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Li-ion batteries, synthetic fuels</td>
</tr>
<tr>
<td>Gallium</td>
<td>Semi-conductors, thin layer photovoltaics, IC, WLED</td>
</tr>
<tr>
<td>Germanium</td>
<td>Fibre optic cable, IR optical technology</td>
</tr>
<tr>
<td>Indium</td>
<td>Displays, thin layer photovoltaics</td>
</tr>
<tr>
<td>Platinum (PGM)</td>
<td>Fuel cells, catalysts</td>
</tr>
<tr>
<td>Palladium (PGM)</td>
<td>Catalysts, seawater desalination</td>
</tr>
<tr>
<td>Niobium</td>
<td>Micro capacitors, ferroalloys</td>
</tr>
<tr>
<td>Neodymium (REE)</td>
<td>Permanent magnets, laser technology</td>
</tr>
<tr>
<td>Tantalum</td>
<td>Micro capacitors, medical technology</td>
</tr>
</tbody>
</table>
US-Report

- *Permanent magnets* (used in wind turbines and electric vehicles)
- *Advanced batteries* (used in electric vehicles)
- *Thin-film semiconductors* (used in photovoltaic power systems)
- *Phosphors* (used in high-efficiency lighting systems)
Critical raw materials

High supply risks

- High share of the worldwide production
  - China (antimony, fluorspar, gallium, germanium, graphite, indium, magnesium, REE, tungsten)
  - Russia (PGM)
  - Congo (cobalt, tantalum)
  - Brazil (niobium, tantalum)

- Low substitutability
  - REE, PGM

- Low recycling rates
  - When used in very low concentrations
Environmental country risk

Ranking of eligible raw materials according to their environmental country risk

REE
Risk analysis

Clays

- Ceramics: 61%
- Paper: 16%
- Others: 18%
- Fiberglass: 5%

Zinc

- Galvanization: 16%
- Brass & bronze: 18%
- Alloys: 14%
- Chemicals: 10%
- Semi-manufactures: 10%
- Other: 2%

The charts illustrate the economic importance and supply risk for different types of materials in RMI | A. Wittenberg | 03.12.2010 | 15/26
Critical raw materials

Economic Importance vs. Supply Risk
### 14 critical raw materials

- Graphite
- Fluorspar
- Platinum Group Metals (PGM)
- Rare Earth Elements (REE)

#### Platinum Group Metals (PGM)

#### Rare Earth Elements (REE)

#### Lanthanide series
- La
- Ce
- Pr
- Nd
- Pm
- Sm
- Eu
- Gd
- Tb
- Dy
- Ho
- Er
- Tm
- Yb

#### Actinide series
- Ac
- Th
- Pa
- U
- Np
- Pu
- Am
- Cm
- Bk
- Cf
- Es
- Fm
- Md
- No
**Figure 1-1. Key materials within the periodic table of the elements**

![Periodic Table](image)

- **Key material addressed in Strategy**
- **Lanthanides**
- **Actinides**
Material Flows -

- raw materials availability
  - Primary raw materials – base metal and by-product relationship (e.g. Zn – In)
  - Recovery rate and recycling
  - Urban mining and landfills
Thank you for your attention!

References:

Report on critical raw materials:

Report on best practices in area of land use planning, permitting and geological knowledge:

Natura 2000 guidelines:

Trade raw materials activity report 2009:

Communication on the EU 2020 Flagship Initiative Innovation Union:
Recommendations

Two types of recommendations

- follow-up and further support
- policy-oriented recommendations
  (areas where measures should be undertaken)
Follow up and further support

- Update the list every 5 years and enlarge the scope
- Improve the availability and quality of statistical information and prepare a Yearbook
- Carry out further studies, e.g. competition to land use, « cradle-to-grave » LCAs, emerging technologies
- Establish a sub-group of the Raw Material Supply Group on criticality
Policy-oriented

- Recycling
  - Improve collection
  - Prevent illegal exports of End-of-Life products
  - Promote research

- Substitution
  - Promote research

- Material Efficiency
  - Minimise the raw material used
  - Minimise raw material losses
This image shows a bar chart depicting the NE Extractive Industry EU27. The chart details the volume and value of various construction materials, industrial minerals, and metals extracted in EU27. The data covers the years EU 2007, with the latest update provided by Eurostat on 09/09/2010.
Efficiency & recycling

- Huge potential of EU’s Urban Mines
- Tackle illegal shipment of waste to third countries through a more harmonised enforcement of Waste Shipment Regulation
- Develop best practices in the area of collection and treatment of key waste streams
- Develop eco-design measures aimed at fostering more efficient use of raw materials in products
Increase resource efficiency

- The Commission plans to publish a Roadmap on how to move towards a resource efficient Europe by summer 2011.

- The roadmap will set out specific resource efficiency objectives, and how to meet them, based on actions up to 2020 with a time perspective of up to 2050.
Promote research

- Under FP7 new funding opportunities have recently been created for projects on:
  - Advanced underground technologies for intelligent mining
  - Substitution of critical raw materials
  - Coordination of activities in Member States in the area of the industrial handling of raw material