Rare Metals & Rare Earth: “The Next Oil”

European Nanoelectronics Consortium for Sustainability (ENCOS)

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Agenda

- Rare Metals & Rare Earth: Which Definitions?
- A Myriad of High-Tech Applications
- China, Rare Metals & Economic War
- States’ Strategies Towards Mineral Independance
- Manufacturers’ Strategies to Limit Supply Tensions
- Q&A
Rare Metals and Rare Earth: Which Definitions?

Geological Scarcity
- Byproducts of base metals
- Neodymium/iron ratio: 1/1 250
- Gallium/iron ratio: 1/2 650

“Strategic Metals”
- Metals used in strategic industries
- Originally, military industries
- Move towards economic factors

Industrial Scarcity
An Ecosystem under:
- Ecological tension (1 t. REE = 200 m³ water)
- Industrial tension (mine opening: 20 years)
- Social tension (with surrounding populations)
⇒ “The problem is less the demand than the supply.”

“Critical” Metals
- Scarcity risks

<table>
<thead>
<tr>
<th>Material</th>
<th>Fluorspar</th>
<th>LREEs</th>
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</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>Fluorspar</td>
<td>LREEs</td>
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<tr>
<td>Phosphorus</td>
<td>Baryte</td>
<td>Gallium</td>
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<tr>
<td>Magnesium</td>
<td>Scandium</td>
<td>Tungsten</td>
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<tr>
<td>Beryllium</td>
<td>Tantalum</td>
<td>Vanadium</td>
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<tr>
<td>Germanium</td>
<td>Natural graphite</td>
<td>Silicon metal</td>
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<tr>
<td>Bismuth</td>
<td>Hafnium</td>
<td>Natural rubber</td>
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<tr>
<td>Borate</td>
<td>Helium</td>
<td>Niobium</td>
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<tr>
<td>Cobalt</td>
<td>HREEs</td>
<td>PGMs</td>
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<tr>
<td>Coking coal</td>
<td>Indium</td>
<td>Phosphate rock</td>
</tr>
</tbody>
</table>

Source: European Commission
A Myriad of High-Tech Applications

Greentech
- *Drivers*: electric mobility, energy storage, permanent magnets, catalysis.
- NdFeB Magnets: 8.15 Billion USD Market in 2013/ 12.7 Billion USD in 2019
  => CAGR: 8.9%.

Needs Will Explode as of 2035
- *Drivers*: population growth, new consumption trends...
- REEs: + 13.67% growth/year btw. 2018 & 2021
- Consumption btw 2013 and 2035: germanium (X2), dysprosium (X4), scandium (X9), cobalt (X24), lithium (X180)

Digital
- Indium (Chips, LCD Screens…)
- Germanium (Optical Fibers)
- Cobalt (batteries)
- Neodymium (permanent magnets)
- Digital Economy: 320 tons of gold/year, 7,500 tons of silver/year & 22% of world consumption of mercury
- New Information and Communication Technologies: 10% of world electricity consumption
A Myriad of High-Tech Applications

Share of CRMs used in the electric and electronic sector

Source: JRC elaboration based on data from the 2017 EU criticality assessment (Deloitte Sustainability et al., 2017) and other references.
A Myriad of High-Tech Applications

The Most Critical Metals in the Future

Source: German Mineral Resources Agency
China, Rare Metals & Economic War

Countries’ World Production of Rare Metals

Source: European Commission
China, Rare Metals' New Master
- Near monopole over the production of: REEs (95%), antimony (87%), tungsten (84%), scandium (66%), magnesium (87%)...
- Deng Xiaoping: “The Middle East has oil, China has rare earth” (1992)

Taxes, Quotas & Embargos
- Export Taxes: 20% on graphite
- REEs Embargo: 6 month from 09/2010 (Japan & USA)

A Strategy of Moving up the Value Chain
- Innovation: 7 strategic industries identified in the 12th 5 year Plan (2011-2016):
- China: 80% of EV batteries production in 2020

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China, Rare Metals & Economic War

Rare Earth Export Quotas (2005-2016)

- ** tons/year
- Linear (tons/year)
States’ Strategies Towards Mineral Independence


The Challenges of Rebuilding an Integrated REE Supply Chain

How to Secure Rare Metals Abroad?

China’s Grab Over DRC’s Cobalt

- DRC: 64% of world cobalt production
- Chine has secured 80% of DRC’s cobalt via Glencore
- Glencore: contract with GEM (2018) for supply of 52,800 tons of cobalt between 2018 and 2020

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Manufacturers’ Strategies to Limit Supply Tensions

Rebuilding an Entirely Integrated Supply Chain
- « Just in time » & « Zero Stock »
- Recent attempts by VW, BMW, SAMSUNG to integrate mining processes
- Apple : 5 year contract for several thousands tons of cobalt

Limited Substitutes
- 2018 : Toyota develops magnets with 20-50 % less neodymium
- Nearly zero rare metals substitution in industry
  (source : EU Commission, 2017)

Reverse Supply Chain
- 4 500 Eiffel Tower of EW produced in the world in 2016
- Challenges : unknown quantities of EW, lack of eco-design...

Stammering Recycling Processes
- 1/4 of Metals in EW are recycled
- Less than 1 % of rare metals are recycled
Manufacturers’ Strategies to Limit Supply Risks

Metals’ Recycling Rate (source: UN)
Bibliography

- “How Clean is Your Cloud ?”, Greenpeace, April 2012
Q & A