Critical Raw Materials: the European perspective

SDIMI 2015
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Joint Research Centre (JRC) is the European Commission's in-house science service and the only DG executing direct research

Institute for Environment and Sustainability (IES)

“The mission of the IES is to provide scientific-technical support to the European Union's policies for the protection and sustainable development of the European and global environment”
Outline:

1. RAW MATERIALS INITIATIVE
2. CRITICAL RAW MATERIALS
3. European Innovation Partnership on Raw Materials
4. HORIZON 2020
1. RAW MATERIALS INITIATIVE
Building blocks of the EU RMI

Raw Materials Initiative

European Innovation Partnership

Horizon 2020

European Commission
EU “Raw Materials Initiative”

- **Aim**: securing sustainable supply of raw materials
- **Launched in 2008, consolidated in 2011**
- **Non-energy, non-agricultural raw materials**
- **Connecting EU external and internal policies**
- **Integrated strategy (3 pillars)**
- **Introduced list of Critical Raw Materials (CRMs) in 2011 and 2014**
2. CRITICAL RAW MATERIALS
# How to assess Critical Raw Materials?

## Economic importance
- Importance of a raw material per economic sector & importance of the sector in the EU economy

## Supply risk
- Political and economic stability
- Level of production concentration
- Potential for substitution
- Recycling rate

![Diagram](image-url)
Outcome 2014

The diagram illustrates the economic importance and supply risk of various minerals and materials. The X-axis represents economic importance, while the Y-axis indicates supply risk. The shaded areas distinguish between light and heavy rare earth elements, as well as other minerals such as Magnesium, Niobium, Antimony, Natural Graphite, Magnesite, Tungsten, Coking coal, Chromium, Vanadium, Bauxite, Zinc, Potash, Nickel, Scandium, Rhenium, Silver, Feldspar, Bentonite, Clay, Gypsum, Lithium, Molybdenum, Tin, Tantalum, Natural rubber, Manganese, Halium, Iron, Aluminum, Sulfur, Gold, Diatomite, Pumice, Titanium, Silicon sand, Limestone, Copper, Selenium, Tellurium, Ilmenite, Vanadium, Titanium, Bauxite, Zinc, Potash, Nickel.

This visual representation helps in understanding the strategic importance and potential risks associated with these materials.
Major producers of CRMs

- **USA**: Beryllium (90%) • Borates (30%)
- **Turkey**: Borates (38%)
- **Brazil**: Niobium (92%)
- **South Africa**: Chromium (43%) • PGM (61%)
- **Kazakhstan**: Chromium (20%)
- **Russia**: PGM (27%)
- **China**: Antimony (87%) • Coking Coal (51%) • Fluorspar (56%) • Gallium (69%) • Germanium (59%) • Indium (58%) • Magnesite (69%) • Magnesium (86%) • Natural Graphite (69%) • Phosphate Rock (38%) • REE (Heavy) (99%) • REE (Light) (87%) • Silicon Metal (56%) • Tungsten (85%)
Reviewed methodology should be available early 2016. The following will be assessed by GROW-JRC:

- Supply risk and economic importance re-evaluated, also export restrictions and import dependency on board?
- Reliable data for assessing criticality
- Additional influences on criticality
- Refined methodology for biotic materials
- Identification of actual and potential uses of the list of Critical Raw Materials by stakeholders including Member States and industry
- Delivery of an improved integrated methodology and knowledge transfer to the consultants in charge of the next revision of the list of CRMs 2017
• **Critical raw materials list as a policy tool:**

  • Contribute to the implementation of the EU industrial policy
  
  • Incentivise the European production of critical raw materials and facilitate the launching of new mining activities
  
  • Monitor issues of critical raw materials to identify priority actions (trade, legislation, research)
  
  • Policy actions not limited to critical raw materials exclusively
  
  • Among the most "critical" were REEs: ERECON initiative
  
  • List as source of inspiration and/or similar criticality initiatives ongoing e.g. NL, D, FR, FI or UK
Criticality in partnering countries

- **EU-US-JP:** trilateral conferences on CRMs
  - 2013 Brussels, BE
  - 2014 Ames, Iowa, US
  - 2015 Tokyo-Sendai, Japan

- **US:** proposal on "Critical Materials" from US Senator Ms Murkowski (R, Alaska). The proposal foresees, inter alia, a US list of critical materials. - No single US Department is solely competent: USGS, DOE (in connection to clean energy deployment), Dep. of Defense (supply management), Dep. of Commerce etc.

- **Japan:** Policy focus on a selection of 30 elements qualified as “Strategic Mineral Resources” (economic importance)

- (...) Canada, Korea, ...
EU list of Critical Raw Materials

DG GROW → DG JRC

→ Revision of the methodology (2015)
  (Administrative Arrangement)

→ Updated list of CRMs (early 2017)
  (call for tender out)
### Materials Scoping (2013-14)

<table>
<thead>
<tr>
<th>Material</th>
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<th>Material</th>
<th>Material</th>
<th>Material</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>Antimony</td>
<td>Barytes</td>
<td>Bauxite</td>
<td>Bentonite</td>
<td>Beryllium</td>
</tr>
<tr>
<td>Borates</td>
<td>Coking Coal</td>
<td>Chromium</td>
<td>Clays (and kaolin)</td>
<td>Cobalt</td>
<td>Copper</td>
</tr>
<tr>
<td>Diatomite</td>
<td>Feldspar</td>
<td>Fluorspar</td>
<td>Gallium</td>
<td>Germanium</td>
<td>Gold</td>
</tr>
<tr>
<td>Gypsum</td>
<td>Hafnium</td>
<td>Indium</td>
<td>Iron ore</td>
<td>Limestone (high grade)</td>
<td>Lithium</td>
</tr>
<tr>
<td>Magnesite</td>
<td>Magnesium</td>
<td>Manganese</td>
<td>Molybdenum</td>
<td>Natural Graphite</td>
<td>Natural Rubber</td>
</tr>
<tr>
<td>Nickel</td>
<td>Niobium</td>
<td>Perlite</td>
<td>Phosphate Rock</td>
<td>Platinum Group Metals</td>
<td>Potash</td>
</tr>
<tr>
<td>Pulpwood</td>
<td>Rare Earth Elements - Heavy</td>
<td>Rare Earth Elements - Light</td>
<td>Rhenium</td>
<td>Sawn Softwood</td>
<td>Scandium</td>
</tr>
<tr>
<td>Selenium</td>
<td>Silica Sand</td>
<td>Silicon Metal</td>
<td>Silver</td>
<td>Talc</td>
<td>Tantalum</td>
</tr>
<tr>
<td>Tellurium</td>
<td>Tin</td>
<td>Titanium</td>
<td>Tungsten</td>
<td>Vanadium</td>
<td>Zinc</td>
</tr>
</tbody>
</table>

...Fifty-four non-energy, non-food abiotic and biotic materials which have been identified as important to the EU’s economy
- Revised methodology to assess the economic importance (EI)

- Proposals to incorporate substitution either in EI or SR (or both)

*Source: Fraunhofer ISI.*
Economic importance and/or Supply risk

Substitutability:

e.g. COBALT

http://www.criticalrawmaterials.eu/
Supply risk

Supply risk = HHI x WGI x (1-R) x S

Source: Fraunhofer ISI.
Supply risk (1)

Country concentration and governance

The global supply of all critical and certain non-critical raw materials is highly concentrated in a few countries with a low score on the World Governance Index.

Legend of governance scores (-2 to +2), based on World Governance Index
Supply risk (2)

Export restrictions vs Trade agreements

Figure 1: Year of introduction of export restriction measures present in 2012 (OECD database)

Figure 2: Raw materials supply (%) subject to export restrictions (quotas, taxes and licencing requirements) (2009-2012)
Supply risk (3)

Recycling vs recyclability:

<table>
<thead>
<tr>
<th>Material</th>
<th>Recycling Input Rate (EoL %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bauxite</td>
<td>0%</td>
</tr>
<tr>
<td>Bentonite</td>
<td>0%</td>
</tr>
<tr>
<td>Clays</td>
<td>0%</td>
</tr>
<tr>
<td>Coking coal</td>
<td>0%</td>
</tr>
<tr>
<td>Diatomite</td>
<td>0%</td>
</tr>
<tr>
<td>Feldspar</td>
<td>0%</td>
</tr>
<tr>
<td>Gypsum</td>
<td>1%</td>
</tr>
<tr>
<td>Limestone</td>
<td>0%</td>
</tr>
<tr>
<td>Magnesite</td>
<td>0%</td>
</tr>
<tr>
<td>Natural Graphite</td>
<td>0%</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>0%</td>
</tr>
<tr>
<td>Perlite</td>
<td>0%</td>
</tr>
<tr>
<td>Pulpwood</td>
<td>51%</td>
</tr>
<tr>
<td>Sawn Softwood</td>
<td>9%</td>
</tr>
<tr>
<td>Silica sand</td>
<td>24%</td>
</tr>
<tr>
<td>Talc</td>
<td>0%</td>
</tr>
</tbody>
</table>

Periodic table of global average end-of-life (post-consumer) recycling input rates (EOL-RIR)
Unfilled boxes indicate that no data or estimates are available, or that the element was not addressed by the EU study on CRMs (2013).
Analysis of Data availability and quality

- Detailed overview of data to be used for the next revision
- Assessment on data use

Example: Distribution of data sources for end use data.
Additional influences on criticality

In 2013, eight "additional influences on criticality" were discussed:

- Exploration
  - Ore grades
  - Land use competition

- Mining
  - Mining governance
  - Corporate concentration

- Refining
  - Mined and refined production
  - By-product dynamics

- End-use
  - Price volatility
  - Environmental issues

Further assessment of five (in red) additional influences in 2015
Biotic Materials

Suitability of the refined methodology for biotic materials

- Biotic materials first included in 2013 revision of methodology
- 3 exemplary biotic materials were assessed: pulpwood, sawn softwood, natural rubber
- A number of specific issues requiring further investigation were identified for biotics,
  ✓ e.g.: definition of specific thresholds for biotics?
  ✓ Consideration of additional selection criteria?
  ✓ Data availability?

Use of the list of Critical Raw Materials

Assessment of national and other criticality assessments

Better understand on how the CRM list is being used by Member States, regions and various public and private stakeholders.

- How frequent and for which purposes is the current CRM list is being used?
- Does it address the needs of the users?
Delivery of an improved integrated methodology

Deadline end of 2015...

WORK IN PROGRESS
3. European Innovation Partnership on Raw Materials
European Innovation Partnership on Raw Materials

- **Speed up breakthrough innovations**
  - by pooling resources through a challenge-driven approach
  - and acting across research and innovation cycle
  - bringing together all relevant actors to connect supply and demand side for a societal challenge, covering much more than R&D

- **Innovation required for the entire value chain of raw materials — industrial approach**
  - Exploration, exploitation, processing, using, recycling, substitution, etc.
  - **Sectors**: mining, engineering, pulp and paper, product design, robotics, etc.

Commission adopted the **proposal for an Innovation Partnership on raw materials** on **29 February 2012** COM(2012) 82 final
Objectives

• Overall objective:
  Contribute to the 2020 objectives of the EU Industrial Policy (to increase the share of industry in GDP to 20%, the Innovation Union and the Resource Efficiency 4flagships')

Specific objectives:
• Reduce import dependency
• Improve supply conditions from European and other sources
• Push Europe to the forefront in raw materials sectors
• Provide alternatives in supply
• Mitigate negative environmental and social impacts
EIP Call for Commitments

- Launched on 31 October 2013 (closed on 7 February 2014)
  - 80 Raw Materials Commitments endorsed
  - cca. 700 partners, but relative deficit from EU-13 group*

- **Next calls** end of 2015, 2017 and 2019

* EIP Annual Monitoring Report 2014
• **Critical Raw Materials Innovation Network: CRM_Innonet** (substitution of CRMs)
• Employ of Waste instead of Quarry for substitution of **AnTimOny** as fire Retardant additive
• Environmentally sound Advanced Recycling Technologies for Hi Tech products: An innovative technology framework for the development of advanced recycling systems of **critical and precious raw materials** from hi tech products
• Innovation Network to increase the **COmpetitiveness** of the European **Magnesium/Magnesite** sector through Environmental and Social Sustainability
• Innovative Hydrometallurgical processes to recover precious and **critical metals** from WEEE and other HighTech products
• Innovative New Hydrometallurgical Process for **Nb & REE** Valorization from Pyrochlore Ores
• Recovery of **Critical Metals** from the Bauxite Residues (red mud) of the primary alumina refining industry
• Recycled Carbon Fibres Substitute for **Natural Graphite** & Industrial Applications
• **Substitution of CRM** – place for graphene in EIP on RM
• The **Platinum** Consortium: promoting research and innovation on platinum and related metals
• Waste to Product in **Magnesium Chloride** - Innovative Manufacturing Process for solid Magnesium Chloride
4. HORIZON 2020
Horizon 2020

HORIZON 2020

• A €80 billion research and innovation funding program (2014-2020)

• A response to economic crisis by investing in future jobs and growth

• Focus on societal challenges: health, clean energy, transport, resources, etc.

• Coupling research with innovation: 'from lab to market'

• Open to participation: companies, universities, institutes in EU and beyond
"Ensuring The Sustainable Supply Of Non-energy And Non-agricultural Raw Materials"

- New solutions for sustainable production of raw materials
- Innovative and sustainable solutions leading to substitution of raw materials
- Coordinating and supporting raw materials research and innovation
- Cross-challenge topics

"Waste: A resource to recycle, reuse and recover raw materials"

- Recycling of raw materials from products and buildings
- Towards near-zero waste at European and global level
<table>
<thead>
<tr>
<th>Call</th>
<th>Type of action</th>
<th>Project Acronym</th>
<th>Full title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste 3-2014</td>
<td>RIA</td>
<td>CloseWEEE</td>
<td>Integrated solutions for pre-processing electronic equipment, closing the loop of post-consumer highgrade plastics, and advanced recovery of critical raw materials antimony and graphite</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HISER</td>
<td>Holistic Innovative Solutions for an Efficient Recycling and Recovery of Valuable Raw Materials from Complex Construction and Demolition Waste</td>
</tr>
<tr>
<td>Waste 4c-2014</td>
<td>CSA</td>
<td>ProSUM</td>
<td>Prospecting Secondary raw materials in the Urban mine and Mining waste</td>
</tr>
<tr>
<td>SC5-11a-2014</td>
<td>RIA</td>
<td>VAMOS</td>
<td>¡Viable and Alternative Mine Operating System!</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Real-Time-Mining</td>
<td>Real-time optimization of extraction and the logistic process in highly complex geological and selective mining settings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BioMORE</td>
<td>New Mining Concept for Extracting Metals from Deep Ore Deposits using Biotechnology</td>
</tr>
<tr>
<td>SC5-11b-2014</td>
<td>RIA</td>
<td>FAME</td>
<td>Flexible and Mobile Economic Processing Technologies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OptimOre</td>
<td>Increasing yield on Tungsten and Tantalum ore production by means of advanced and flexible control on crushing, milling and separation process</td>
</tr>
<tr>
<td>SC5-12a-2014</td>
<td>RIA</td>
<td>INFINITY</td>
<td>Indium-Free Transparent Conductive Oxides for Glass and Plastic Substrates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>INREP</td>
<td>Towards Indium free TCOs</td>
</tr>
<tr>
<td>SC5-13a-2014</td>
<td>CSA</td>
<td>MINATURA 2020</td>
<td>Developing a concept for a European minerals deposit framework</td>
</tr>
<tr>
<td>SC5-13b-2014</td>
<td>CSA</td>
<td>INTRAW</td>
<td>International cooperation on Raw materials</td>
</tr>
</tbody>
</table>
Horizon 2016-2017

Programming of Work Programme 2016-17 is underway:

- Intention to continue to support activities on:
  - R&D Actions on primary production, recycling and substitution
  - Policy Coordination and Support actions
  - International Cooperation
EU Raw Materials policy outreach

Feasibility study to establish a EU-Canada minerals investment centre
- serving investment purposes for Canadian companies in EU and for EU companies in Canada
- similar to a German-Canadian centre
- budget coming from the financial arm of the EEAS, Foreign Partnership Instrument

Launch of call for tender by the end of 2015

For further contact, unit Resource Efficiency & Raw Materials, DG GROW C2: Sebastian.zaleski@ec.europa.eu
Websites

**EU raw materials webpage:**

**Check the EIP website for fresh news:**

**Horizon 2020 - Raw materials webpage:**

**Juncker plan – European Fund for Strategic Investments (EFSI):**
- [http://www.eib.org/about/invest-eu/index.htm](http://www.eib.org/about/invest-eu/index.htm)

"If further information is needed": alexis.van-maercke@ec.europa.eu

European Commission, DG GROW C2 Resource Efficiency and Raw Materials
Thank you!

Gian Andrea Blengini, European Commission, DG JRC, IES-H08 Sustainability Assessment

European Platform on Life Cycle Assessment (EPLCA):
http://eplca.jrc.ec.europa.eu/

Sustainability Assessment (H08):
http://sa.jrc.ec.europa.eu/

JRC Science Hub:
https://ec.europa.eu/jrc/