Project Final Conference

EU Raw Materials 2050: Roadmap to Success

I. Defining and exploring the playing fields (Scenarios)
RM R&D in plausible futures

EU Raw Materials 2050: Roadmap to Success

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VITO N.V. RINA
Forward to the PPPPP futures

VERAM scenarios

Megatrends

Vision
1. WHERE ARE WE NOW?
Where are we now?

• Inventory of MS, EU, and global
  • RM policies
  • R&D funding opportunities and programmes

• Survey of EU MS funding bodies: 13 MS provided insights

• VERAM portal [http://www.veram.eu/#!/](http://www.veram.eu/#!/)
  • 231 research initiatives
  • 3,026 private & public organizations
  • 91 funding agencies
  • 122 raw material related calls
  • 164 publications
Where are we now?

• Apparent shift from sectoral, technology-oriented research with focus on particular parts of the production cycle (e.g. mining, recycling, and substitution) to more holistic topics, including non-technological issues;

• Focus on the reduction of waste in the public discussion, but primary resources will still be needed and mining will remain an important strategy for the supply of raw materials;

• Transnational cooperation (e.g. within ERA-Nets) fosters a common understanding among funding organizations;

• Topics addressed in Europe and overseas (Australia, Canada, Japan, South Africa and the US) are very similar. International cooperation should thus be pushed in order to join efforts to solve common problems;
Where are we now?

• In 2011, about **0.5% of total final EU output** value consisted of direct inputs of RM from mining and quarrying, with imported RM accounting for > 43 billion €. Both absolute and imported value of metals and minerals in EU final output increased substantially. Manufacture of basic metals is, in €, both the most material-intensive and import dependent sector;

• Absolute value of **forestry and logging products** in EU final output increased modestly, accompanied by a sharp decrease of imported value;

• RM policies designed for the sectors dependent on forestry products, which are mainly EU-sourced, will face **different challenges** and hold **other opportunities** compared to the sectors dependent on RM from mining and quarrying, a relevant and growing share of which are imported.
Where are we now?

- The R&D in the business enterprise sector in Europe shows very **heterogeneous picture**. Three MS account for 68% of total R&D, distributed over country specific sectors;

- Important and sustained gap of business R&D expenditure as % of GDP between the EU and the US, China, Japan, and Korea. Contrary to the US, the list of EU top R&D performers is dominated by **businesses founded before 1975**.

- Ongoing and planned initiatives such as the Public Private Partnership (PPP) driven by the European process industry and successfully achieved synergies between industrial strategies and national and regional research agendas can transform the European manufacturing industry. ‘**Europe seems to be not far away from bringing to fruition the true vision of a connected enterprise**’ (https://www.forbes.com).
2. PLAUSIBLE FUTURES
EU stagnation

<table>
<thead>
<tr>
<th>Rank</th>
<th>Metropolitan</th>
<th>Country</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Tokyo</td>
<td>Japan</td>
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<tr>
<td>2</td>
<td>Shanghai</td>
<td>China</td>
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<tr>
<td>3</td>
<td>Jakarta</td>
<td>Indonesia</td>
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<td>4</td>
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<td>5</td>
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<tr>
<td>20</td>
<td>Chongqing</td>
<td>China</td>
</tr>
</tbody>
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Techtonic shift

China’s tech sector as % of United States

- Five years ago
- 2018 or latest

Twice the level of the United States

- Market value of listed Internet stocks
- Venture capital funding
- Value of “unicorns” (startups valued at over $1bn)

1,068% Mobile payments

https://www.economist.com/

https://www.europeanhorizons.org/

VERAM
EU Raw Materials 2050: Roadmap to Success
Brussels, 17th April 2018
Global deficiency

Future heat waves, droughts, and floods in major European cities

Global Temperatures
Average global temperatures rise as a result of human carbon emissions

Resources
This causes scarcity in some key resources - especially water and viable agricultural land

Conflict
Disputes over land, water and other resources lead to armed violence

http://www.newslettereuropean.eu/
http://www.sameworld.eu/
World of ethics and innovation
VERAM Research Areas

• Fostering a sustainable supply of RM to feed new and existing value chains
  • Primary supply of EU raw materials for sustainable value chains (∼‘new exploration tech’)  
  • Improved utilisation of raw materials supply from EU sources (∼‘EU sourced supply’)  

• Resource-efficient processing for RM
  • Development of resource-efficient, advanced processing for raw materials (∼‘resource efficient processing’)  
  • Minimisation and valorisation of residues (∼‘valorisation of residues’)  

• RM in new products and applications
  • Development of material applications and markets (∼‘hybrid materials’)  
  • Development of new biobased products (∼‘new biobased’)  
  • Substitution of critical raw materials (∼‘substitution of CRM’)  

• Closing material loops by maximising the recycling of products, buildings and infrastructure
  • Increasing material recovery by efficient detection, sorting and separation (∼‘efficient sorting’)  
  • Reuse and recycling technologies adapted to complex, durable or miniaturised products (∼‘complex products recycling’)  
  • Developing and integrating methods for assessing and optimising cost and benefit in recycling (∼‘CBA in recycling’)
Multiple Correspondence Analysis

- We substituted the car attributes by, for instance, KET innovation fields, and the car brands by future scenarios and research areas.

<table>
<thead>
<tr>
<th>This field of innovation will be...</th>
<th>...in this future scenario and to this research area.</th>
</tr>
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<tbody>
<tr>
<td>E=Essential</td>
<td>E=Essential</td>
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<tr>
<td>I=Important</td>
<td>I=Important</td>
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<tr>
<td>N=Neutral</td>
<td>N=Neutral</td>
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<tr>
<td>O=Obsolete</td>
<td>O=Obsolete</td>
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<table>
<thead>
<tr>
<th>This research area is...</th>
<th>...in this future scenario and for this economic activity.</th>
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<table>
<thead>
<tr>
<th>The contribution from patents &amp; research in this industrial sector is...</th>
<th>...in this future scenario and to this economic activity.</th>
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</table>
Relevance of field of innovation in future scenario / to research area

- EU STAGNATION
- ETHICS
- GLOBAL DEFICIENCY
Relevance of research areas in future scenario / to economic activity
3. THE FUTURE WE ARE AIMING AT
Strategic Innovation and Landscape Analysis

- **Innovation methodology** developed by RINA is based on an **8-steps structured approach**. The aim is to interpret today’s reality for understanding, anticipating and finally meeting the needs and desires of tomorrow’s customers, from idea conception to market deployment.

- **Landscape Analysis**, performed through specific databases, is the third step, at **low-medium TRL**, to acquire all the information needed to get insight into any matter subject, from different perspectives.
VERAM - Technology Landscaping

• **Scope:** to identify the *current trends in future technology developments*, involving raw materials, of interest for *industry* in EU

• **Methodology deployed:**
  
  - Selection of **13 Key industrial sectors**, grouped into 6 industrial fields, characterized by *highest investments* in the field or *Raw Materials*
  
  - Identification of the main, **big industrial players** (2-3 for each sector) in the European field (market analysis)
  
  - Extensive **patents and scientific publications analysis**: intellectual property and papers affiliation landscaping through specific databases mining
  
  - Analysis of the **KETs Innovation Fields**, as a basis to understand the fastest growing sectors related to Raw Materials priorities

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A. **Building Materials**
   1. Glass & Ceramics
   2. Cement

B. **Industrial Metals**
   3. Steel
   4. Catalysis
   5. Aluminium & Alloys
   6. Fine Chemicals

C. **Chemistry**
   7. Bio-Plastics

D. **Forest-based**
   8. Pulp & Paper

E. **Transport**
   9. Automotive
   10. Aerospace
   11. Tyres

F. **Telecommunications**
   13. Automation
Example: Steel industry – Patent Landscaping

- Patents present in databases are extracted through queries and represented as points in the map.
- Peaks represent the highest concentration (grouped through semantic analysis around the main topic).
- The highest intensity of research on Raw Materials topics is therefore evident.

Map developed utilizing Themescape™ Derwent Innovation – RINA Consulting elaboration
Example: Pulp and Paper – Patent Landscaping

Map developed utilizing Themescape™ Derwent Innovation – RINA Consulting elaboration

1. Packaging: methods for the production of containers, fibers orientation
2. Methods for producing micro-fibrillated cellulose or composites
3. Methods for paper making
4. Surface treatments for paper
5. Betulin acid preparation
6. Wood as building material

Example: Pulp and Paper
- Patent Landscaping
- Map developed utilizing Themescape™ Derwent Innovation – RINA Consulting elaboration
- Brussels, 17th April 2018
- EU Raw Materials 2050: Roadmap to Success
Key Enabling Technologies (KETs)

- KETs have applications in multiple industries, in both emerging and traditional sectors

- **KETs are 6 technologies** having a wide range of product applications and a huge potential to fuel economic growth and create jobs in the EU. They have been extensively mapped and analysed into their cross-functional relationships within the RO-cKETs study (Roadmap for cross-cutting KETs activities in Horizon 2020). The so-called Innovation Fields are extracted, as the market segments receiving relevant boost in the future innovation perspectives, thanks to the KETs

- **VERAM approach**: Selection of those Innovation Fields related to Raw Materials representing the most promising innovation opportunities, and association to the different categories of Raw Materials which can be impacted

- The result is a series of tables gathering opportunities of development with a high impact on specific Raw Materials

**Micro- and Nano-electronics (MNE)**

**Nanotechnology (N-T)**

**Industrial Biotechnology (IB)**

**Advanced Materials (AM)**

**Photonics (PhT)**

**Advanced manufacturing systems (AMS)**

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http://ec.europa.eu/growth/industry/key-enabling-technologies_en

The analysis brought to the selection of a total of 65 Innovation Fields, used as input for the VERAM Scenario’s Gap Analysis.

The Gap Analysis was the basis for our Roadmap development.
Questions and answers

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