

VERAM Final Conference - #VERAM2050

EU Raw Materials 2050: Roadmap to Success

17 April 2018

The Royal Flemish Academy of Belgium for Science and the Arts, Brussels

The Final Conference of the [VERAM Horizon2020 project](#) took place in Brussels on 17 April 2018. This project brought together diverse stakeholders – including five European Technology Platforms (ETPs): Sustainable Minerals Resources, Forest, Construction, Sustainable Chemistry and Advanced Materials – to produce a medium-term (2030) Vision and a longer-term (2050) Strategic Research and Innovation Roadmap for raw materials. The conference discussed the work of the project, its methodologies and its results including the [‘Research and Innovation Roadmap: A Sustainable and Competitive Future for European Raw Materials’](#).



Conference participants were welcomed by **Patrick Wall**, VERAM’s project coordinator from the European Technology Platform on Sustainable Mineral Resources (ETP SMR). He emphasised the strong partnership that had been forged through the project that linked diverse ETPs, value chains, industry sectors and academe.



Patrick Wall, VERAM Project Coordinator, ETP SMR

The project had considered the challenges facing Europe to ensure an appropriate and sustainable supply of vital raw materials. These challenges included areas such as policy, establishing a common understanding of the resources that were of public importance, dispersed knowledge and the need for enhanced coordination along the whole value and research and innovation chains, and the need to better exploit synergies in raw materials R&D.

VERAM’s response had been to initiate communication and dialogue between the different raw materials sectors, stakeholders (including civil society organisations) and all parts of the value chain to pool experience and knowledge and build the VERAM Vision and Roadmap for Raw Materials¹.



Henk Pool, Cefic

Henk Pool, Innovation Manager at CEFIC introduced the conference agenda and acted as Master of Ceremonies for the day. He reminded attendees using social media to use the #VERAM2050 hashtag. 2050 was 32 years away – equivalent to someone in 1986 looking forward to today. In the year of Chernobyl and the first mobile phone, who could have predicted the world of today? Predicting the future is a significant challenge, especially in a world that is experiencing rapid change including accelerators of change such as digitalisation, however we can be certain that there will still be a need for raw materials in 2050!

¹ [RESEARCH AND INNOVATION ROADMAP 2050 A Sustainable and Competitive Future for European Raw Materials](#)

EESC perspective

Dumitru Fornea, Secretary General of the Romanian National Trade Union Confederation MERIDIAN and member of the European Economic and Social Committee (EESC) gave the opening keynote speech. Since 2007, with EESC colleagues, he has been promoting raw materials issues and their associated EU industries. From an Eastern European perspective, the role of raw material industrial sectors is crucial. There are many large projects in progress in Member States such as Romania, Greece and Bulgaria that are catalysts for jobs and growth. New extractive projects bring with them associated industrial parks and improved industrial infrastructure and this trio of developments is key - especially in rural areas where industrial jobs are scarce.



Dumitru Fornea, European Economic and Social Committee, National Trade Union Confederation MERIDIAN from Romania

Mr Fornea saw a completely different world by 2050: in particular for the energy sector. And raw materials had a vital role in this future especially for energy storage applications. Raw materials access was a global issue and he saw two challenges: to ensure Europe did not lose the “technology race” and continuing access to required raw materials. Today we are used to the idea that we can access raw materials globally, but this may not be true in the future. This was cause for concern. In the EU continuing access to rare earth elements (REE) was essential to enable the achievement of targets for decarbonisation by 2050.

He also thought that Europe and its citizens needed to appreciate better the value of the mining sector as it was essential for a sustainable future. Is it possible to rebrand the sector? This could be important to ensure that EU policy makers were able to make the right decisions for the future.

VERAM 2050 scenarios



Karl Vrancken, VITO

Karl Vrancken, Research Manager Sustainable Materials at VITO introduced the first session on VERAM scenario development. These were developed to analyse plausible futures that were then applied to the Raw Materials Sector to help identify opportunities and threats and therefore define required research and innovation (R&I) actions to minimise perceived threats and/ or seize opportunities.



Dirk Nelen, VITO

Dirk Nelen from VITO opened the discussion on scenarios with a description of how they were developed in VERAM. Of all potential futures there were a subset of possible future of which some were plausible. Of the plausible futures, some were more probable than others and then there was the subset of futures that were preferable.

The project had surveyed the current state of play to answer the question: Where are we now? It had established an inventory of current Member State, EU and global raw materials policies and R&D funding calls and had surveyed EU Member State funding bodies with 13 Member States providing insights. The inventory database is available on the VERAM portal².

Analysis of the input showed that there was a move towards more holistic rather than sector specific approaches to raw materials issues including non-technical issues. Mining will remain important as there will still be a need for primary material resources despite the expected transition to a more circular economy. Growing transnational cooperation was fostering common understanding of issues across funding bodies and with common topics addressed globally, it made sense to boost international cooperation efforts.

In terms of economic output raw materials represented EUR 123 billion or 0.5% of total final EU output in 2011 including imported raw materials worth more than EUR 43 billion. Research effort was highly heterogeneous with three Member States accounting for 68% of total R&D in the sector. In terms of business R&D expenditure there was a clear gap between the EU (low) and competitors like the US, China, Japan and Korea (high). However, initiatives such as the establishment of Public-Private-Partnerships (PPPs) was helping to transform EU manufacturing industry.

Three scenarios describing plausible futures were outlined: EU stagnation; Global deficiency (with effects of climate change causing major global instability); and the 'world of ethics and innovation'.

These three scenarios were used in a gap analysis of the four VERAM research areas: fostering a sustainable supply of raw materials to feed new and existing value chains; resource efficiency processing for raw materials; raw materials in new products and applications; and closing material loops by maximising the recycling of products, buildings and infrastructure.

Using multiple correspondence analysis, the relevance of current fields of research and innovation to future scenarios were assessed. It was noted that a large number of current research areas were clustered around the EU stagnation scenario! However, innovation projects were dispersed across the plot and should be useful in all scenarios. There was also a cluster of innovation projects associated with the optimistic 'where ethics rule the world' scenario.

² <http://www.veram.eu/#/>



Lorenzo Dall'Oro, RINA Consulting

Lorenzo Dall'Oro of Rina Consulting considered what future the VERAM project was aiming at. Using RINA's own eight-step structured approach, in particular its Technology Landscape Analysis component, the current trends in relevant raw materials technology developments were identified. Thirteen key industrial sectors were grouped into six industrial fields characterised by the highest investment in raw materials and a variety of data identified such as main players, and patents and publications published. An analysis of relevant Key Enabling Technologies (KETs) innovation fields in each area was undertaken. The innovation fields were extracted from the results of the RO-cKETs study³ and the analysis identified 65 innovation fields highlighting opportunities for development relevant to raw materials. This was used as input for the VERAM scenario Gap Analysis which was the basis for the Roadmap development.

Panel discussion

The first panel discussion, moderated by **Karl Vrancken**, featured input from **Lorenzo Dall'Oro** and **Dirk Nelen** together with **Slavko Solar**, Secretary General at EuroGeoSurveys, and **Jan Lagerström** of the Swedish Forest Industries Association.



From left to right, Lorenzo Dall'Oro (RINA Consulting), Dirk Nelen (VITO), Slavko Solar (EuroGeoSurveys), and Jan Lagerström (Swedish Forest Industries Association).

Slavko Solar praised the VERAM's work but said that with so many possible open options for the future and complex future trends it was very difficult to make predictions beyond three to five years. He thought that the raw materials sector needed to be more aware of its role going forward rather than seek more recognition. It needed to integrate more into society and policies to ensure its social licence to operate.

³ [Study on methodology, work plan and roadmap for cross-cutting KETs activities in Horizon 2020](#)

Jan Lagerström also praised VERAM’s work as clearly identifying the opportunities and possibilities. There was also a need to think about the market and consumer behaviour: knowing what they want was extremely important. He also noted the need for large industrial players in the process industries to ensure continuing investment, but also the need for smaller entrepreneurs who can see the possibilities and work closer to consumers.

Lorenzo Dall’Oro commented that all stakeholders had been involved in the projects including entrepreneurial concepts such as mining on demand, however these were currently far from market.

Dirk Nelen said that the Raw Materials sector is demand driven and much current R&D appears to be done with the EU stagnation scenarios in mind, such as how to deal with lack of demand. Solutions to this issue offered opportunities for mining and harvesting in the EU but also in the emerging economies market.

An open Q&A session made a number of interesting points.



In response to the question of Europe’s response to decreasing demand at home Slavko Solar saw some areas of the industry as being quite future orientated in terms of ‘dematerialisation’ and thought that consumer driven demand for such concepts was important. Jan Lagerström felt that if the rest of the world is growing then demand for our products will also grow. He also felt that the sector needed to develop knowledge about substitution and there was a role here for entrepreneurship.

A question on the effect of increasing recycling and reuse of materials on the whole sector saw Dirk Nelen prophesising that in the near future the source of a material – primary or recycled - will no longer be relevant. But he saw the development of more durable/ sustainable devices that will be inherently more difficult to recycle. In developing circular economy policies there is a need to balance when is it sensible to recycle versus the overall environmental costs. Jan Lagerström reinforced the importance of urban mining and recycling critical raw materials (CRM), while Slavko Solar emphasised the need to protect primary resources for future generations and their integration into circular economy processes.

On the question of how reliable the scenarios were Dirk Nelen commented that scenarios are never 100% reliable but they allowed us to prepare for whatever the future may bring. Jan Lagerström concluded the session by saying that scenarios are important in giving us ideas for reality and “lack of raw materials is the mother of innovation”.

Raw Materials in sustainable energy markets

After a coffee break a keynote presentation was given by **Claudiu Pavel** from the European Commission's Joint Research Centre (JRC) on Raw Materials in sustainable energy markets (solar, wind) and e-mobility. In particular he focused on issues around raw materials supply as a bottleneck for the transition to a low carbon economy. Some 25 raw materials are important for low carbon technologies with 10 seen as critical materials due to high and growing demand but supply constraints. The EU was highly dependent on imports for many relevant raw materials, however this was not a unique situation and the EU, China and the US have similar import demands for 11 critical materials. On the other hand, China dominated production of Rare Earth Elements (REE). Raw material prices increased overall from 2000 to 2016 with some massive price rises, for example Cobalt which has seen significant demand increase for battery applications.



Claudiu Pavel, Joint Research Centre (JRC), EC

When considering the recycling potential of materials from current renewable energy and battery technologies some had good potential, but many showed very low potential with some two-thirds showing recycling potential below 30%. Substitution potential could be a better option for the mid to long term but with current technologies this was also generally low. Examples of direct material substitution and also component substitution were shown yielding better materials efficiency or successful substitution.

The JRC had studied the EU's raw materials resilience for renewable energy and battery technologies and found that wind turbine technologies were the most vulnerable. The results are summarised in a JRC Science for Policy report⁴. A further report assessed the EU's resilience to potential bottlenecks by 2030⁵. Overall there is high dependency on imports of the key raw materials needed in current wind, photovoltaic (PV) and electric vehicle (EV) battery technologies. EV technologies are the most critical when considering the full supply chain and there is also a strong dependency on manufacturing capacities downstream. The

⁴ [Materials impact on the EU's competitiveness of the renewable energy, storage and e-mobility sectors](#)

⁵ [Assessment of potential bottlenecks along the materials supply chain for the future deployment of low-carbon energy and transport technologies in the EU: Wind power, photovoltaic and electric vehicles technologies, time frame: 2015-2030](#)

studies foresee that EU resilience to potential supply issues will deteriorate by 2030 unless mitigation measures are taken. These include increasing recycling, substitution and domestic raw material production and also supply chain improvements such as diversification and expansion.

During questions, Claudiu Pavel pointed out that uncertainty in demand was always an issue with forward looking scenarios and that, for example, the uptake of EVs is currently much higher than had previously been assumed.

Creating the VERAM Vision

After lunch delegates focused on how the VERAM Vision 2030 and 2050 for Raw Materials was created. The EU Raw Materials Sector will evolve through increased digitisation and in response to climate change. These changes could dramatically alter the landscape of the sector, but research and innovation actions can help prepare the sector to address these challenges.



Johannes Drielsma, Euromines

The session was moderated by **Johannes Drielsma**, Deputy Director Euromines who described the session as looking at how we moved from scenarios to a roadmap. None of the panellists had been involved in writing the report, so the discussion could be seen as a ‘stress test’ for it.

To set the scene, **Corina Hebestreit**, Director of Euromines, described the VERAM Roadmap process reiterating that merely bringing the various diverse sectors and partners together was a very valuable effort in itself. Using the scenarios and the economic outlook as available today it was seen that whatever the scenario examined there would be a requirement for increased raw material supply. The key was: how would we cope with this demand?

VERAM’s vision for raw materials in 2050 foresaw a significant reshaping of society due to digitalisation that would increase demand for new processes and products. To achieve a global leadership in technology innovation, EU industries would need to develop smart technologies that respond to consumer demand while addressing global challenges such as climate change. By 2050 innovation in raw material value chains will have helped the EU achieve its targets for resource efficiency and enabled a competitive low-carbon economy. This would



Corina Hebestreit, Euromines

require the sector to have fostered truly sustainable supply and use of raw material in existing and new value chains including a diversity of sourcing.

The VERAM approach covers all materials: both the biotic (for example forestry & natural rubber) value chain and metal, minerals and aggregates value chain and looks to reinforce and underpin greater sustainability, economic resilience and technology leadership in the EU. The Vision 2030 - 2050 see increased EU production to ensure a base load supply of materials, improved access to all forms of financial resources to facilitate more investment, development of globally competitive sustainable technologies, investment outside Europe to ensure access to resources, the creation of new jobs across the raw materials sector, and contributing to the replacement of jobs lost in other parts of the economy and through automation.

Four priorities had been identified and formed the core of the Roadmap considerations: I/ Fostering a sustainable supply of raw materials to feed new and existing value chains; II/ Resource-efficient processing for raw materials, III/ Raw materials in new products and applications, and IV/ Closing material loops by maximising the recycling of products, buildings and infrastructure.

Innovation and capacity building across all four priorities required leverage of the European dimension in terms of increased engagement of all Member States through ERA-nets, the creation of economic incentives, leveraging innovation capacity, expanding cross-sector approaches, and consideration of the social challenges including the need to rehabilitate redundant extractive industry sites and their communities alongside the need to ensure a continuing licence to operate for other material extraction. There was also a need to promote an innovation fitness check for IPR and standardisation issues across Europe, support innovation in the raw materials sector and extend awareness of the sector and material science in general.

Panel discussion

The second panel brought together **Werner Annaert**, General Director at Go4Circle, **Pier Luigi Franceschini**, Innovation Hub CLC South General Manager in the European Institute of Innovation and Technology (EIT) Raw Materials, **Jenny Greberg**, Head of Technology & Innovation, Bergforsk, and **Andreas Kleinschmit von Lengefeld**, Director at the French Institute of Technology for Forest based and Furniture Sectors.



From left to right, Andreas Kleinschmit von Lengefeld (French Institute of Technology for Forest Based and Furniture Sectors), Jenny Greberg (Bergforsk), Pier Luigi Franceschini (EIT) Raw Materials, and Werner Annaert (Go4Circle).

As a representative of waste recyclers, Werner Annaert saw the value of the VERAM Vision as identifying opportunities, but he emphasised the need for increased collaboration to achieve the goals. Pier Luigi Franceschini agreed that the road map was well aligned with the EIT RM's view. He looked to increasing recycling rates and highlighted that what we do now [in research] will only see its full impact by 2050.

Jenny Greberg saw many parts of the vision with direct relation to her organisation's activities. It was important that Europe retained world leading mining companies and equipment suppliers. The sector was already working hard towards automation often using technology developed in other sectors. She reemphasised the view that primary production would be required in the future. Andreas Kleinschmit von Lengefeld focused on the biobased sector, the regional diversity of supply in Europe and how to get the most out of the resource.

A wide-ranging conversation brought up issues including how we can learn from diverse sectors, how to translate best practise legislation from country to country, and how education awareness of raw materials issues can be raised especially in terms of career guidance and learning entrepreneurship.

Moderator Johannes Drielsma asked what, apart from increasing production, was needed to ensure demand can be met? Werner Annaert thought it was important for authorities to establish targets that enabled primary mining to support urban mining and recycling. Pier Luigi Franceschini advocated more inter-sector technology transfer, while Jenny Greberg thought greater engagement with the public was essential which meant being able to make a good narrative on why mining was required. Andreas Kleinschmit von Lengefeld agreed and asked why not include society more in our activities? This was essential to ensure continuity of high quality people in the industry.

Werner Annaert thought this would first require that the industry re- educates itself, which was easily said, but hard to do. Andreas Kleinschmit von Lengefeld emphasised that the social value of the sector should not be underestimated citing the concept of forest bathing for wellbeing and cultural heritage.

A question from the audience asked for views on how digitalisation and robotics would impact the sector. Andreas Kleinschmit von Lengefeld said that there was already very high uptake in the furniture sector and robotics would be extremely important. Currently the EU was leading in terms of digital technologies for harvesting, but outside Europe there was increasing competition.



Jenny Greberg agreed, saying that EU led in robotics and artificial intelligence (AI) in process control driven by safety issues. Advanced communication systems were now in many mines allowing remote robotic operations. She believed this would not lead to job losses, but different jobs. Werner Annaert saw huge opportunities for new jobs in the circular economy, the opportunity for robotics would appear when the value of waste materials increased and brought greater investment.

A final question in the session asked whether there was a need to show the consumer what they need rather than respond to consumer demands? Johannes Drielsma wondered how we measured consumer demand? Should we be led by a vision or best guess consumer demand or should we drive as well? Pier Luigi Franceschini thought we should drive it and Jenny Greberg reiterated that we needed to consider not just products but value chains too. She described developments in producing fossil-free steel production replacing coal with hydrogen. Developments like this would provide a competitive advantage for EU. Andreas Kleinschmit von Lengefeld highlighted the recent development of very high (40 storey) timber buildings, which was also driven by Europe innovation.

Creating the VERAM Roadmap

After a final coffee break the creation of the VERAM Raw Materials Roadmap 2050 was addressed. The VERAM Research and Innovation Action Roadmap provides solid and specific recommendations and the final panel discussion brought together representatives of the five diverse European Technology Platforms (ETPs) to discuss what they had learnt by working together.



David Ovidia, International Geoscience Service

This third discussion session was moderated by **David Ovidia** of the International Geoscience Service who said that the roadmap document brought solid and specific recommendation and action, but the key now was who should do what and when to bring the actions to life?



Johan Elvnert, Forest-based Sector Technology Platform (FTP)

To inform the discussion **Johan Elvnert**, Managing Director of the Forest-based Sector Technology Platform (FTP) gave an overview of the Roadmap. The road map was a result of a wide range of inputs including analysis of the five ETPs’ Strategic Innovation and Research Agendas (SIRAs), the European Innovation Platform (EIP) on Raw materials SIRA, public consultations and workshops including a two-day

writers workshop (small group). This was a very inclusive process that resulted in the formulation of some 178 Research & Innovation Areas (RIAs) across the four identified priorities. Remarkably within the RIAs over 50% overlapped between biotic and the metals, minerals and aggregates sectors.

Each priority area and their sub-areas followed the same format: first a rationale explaining why the area was relevant, then the current state of innovation in the area, expected achievements by 2030 and 2050, and finally a list of research and innovation activities 2030-2050 for biotic and the metals, minerals and aggregates sectors. He acknowledged that beyond 2030 the trend to rapid digitalisation is blurring the foresight horizon so perfect visibility was not possible. However, he noted that the roadmap represented the only EU roadmap for 2050 agreed by all non-food, non-energy raw materials sectors in Europe and it would help attract new people to the sector, provide a platform for new value chain cooperation and form the basis for new EU calls over years to come.

Panel discussion

The five panellists for this final debate were **Rafal Szkop**, President of the European Technology Platform on Sustainable Mineral Resources (ETP SMR), **Johan Elnert** of FTP, **Jan Meneve** of European Technology Platform for Advanced Engineering Materials and Technologies (EuMaT), **Christian Artelt**, Chairman of the European Construction Technology Platform (ECTP), and **Pierre Barthélemy**, board member of the Sustainable Chemistry ETP (SusChem).



From left to right, Rafal Szkop (ETP SMR), Johan Elnert (FTP), Pierre Barthélemy (Cefic), Jan Meneve (EuMaT), and Christian Artelt (ECTP).

In opening statements all welcomed the report. Rafal Szkop considered that there was a need to change the image of the sectors: we are very innovative but not seen as modern. Overall there was much common ground and the linking word for all was sustainability. Johan Elnert predicted that materials would be the limiter to progress rather than energy and Jan Meneve looked forward to new collaborations in all priority areas.

Christian Artelt brought an operation perspective and welcomed initiatives that bring cross-sector applications that will valorise residues, minimise environmental impacts, and secure the economic basis of production in Europe. In particular, he saw that closing material loops would need process, technological and regulatory obstacles to be overcome to enable circularity.

Pierre Barthélemy congratulated the consortium partners on this document that would feed well into the last part of Horizon 2020 and also FP9. The European Chemical Industry is currently formulating its mid-century strategy and feedstock was an important element in reducing the sector's carbon footprint. He saw enhanced collaboration between different sectors as essential. In terms of what to do with the document, he recommended presenting it to existing public-private research and innovation initiatives such as the BioBased Industries Joint Undertaking (BBI JU)⁶ and the Sustainable Process Industries for Resource and Energy efficiency (SPIRE)⁷ PPP to see how these recommendations might be included in their calls. He also said that SusChem was in the process of reviewing its SIRA for FP9 and some recommendations could be incorporated there.

David Ovadia asked the panel for the advice they would give to the European Commission with respect to the report. Johan Elvnert saw the VERAM outcomes as a backbone to build on with all funders and advocated taking the document to the Commission as a possible "mission orientated" objective for FP9. Pierre Barthélemy emphasised the role of innovation within the "magic triangle" of competitiveness, innovation and sustainability. He looked for an ambitious Multiannual Financial Framework (MFF) budget and protection of the research and innovation component "If you believe innovation is too expensive, try without," he concluded. Rafal Szkop fully supported this point of view. For many reasons we needed to move from a "resource driven to knowledge driven" economy. Christian Artelt said we needed to see and act on the innovation gaps, but also improve the environment to facilitate commercialisation of new circular economy concepts.

In a final Q&A session it was asked if the panellist could foresee by 2030 a significant self-contained battery supply chain in Europe? With the huge interest in EVs and the recent launch of a battery technology flagship Pierre Barthélemy was optimistic. The speed at which technologies develop was high but scaling innovation to commercialisation presented more constraints. Johan Elvnert highlighted the possible development of graphene-based batteries from tree materials. "Li-ion not the last technology for batteries," he noted. Rafal Szkop emphasised the need to reclaim valuable metals from batteries which could be an opportunity for Europe.

The panellists also touched in the role of blockchain technologies in the circular economy. Jan Meneve saw a big role for the Commission to play as a basis to establish a true circular economy running new business models, but this would require new legislation. Johan Elvnert agreed that the use of blockchain technology is of interest in terms of certification of materials.

⁶ <https://www.bbi-europe.eu/>

⁷ <https://www.spire2030.eu/>

Commission remarks and close



Marcin Sadowski, EASME, EC

Closing Remarks were made on behalf of the European Commission by **Marcin Sadowski**, Head of Sector - Raw Materials at the European Commission’s Executive Agency for SMEs (EASME). He noted that despite this being VERAM’s closing conferences, the project was not yet finished: with six weeks to go: “the ball was still in play”. He praised VERAM for bringing together different players for the first time and the large value added for the project. Raw materials are important and bringing the major players together was crucial, but he also noted the need to integrate societal interests. He urged VERAM partners to disseminate the final roadmap as widely as possible, so that its recommendations and ideas are brought to fruition as soon as possible.

The conference was wrapped up by **Patrick Wall** who called on participants to “get to work” and use the VERAM results to redefine and refine research priorities. Henk Pool agreed saying that the VERAM report and conference proceedings would be officially published soon and everyone should join share the findings as widely as possible. “The project is not finished – there is more to come,” he concluded.



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