ADVANCED ENGINEERING MATERIALS & TECHNOLOGIES FOR A CIRCULAR ECONOMY

Jan Meneve
VITO Vision on Technology
Belgium
VITO: RESEARCH & INNOVATION DRIVEN BY SOCIETAL CHALLENGES

Energy

Materials

Chemistry

Health

Land use
Materials linking SDG 9 and SDG 12

**SDG9**: build resilient infrastructure, promote sustainable industrialization and foster innovation.
- 9.4: upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.

**SDG12**: ensure sustainable consumption and production patterns.
- material footprint
- domestic materials consumption
- food loss
- recycling rates
- hazardous waste production
- sustainable public procurement actions.
INSPIRED BY THE CIRCULAR ECONOMY

Circular by Design
EEA Report No 6/2017

CIRCULAR ECONOMY PERSPECTIVES

- VALUE OF PRODUCTS AND MATERIALS IS MAINTAINED FOR AS LONG AS POSSIBLE
- WASTE AND MATERIAL & ENERGY RESOURCES USAGE ARE MINIMISED
- FOR ECONOMIC, SOCIAL AND ENVIRONMENTAL BENEFITS

ENF17 MAT4CE - 22 June 2017
Key role of advanced materials & technologies
SUSTAINABLE MINING

H2020 MetGROW+ project
http://metgrowplus.eu/

- To develop new metallurgical unit operations for metal extraction, with a focus on economically important (Ni, Co, Zn, Cu, Fe) and critical metals (In, Ga, Ge, Cr, Sb and Co).
- A metallurgical toolbox is being developed for the zero waste exploitation of complex, low grade ores and industrial residues, including novel bio- & solvometallurgy and plasma-pyro technologies.
Strippable topcoats for aircraft refurbishment

Plasma surface engineering enabled bioplastics for food packaging
FP7 PlasmaNICE project http://www.tut.fi/plasmanice/
Laser additive manufacturing
VITO, 2012, YouTube

 RESOURCE EFFICIENT PRODUCTION

CAD design process

DCAM slicing and tool path generation

Additive

Final component
RESOURCE RECOVERY

*Electro-crystallization recovery of Rare Earths from aqueous waste stream*

*VITO, 2015*

*Patented VITO process*
Phosphate sorbents from waste iron sludge
VITO, 2015
AN EFFECTIVE CIRCULAR ECONOMY

SHORTER PRODUCT LOOP CLOSURE BY NEW BUSINESS MODELS

- PRODUCT LIFE EXTENSION BY REPAIR, RE-USE, UPGRADING, REMANUFACTURE
- SHARED USE/ACCESS/OWNERSHIP
- PRODUCT AS A SERVICE

Accenture Strategy
Circular Advantage
Accenture 2014
Circular business models enabled by the Internet of Things

- Internet of Things [Wikipedia]: the inter-networking of physical devices, (also referred to as "connected devices" and "smart devices") - embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data
- Software (the Internet) & hardware (the Things)
- The Things most often made possible by advanced materials & nanotech

Source: Cisco United Nations
Circular business models enabled by the Internet of Things

- E.g. (autonomous) car sharing platform: **cars become computers on wheels** enabling mobile app based sharing, remote tracking & management of assets, while ensuring safety and regulatory compliance.
IMEC
Dematerialisation for sustainable consumption

CATO Institute blog, 2012
The Miracle that Is the iPhone (or How Capitalism Can Be Good for the Environment)
Resource effective manufacturing & processing IND 4.0
“We have automated hauling. We have automated drilling. These are technologies that have now been commercialized—which means that in some mining operations out there, we have these massive fleets of giant ore trucks, pieces of gear that are the size of your house, driving and navigating their way around an open pit without anybody sitting in them. This is a self-driving car on steroids, essentially.”

McKinsey podcast May 17, Mining for growth

ETF mining equipment
http://www.etf.equipment/
CONCLUSIONS

- Circular economy needs systems thinking, to keep the value of resources at the highest possible level at all times.

- Advanced materials & technologies are key in closing material and product cycles.

- The Internet of Things & related nanotech are essential for enabling circular business models.

- Nanotech, IoT and related AI, big data and IND4.0 robotics render consuming, manufacturing and processing, and mining more sustainable.

- Vast, exciting and yet relatively unexplored field for advanced materials technology RR&D&I.
RAW MATERIALS FOR A CIRCULAR ECONOMY – JOIN OUR COMMUNITY!

http://www.eumat.eu/

Raw Materials (Working Group 8)

Non-energy and non-agricultural raw materials underpin the global economy and our quality of life. They are vital for the EU’s economy and for the development of environmentally friendly technologies essential to European industries. However, the EU is highly dependent on imports, and securing supplies has therefore become crucial [ERA-MIN Research Agenda, 2013]. Moving from the traditional, linear ‘make, use, dispose’ economy to a circular economy requires increased reuse, remanufacturing and recycling of products. This is an important aspect of the EU’s strategy to ensure the security of supply [EIP Raw Materials Scoreboard, 2016]. Advanced material technologies are key to sustainable resource use. Moreover, advanced material technologies enable new business concepts that support the emerging circular economy.

Challenges

Resource efficiency, substitution of critical materials, and recycling of waste streams will be essential in the future manufacturing and processing value chains within a materials constrained world. Advanced material technologies play a vast yet largely unexplored role in this domain.

In technological terms, this translates in advanced engineering materials and technologies for optimal resource use, substitution of critical materials, metal recovery and recycling of waste streams. As such, advanced material technologies are key to sustainable mining and recycling, to feed and close cascaded material and product cycles in a viable, growing circular economy. And more than that, advanced material technologies enable new business concepts that support the circular economy in the shorter closing of material and product loops, such as product-service systems and product sharing, by manufacturing stronger, modular, products with embedded sensors and data communication that can be monitored and upgraded.
Global Science, Technology and Innovation Conferences

Circular Economy Session: Digitalisation as a driver for Circular Economy

1. Envisioning a CE based industry towards 2030
2. Value Chain innovation by combining IND4.0 and the CE
3. The impact of CE and IND4.0 on the waste sector
4. Implementing CE and IND4.0

www.gstic.org
CONTACT

Thank you for your attention

Jan Meneve
Research Programme Manager
jan.meneve@vito.be