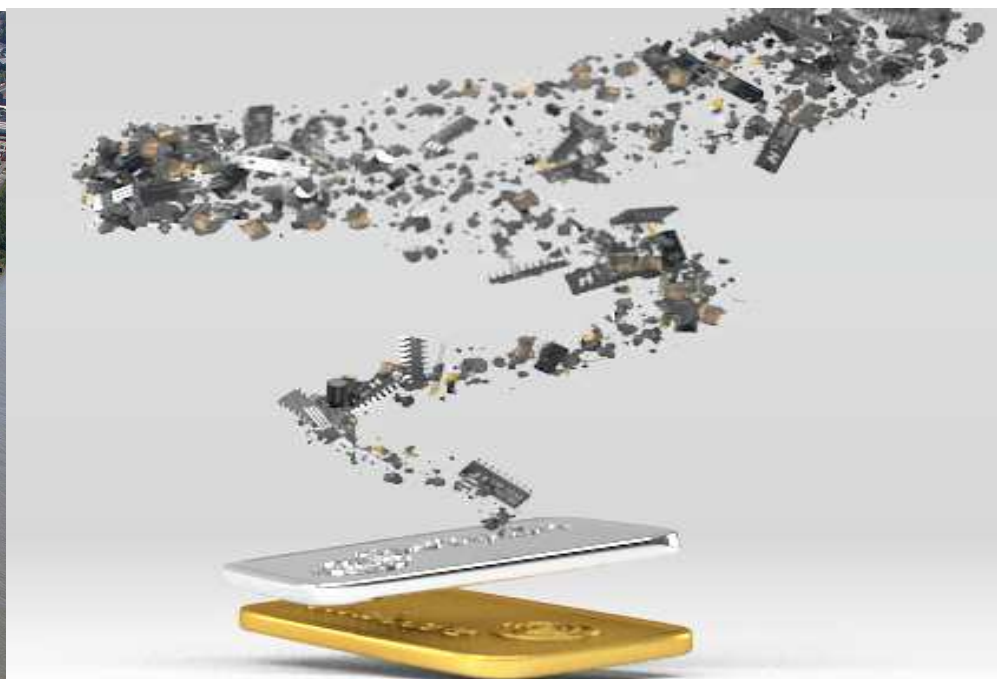


Giving a new life to end-of-life electronic equipment in a sustainable and responsible way

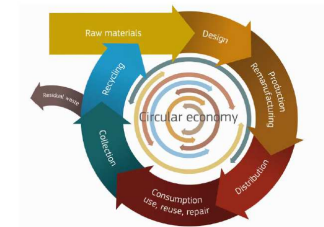


Dr. Christian Hagelüken & Dr. Egbert Lox

Umicore Government Affairs

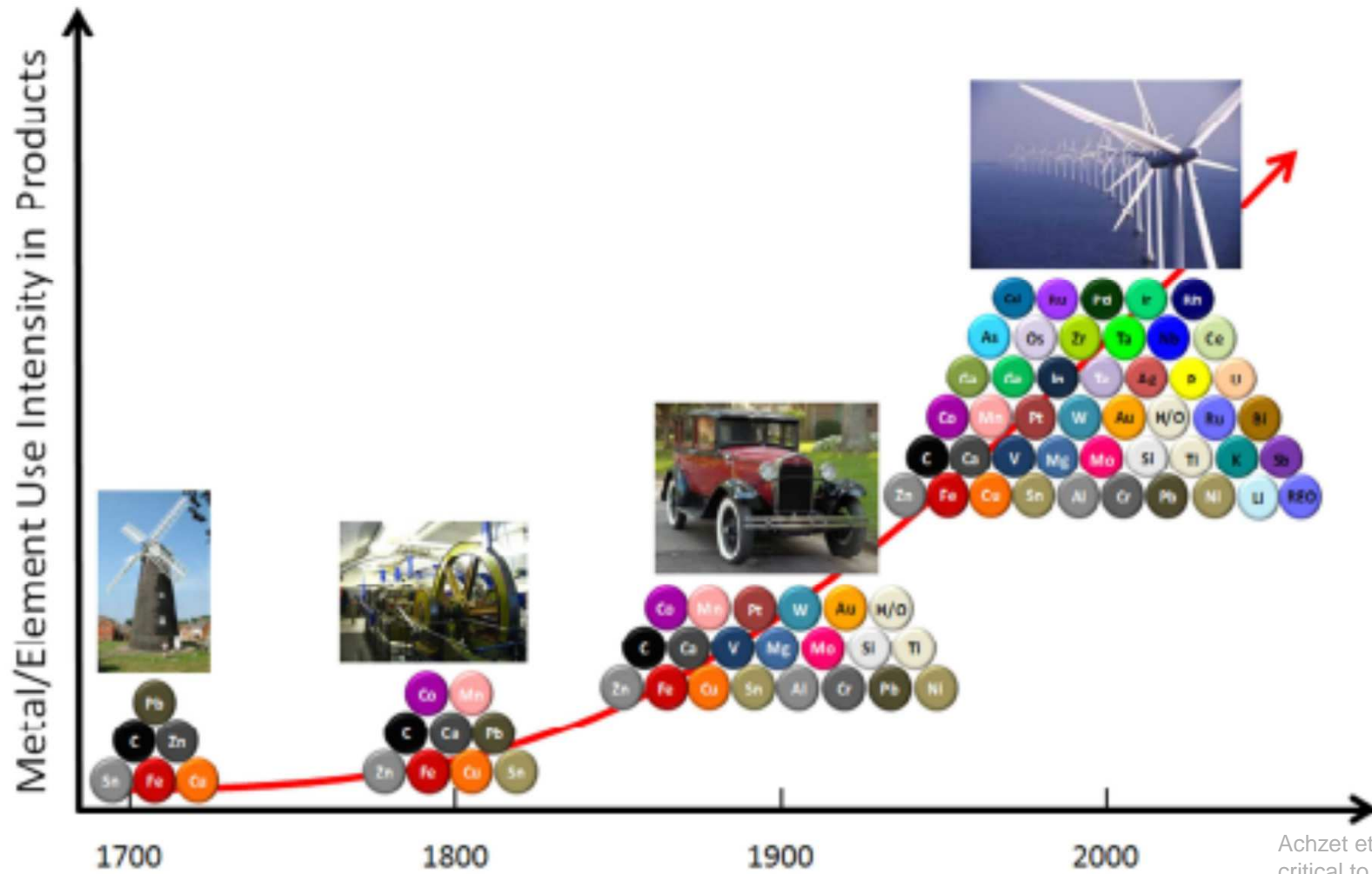
EPFL, Lausanne 25. Oktober 2014

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- **Case studies Umicore**
- **Recycling challenges**
- **Conclusion - take away**

Growing importance of metals

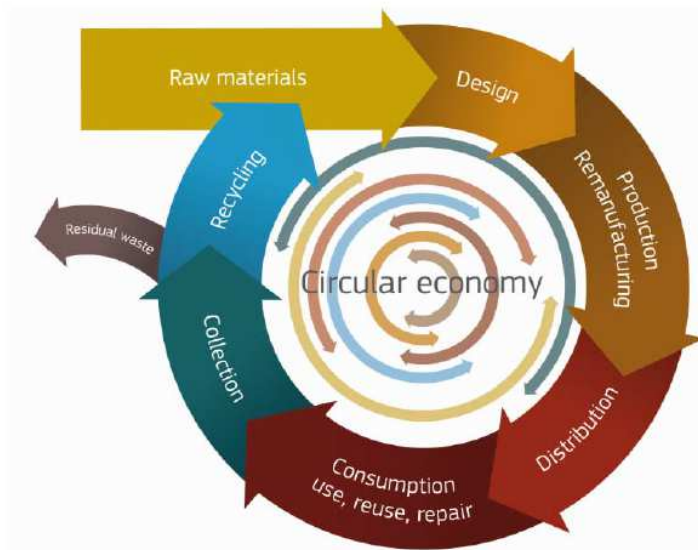


Achzet et al., Materials critical to the energy industry, Augsburg, 2011

Boost in anthropogenic “deposits”

Electric & Electronic Equipment	Cars	Clean Energy
		
<p>> 40% of world mine production Co, Sn, Sb, In, Ru, REE</p> <p>4% Au & Ag, 20% Co & Pd in mobile phones and laptops</p>	<p>> 60% of PGM mine production for autocatalysts</p> <p>Growing “computers on wheels”</p>	<p>Clean high tech applications will further accelerate demand for “technology metals”</p> <p>No sustainable development without access to these metals</p>

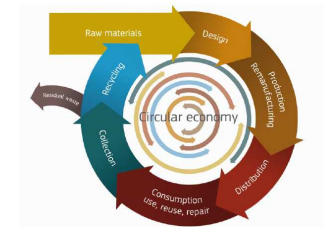
Towards a circular economy – the case of metals



Source: EU-COM (2014) 398, Towards a circular economy, 2.7.2014

- ⇒ Recycling cannot entirely fulfil metal needs
- ⇒ Products/metals to be recycled as efficiently as possible at EoL
- ⇒ Smart recycling & mining – complimentary tools to secure supply
- ⇒ Innovative materials, product design & resource efficient use - essential to optimise material demand
- ⇒ Optimise utilisation along lifecycle instead of reducing use
- ⇒ Complex & interdependent
- ⇒ System approach – whole value chain

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Umicore's business today



Recycling

- We operate a unique recycling process to deal with complex industrial residues and end-of-life materials
- The business is driven by materials scarcity and recycling legislation

Catalysis

- We develop technologies to treat automotive emissions
- The business is driven by increasingly stringent emission norms to promote clean air

Performance Materials

- We produce a range of essential materials and chemicals based on precious metals and zinc
- Diverse applications, such as high-purity glass, construction, pharma, electrics/electronics

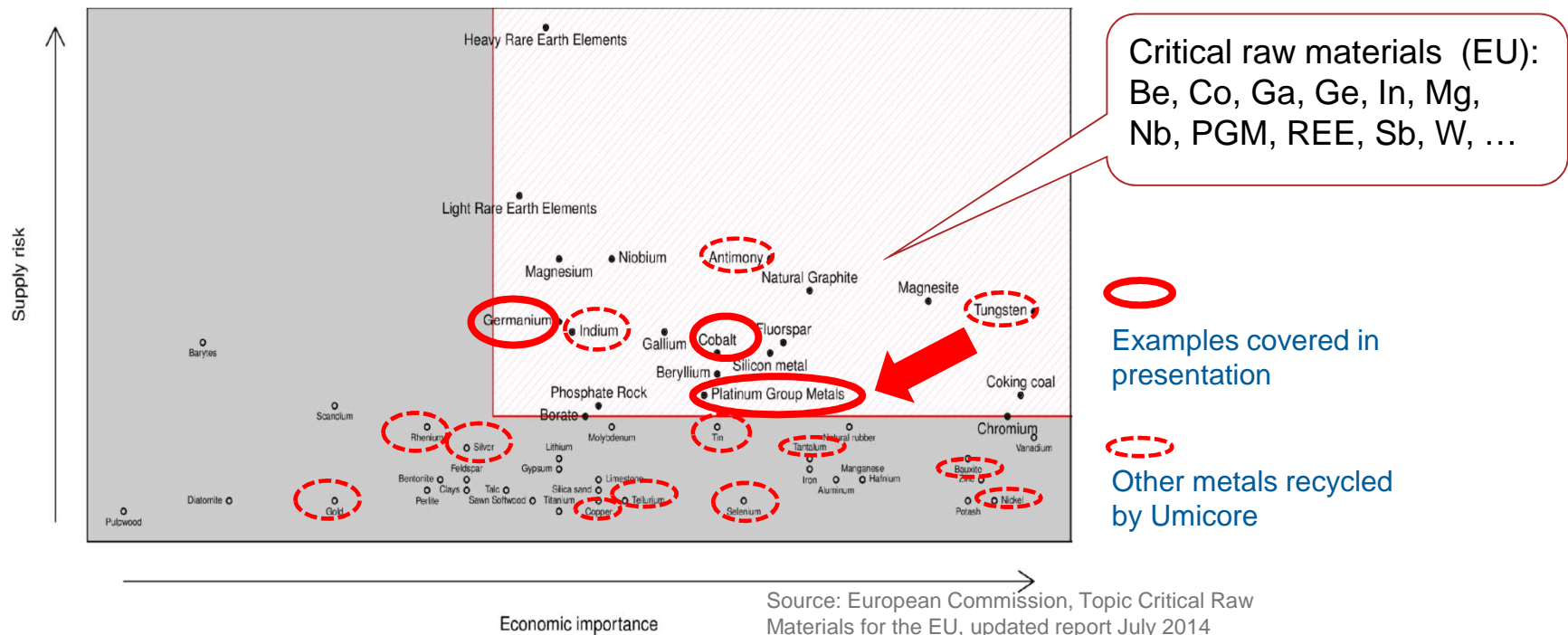
Energy Materials

- We develop materials which enable the clean production and storage of energy
- The business is driven by the demand for clean, low-carbon energy solutions



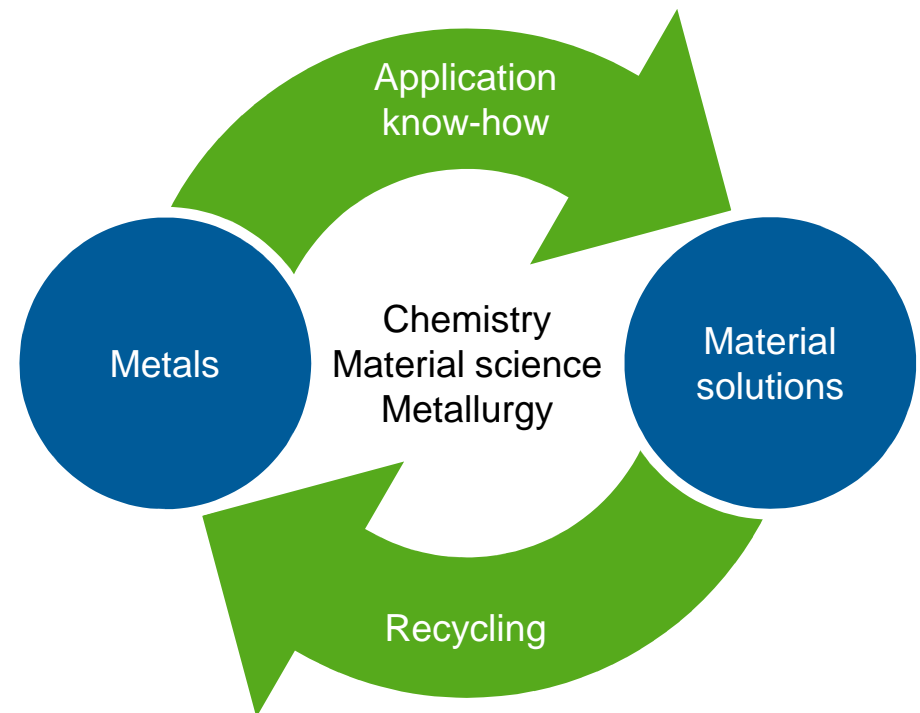
Our products & services cover 29 metals & materials

Co Cobalt	Ni Nickel	Cu Copper	Zn Zinc	Ga Gallium	Ge Germanium	As Arsenic	Se Selenium	S Sulfur	
Ru Ruthenium	Rh Rhodium	Pd Palladium	Ag Silver	In Indium	Sn Tin	Sb Antimony	Te Tellurium	Ta Tantalum	W Tungsten
Re Rhenium	Ir Iridium	Pt Platinum	Au Gold	Pb Lead	Bi Bismuth	La Lanthanum	Ce Cerium	Pr Praseodymium	Nd Neodymium



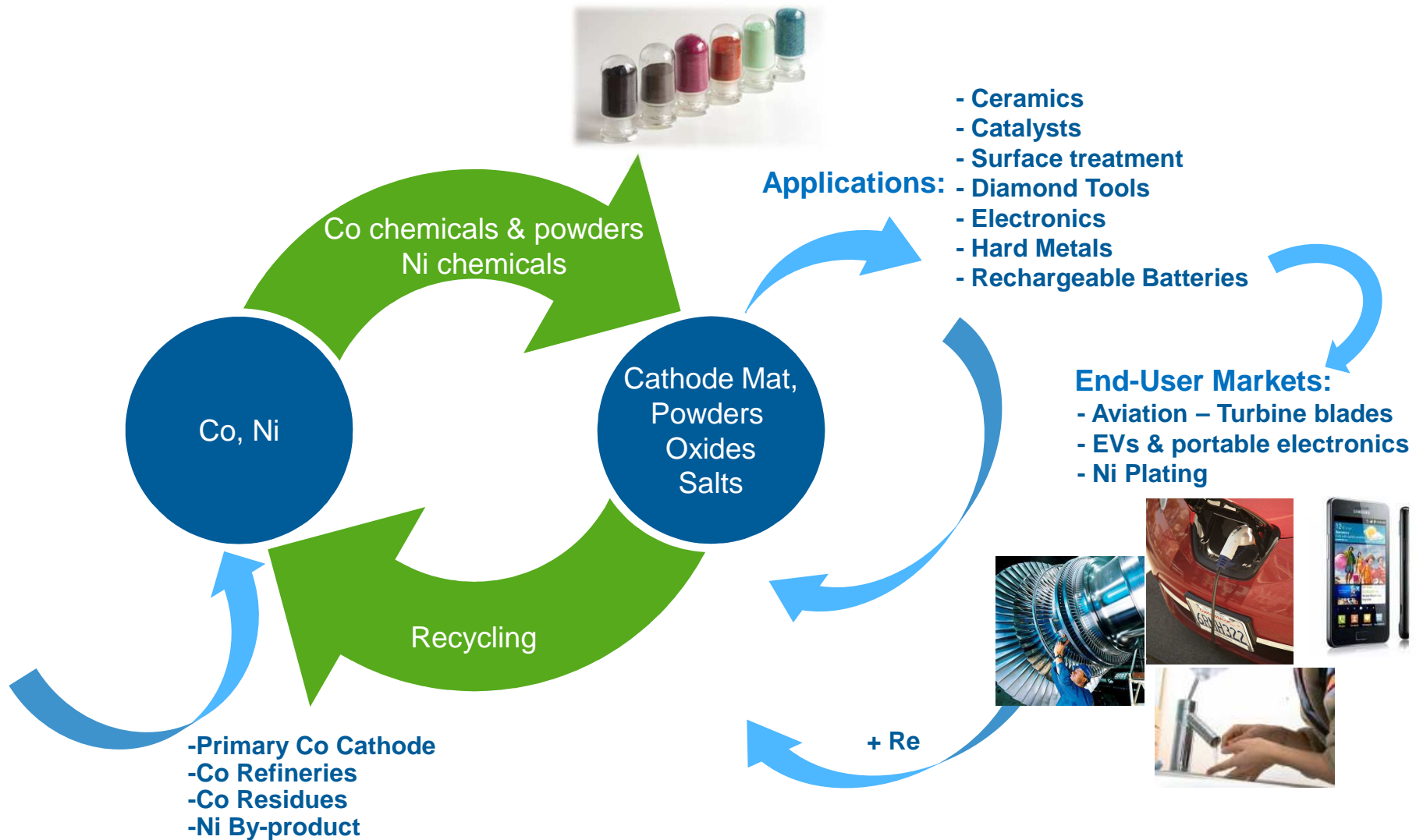
Umicore's business approach

- We transform metals into hi-tech materials
- We use application know-how to create tailor-made solutions in close collaboration with our customers
- We close the loop and secure supply by recycling production scrap and end-of-life materials
- We aim to minimize our environmental impact and be the best employer and neighbour



Umicore Cobalt & Specialty Materials

Closing the loop for cobalt and other metals



Umicore Electro Optical Materials

Closing the loop for Germanium



Optical Fibres
Solar Cells and
LEDs
Infrared & Optics

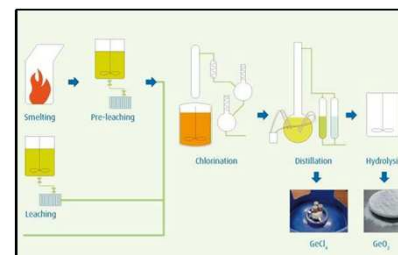
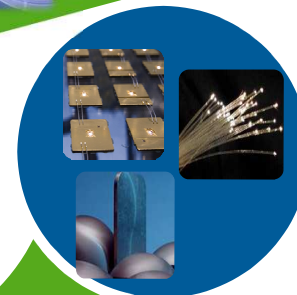
Substrates
Optics

NASA Mars Exploration Rovers
Spirit and Opportunity

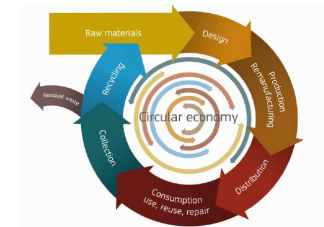


Recycling

By-products
from Zn-mining
& coal fly ashes

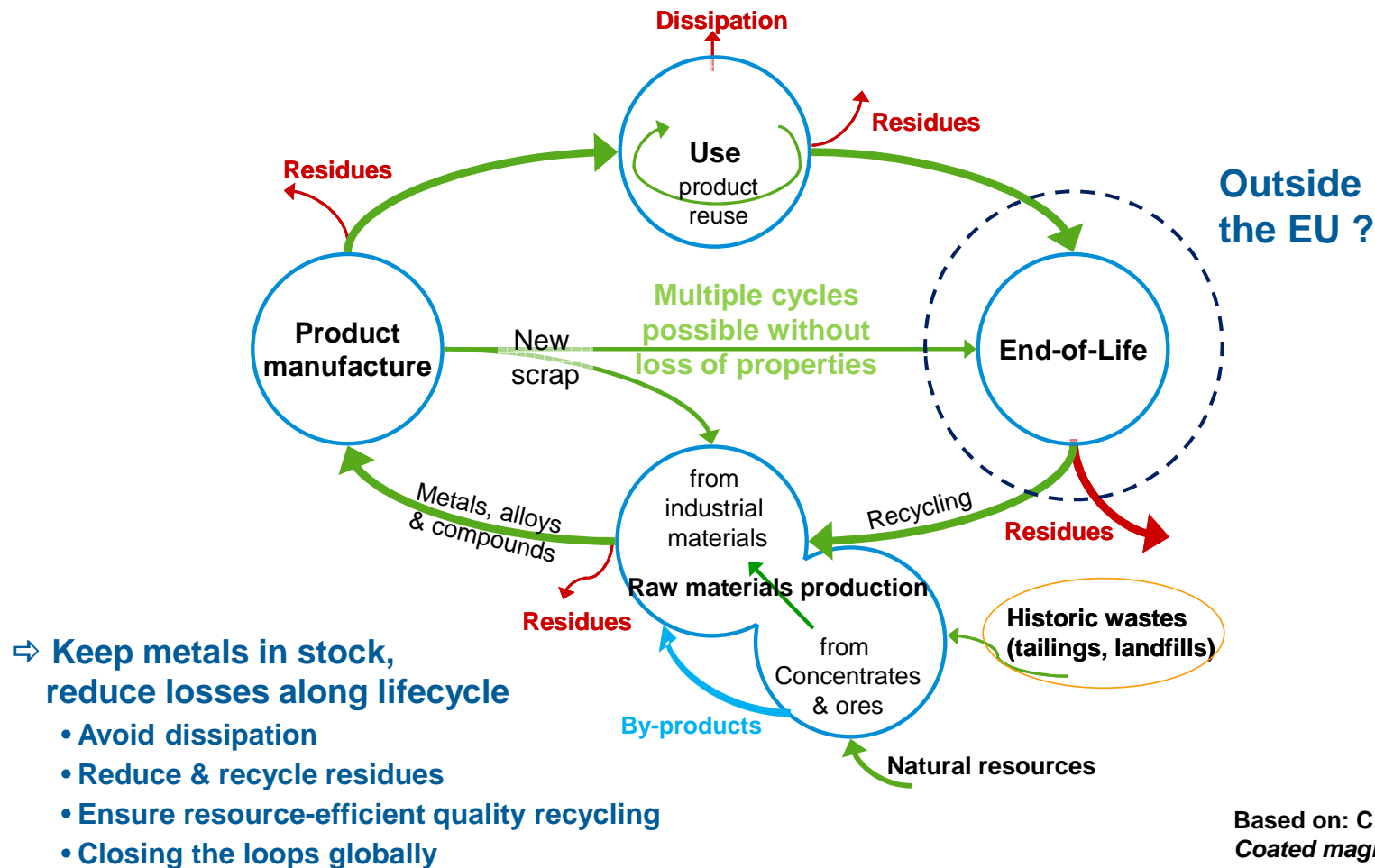


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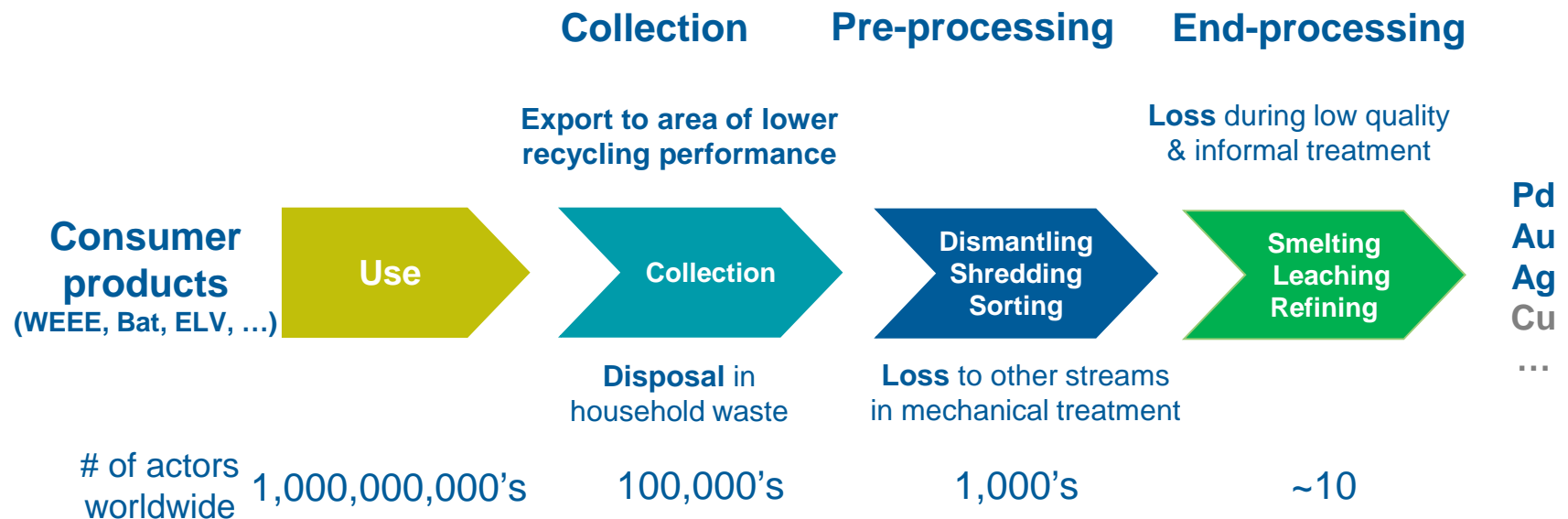
Metals: Ideal for a circular economy



**Based on: C.E.M. Meskers:
Coated magnesium,
designed for sustainability?,
PhD thesis Delft University
of Technology, 2008**

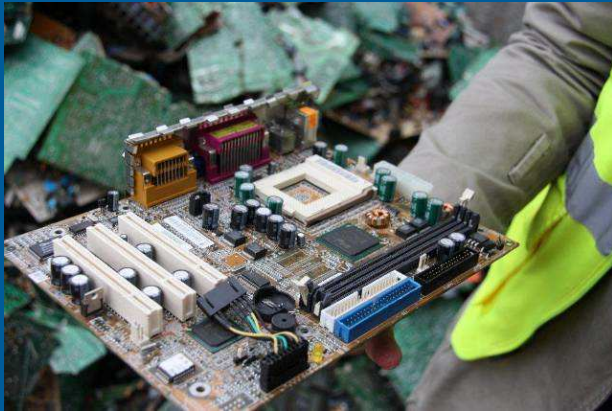
Recycling is a chain

... and a funnel



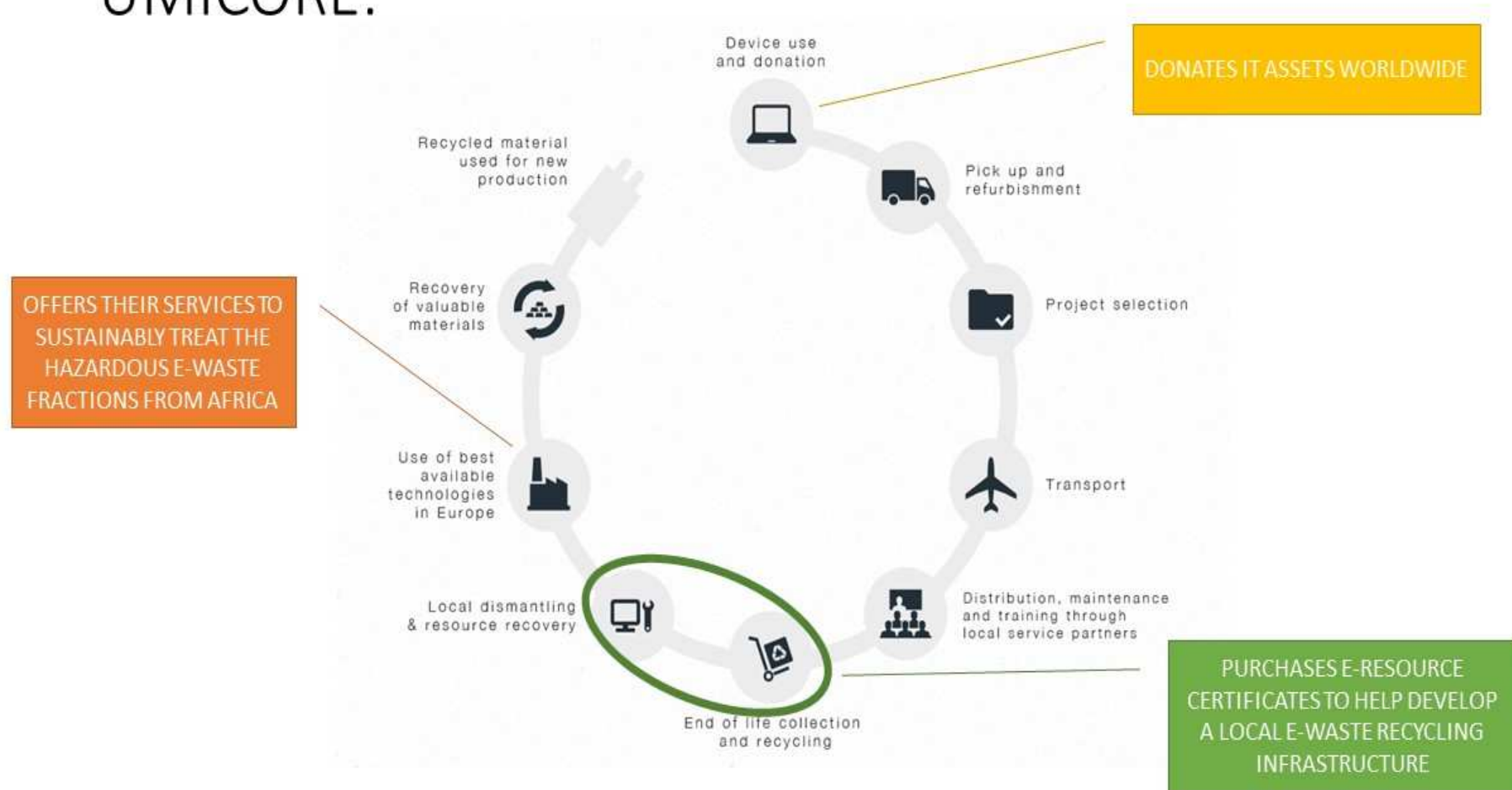
All steps are important but no metals recycling without final metallurgical recovery

⇒ to be considered for recycling definitions & monitoring of flows



Umicore & WorldLoop: closing the e-waste cycle

Circular economy across all business activities, UMICORE:



WorldLoop

incubator for self-sustaining recycling

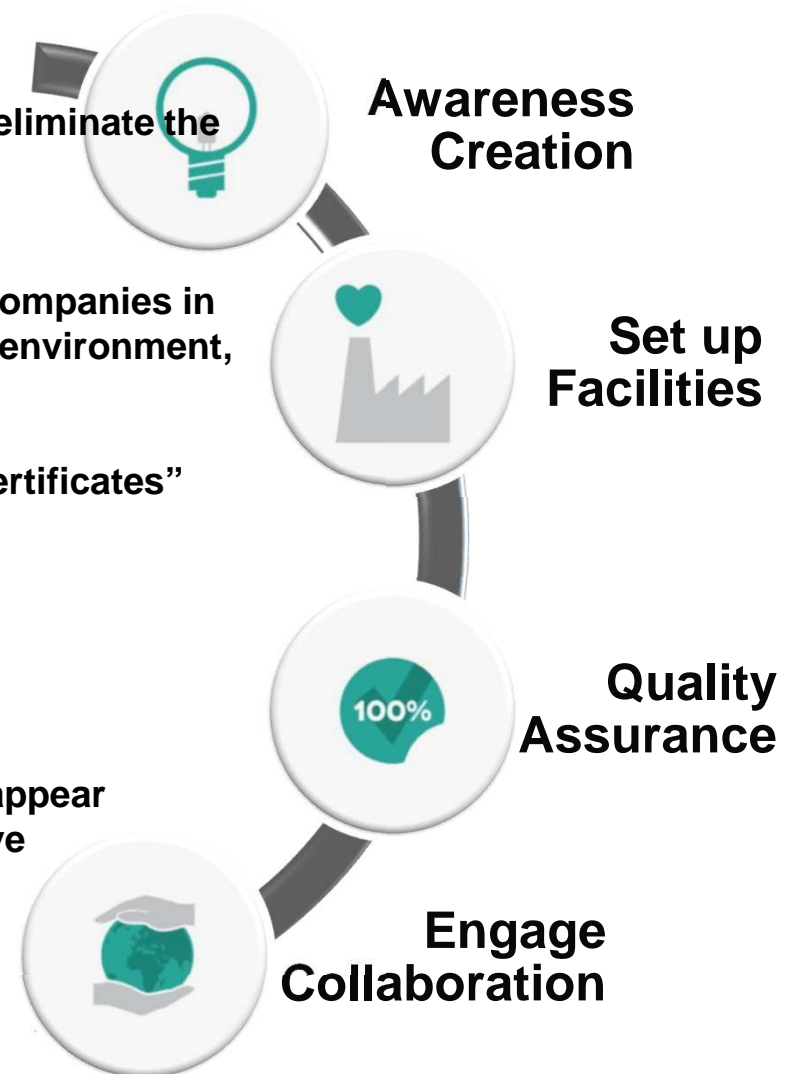
WorldLoop's, a non for profit organization: mission is to eliminate the negative impact of e-waste by turning it into **sustainable, human and economic resources**.

It will achieve this by supporting new e-waste recycling companies in Africa to do their jobs successfully whilst respecting the environment, health, safety and resources.

Financial support is a.o. obtained by their “e-Resource certificates” system, linked to their mother company “Close the Gap”

WorldLoop cooperates with **recycling partners in developing and developed countries** to reach this mission.

The aim of WorldLoop is to become “unneeded” and disappear eventually. This means that the local African partners have become self-sustaining



Capabilities of partners

are complimentary to their needs

Umicore

- expertise on dismantling techniques and e-waste
- expertise on international shipping practices & rules
- environmentally sound treatment of complex hazardous components like circuit boards and batteries, with more value return
- fair & transparent pricing based on reliable sampling & assaying and prior agreed treatment cost
- expertise on sound business practices

WorldLoop

- not profit oriented
- financing & audit model to
 - 1) bridge time between shipping and payment
 - 2) ensure sound treatment of all fractions
- expertise on training and coaching of local entrepreneurs
- consolidation of e-waste fractions from various entrepreneurs into large shipments
- scalability to reach many small companies

Local entrepreneurs

- Infrastructure and available workforce to do proper dismantling of e-waste
- knowledge of local market (collection network)
- presence in different regions in Africa
- knowledge of local outlets for materials
- knowledge about local situation for tailor-made solutions

Benefits of the partnership *for the different partners*

Economical benefits

~ 16 000 ICT assets or
185 tons collected &
processed = waste
avoided

~ 51 tons hazardous
material shipped to
Europe

~ 65 000 € revenue made
through resource
recovery & fraction
resale

Social benefits

50 new direct jobs
created and about 100
indirect jobs

~ 1 500 ICT users
reached through
international awareness
raising

4 countries involved in 2
continents, more in 2014

6 countries identified for
pilot projects

Environmental benefits

ability to treat all
fractions thanks to
maximum value return
of PWB treatment

negative impacts of
improper recycling
processes avoided

conservation of non-
renewable resources

Recycling is dynamic

Products are rapidly changing – example: electronics

Cloud



**Unit weight decrease
& miniaturization**

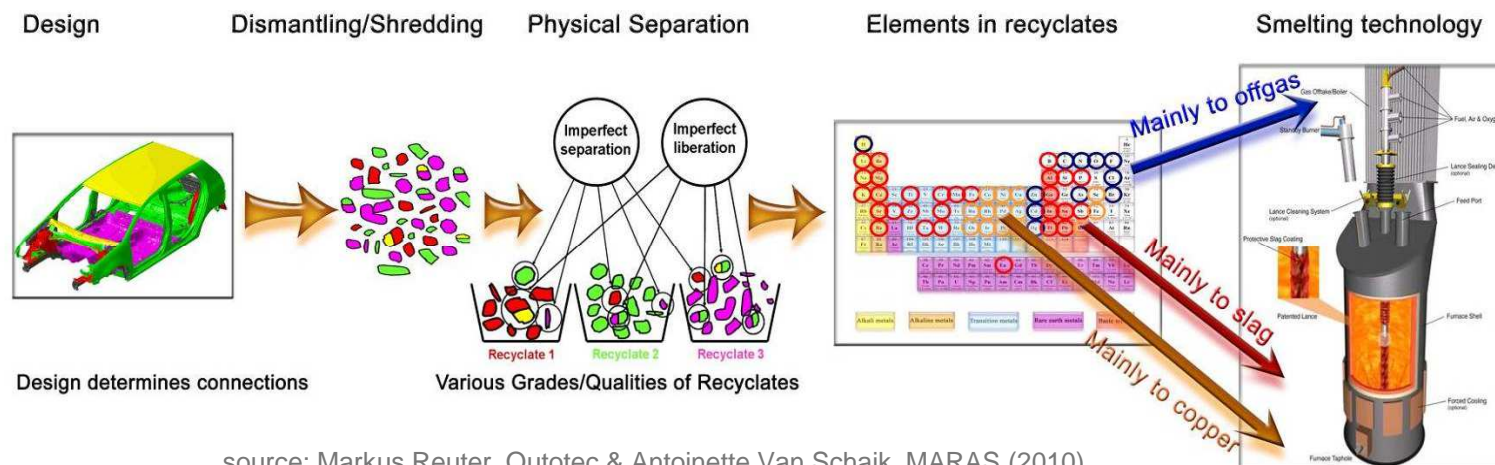


Convergence of devices

Trends are already felt in recycling industry and impact:

- **Volumes & tonnages -> risk of capacity mismatch**
- **Material composition -> what's in there?**
- **Recyclability -> which materials to focus on?
need to rethink approaches?**

Recycling is technologically challenging

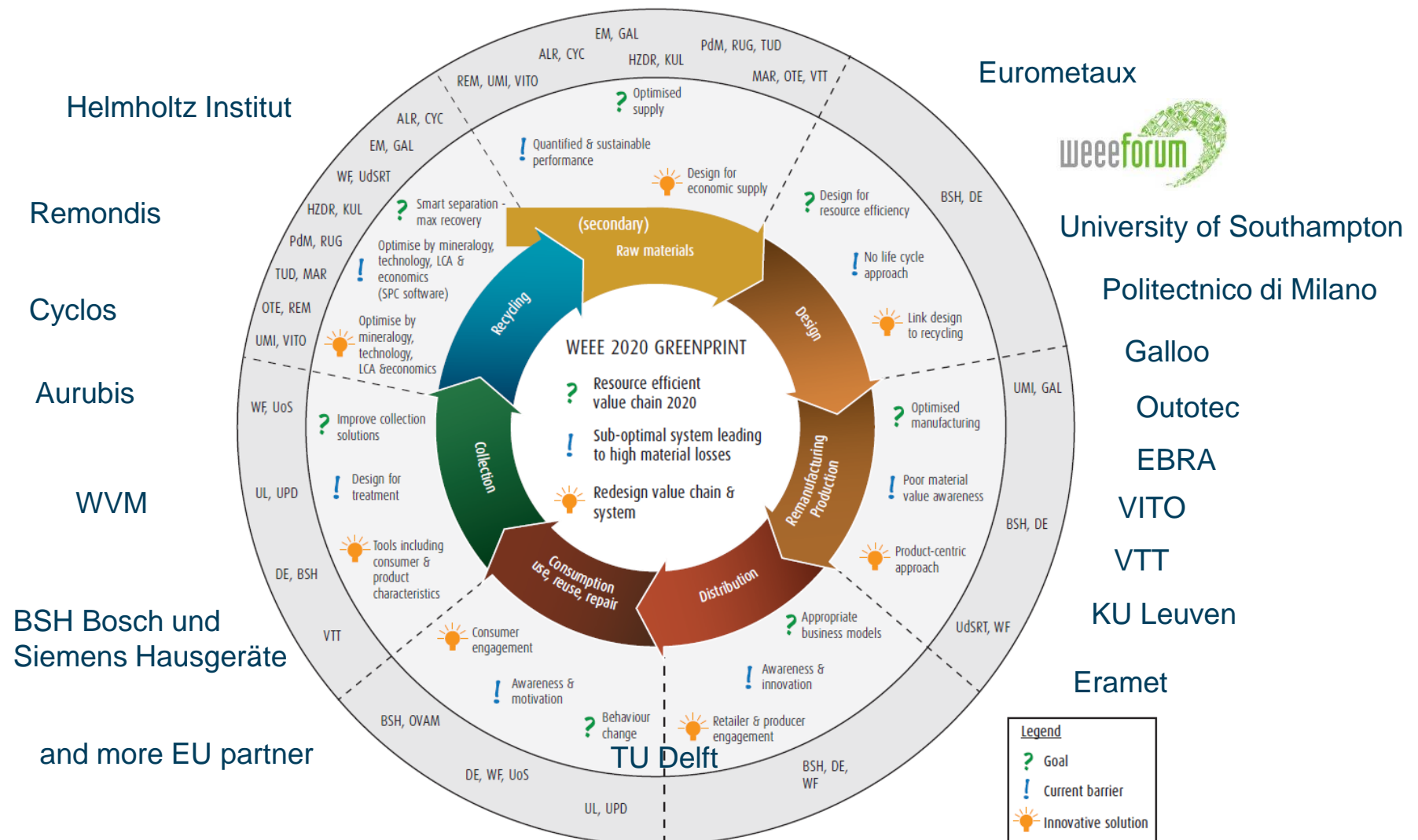


source: Markus Reuter, Outotec & Antoinette Van Schaik, MARAS (2010)

Technical-organisational improvement needs along entire chain:

- Product design
- Alignment within recycling chain (system & interface management)
- More use of recognised high-quality recycling installations
- Laws of nature (thermodynamics) prohibit recovery of all metals in some complex “inappropriate” material mixes (“composition conflict”)

Umicore engaged with other key stakeholders in EU Horizon 2020 project proposal



Promoting innovation and entrepreneurship



European Institute of
Innovation & Technology

established in March 2008

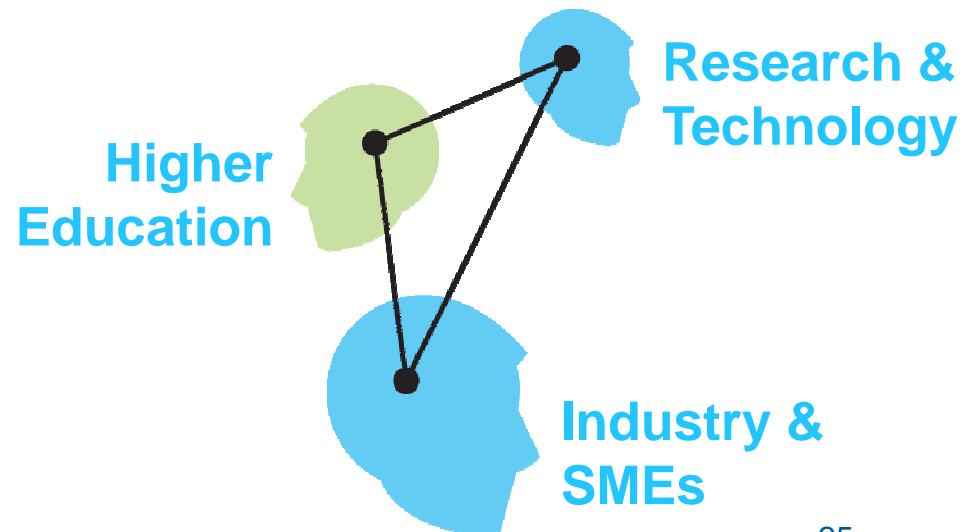
- **Mission:** increase European sustainable growth and competitiveness by reinforcing the innovation capacity of the EU
- **Methodology:** integrate higher education, research and business in areas of high societal need (the knowledge triangle)

EIT boosts innovation process

idea → product

laboratory → market

student → entrepreneur



Knowledge and Innovation Community

= operational part of EIT

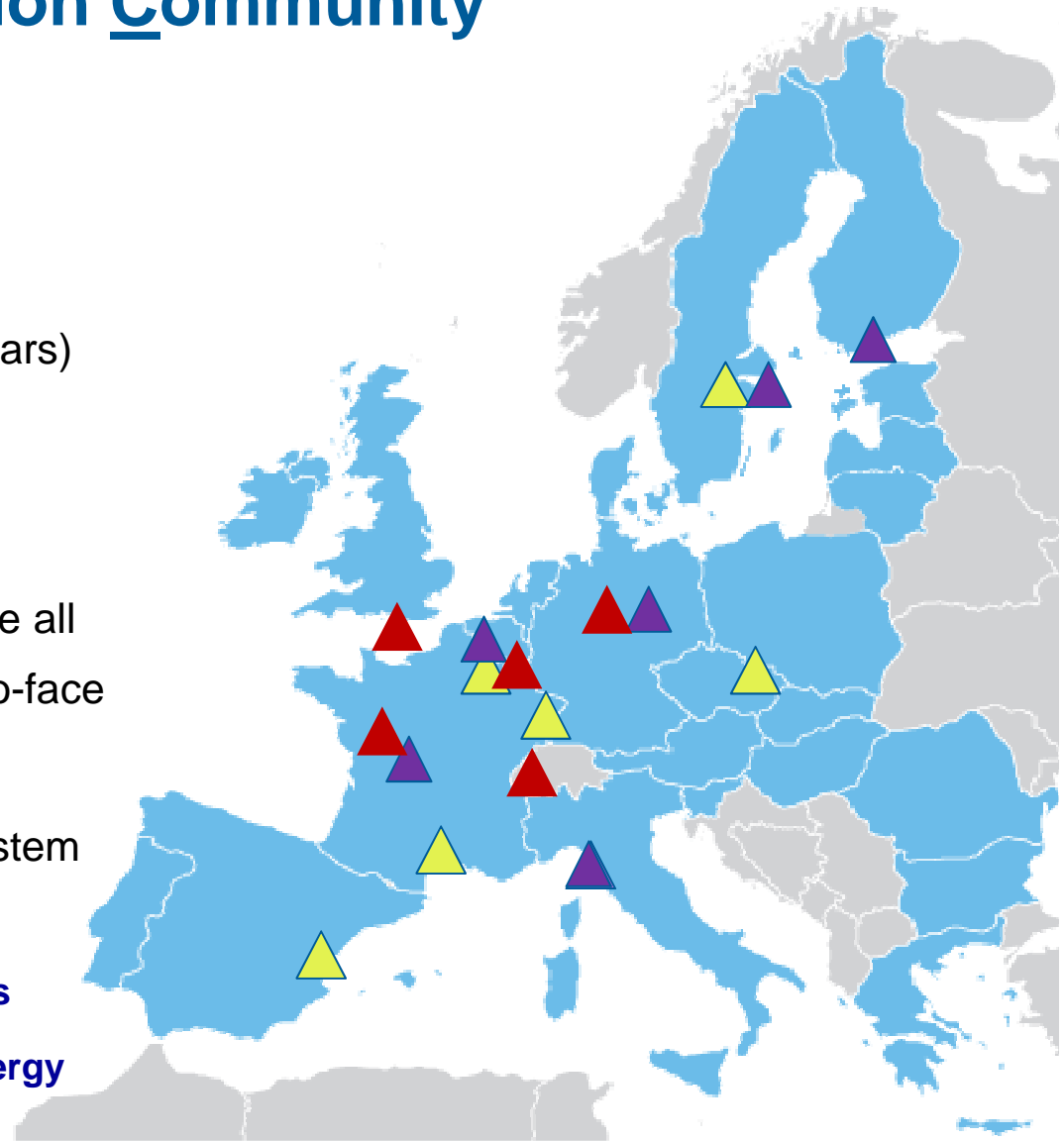
- **Network of excellence:**

- long-term partnerships (7+ years)
- creation of critical mass

- **Co-location centers:**

- physical meeting places where all partners work together face-to-face in highly integrated teams
- supported by regional eco-system

- ▲ **Climate-KIC**
- ▲ **EIT ICT Labs**
- ▲ **KIC InnoEnergy**



Recycling is economically challenging

- matching product properties & process capabilities

Product: Sufficient (extractable) value

- Composition (what is in?)
- Concentration (how much of it?)
- Material prices
- Price level for recycling service

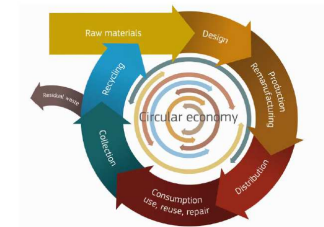
} Product & technology development
→ Market development
→ Competition,
legal / societal frame conditions

Process: Performance & costs

- Technological efficiency for value recovery (range, yields, energy, ...)
- Process robustness & flexibility
- Environmental & social compliance
- Available volumes
→ Economies of scale
- Factor costs (labour, energy, capital)
- Process chain organisation / interface management

} Process quality
} Legal, societal
& other frame conditions

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Take away – enhanced approaches for recycling of technology metals

- Incentives & business models for better collection and comprehensive systems
 - Better transparency & monitoring of flows, avoidance of illegal/dubious exports
 - Standards & certification systems to secure use of best performing industrial infrastructure (BAT - EHS) and enhance a level playing field
 - Introduction of quality criteria in definitions/interpretations of recycling rates to push BAT and recycling of technology metals
 - Facilitate imports to European BAT recycling plants & recycling of industrial residues
-
- ⇒ Better, long-term oriented cooperation of stakeholders along recycling value chain
 - ⇒ Supportive, reliable & consistent policy framework and its enforcement
 - ⇒ Support of „front runners“
 - ⇒ Importance of material & product innovation, design and efficient product use

http://ec.europa.eu/environment/circular-economy/ Moving towards a ci...

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European Commission

European Commission > Environment > Moving towards a circular economy

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Moving towards a circular economy

The circular economy package

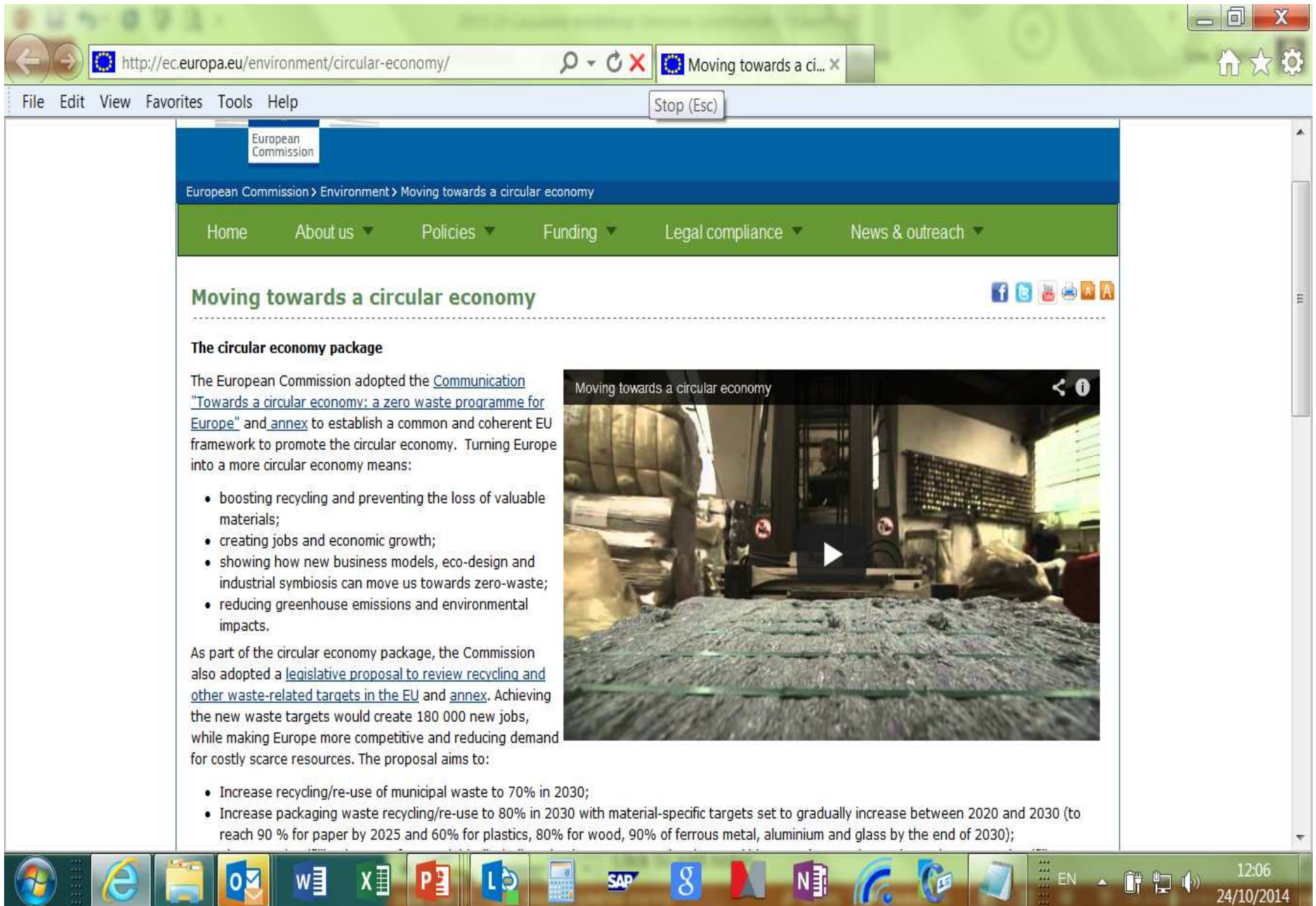
The European Commission adopted the [Communication "Towards a circular economy: a zero waste programme for Europe"](#) and [annex](#) to establish a common and coherent EU framework to promote the circular economy. Turning Europe into a more circular economy means:

- boosting recycling and preventing the loss of valuable materials;
- creating jobs and economic growth;
- showing how new business models, eco-design and industrial symbiosis can move us towards zero-waste;
- reducing greenhouse emissions and environmental impacts.

As part of the circular economy package, the Commission also adopted a [legislative proposal to review recycling and other waste-related targets in the EU](#) and [annex](#). Achieving the new waste targets would create 180 000 new jobs, while making Europe more competitive and reducing demand for costly scarce resources. The proposal aims to:

- Increase recycling/re-use of municipal waste to 70% in 2030;
- Increase packaging waste recycling/re-use to 80% in 2030 with material-specific targets set to gradually increase between 2020 and 2030 (to reach 90 % for paper by 2025 and 60% for plastics, 80% for wood, 90% of ferrous metal, aluminium and glass by the end of 2030);

Moving towards a circular economy



EN 12:06 24/10/2014

Thanks for your attention



contact: christian.hagelueken@eu.umicore.com ; egbert.lox@umicore.com; christina.meskers@umicore.com

www.umicore.com

For more background:

UNEP (2013): Metal Recycling: Opportunities, Limits, Infrastructure

Hagelüken, C.: Recycling of (critical) metals, in: Gunn, G. (ed): Critical Metals Handbook, Wiley & Sons, 2014