The Urban Mine: Recycling Technology Metals

Dr. Christian Hagelüken

S&D The Circular Economy event

Date

Brussels, 13.10.2016

Agenda

1

Umicore's approach

2

EU circular economy & Case study

3

Conclusions

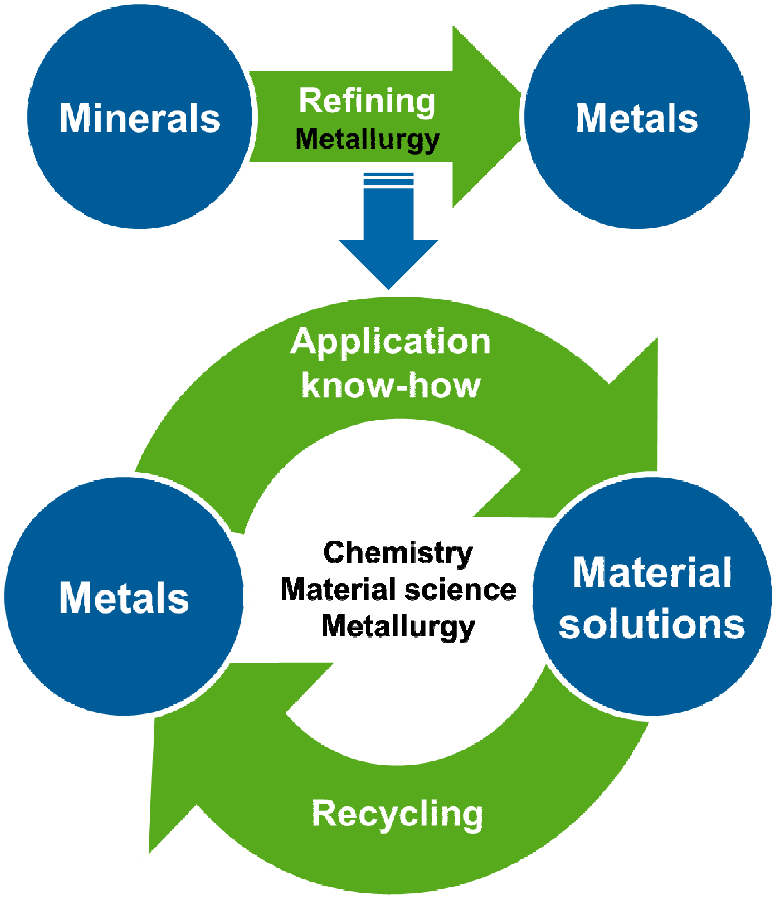
Umicore

From Linear to "Closing the Loop"

<u>19th century</u>: start as a mining company Union Minière

<u>1990s</u>: moving away from mining and commodities/base metals production to high-tech products and recycling

<u>2001</u>: New name: Umicore, promoting the "closing the loop" philosophy



A global materials technology & recycling group

10,400 people, 66 manufacturing sites, €2.6 Bn revenues

One of three global leaders in emission control catalysts for light-duty and heavy-duty vehicles and for all fuel types

A leading supplier of key materials for rechargeable batteries used in portable electronics and hybrid & electric cars

The world's leading recycler of complex waste streams containing precious and other valuable metals

Providing innovative solutions across industries

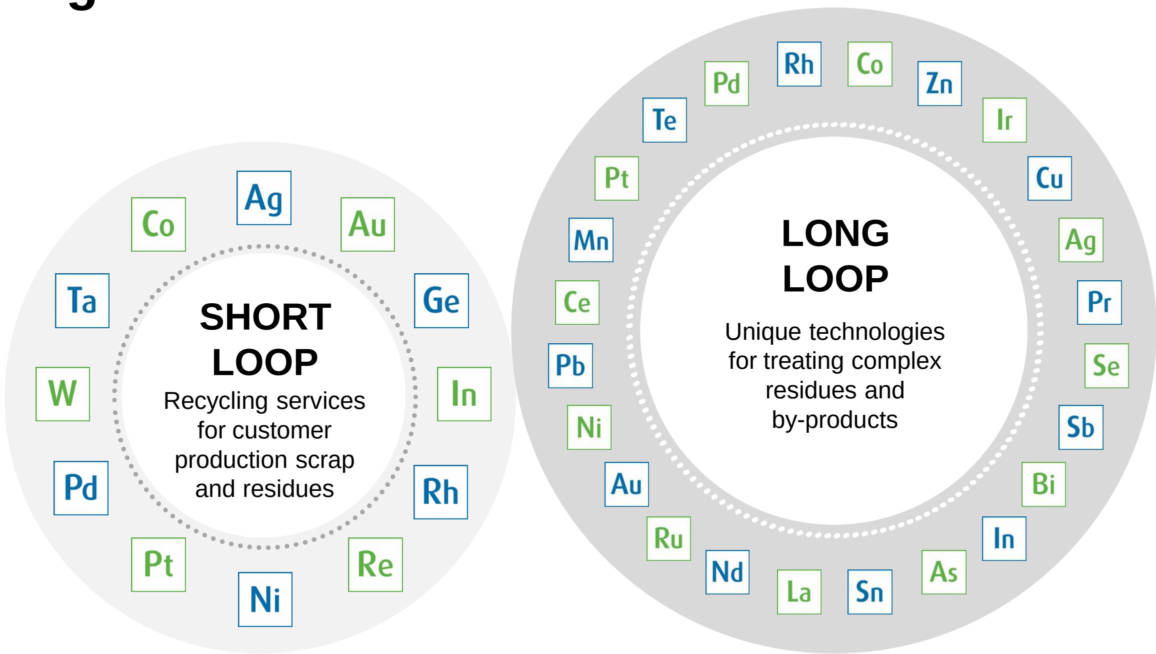
Leadership
in clean mobility
materials and
recycling

29 different metals within Umicore’s portfolio

Unique position

in recycling

umicore



B2B - closed - market driven

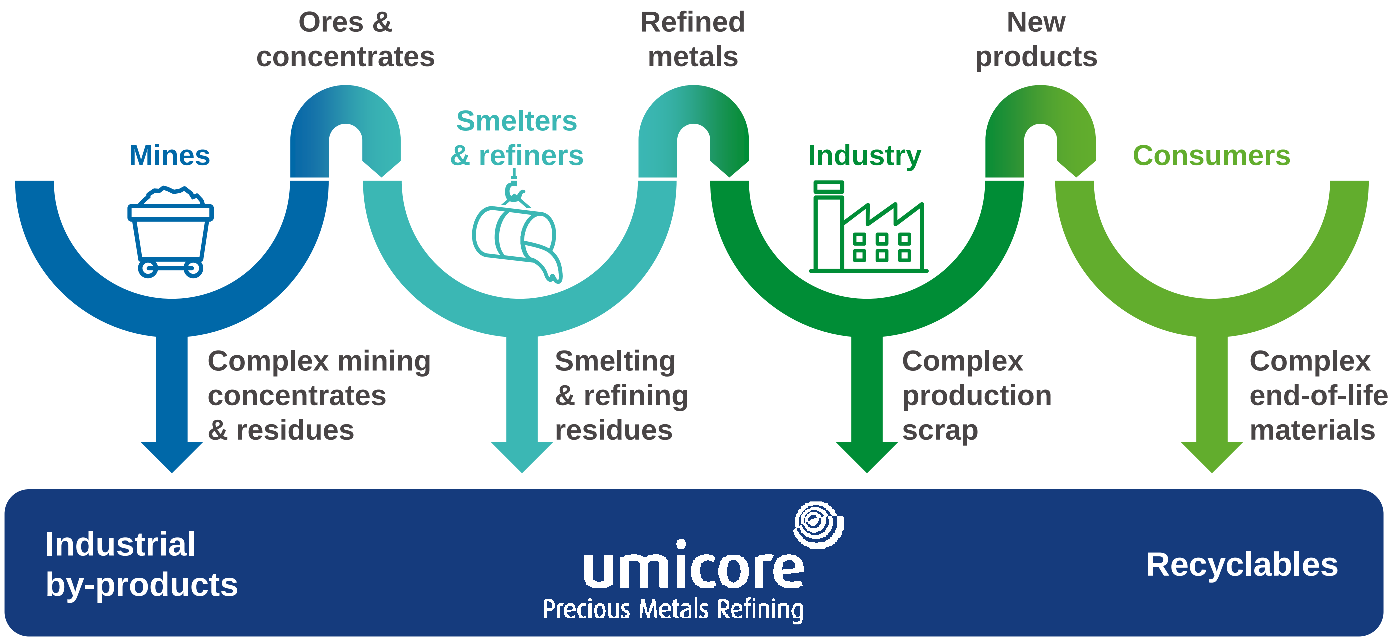
- Tailored solutions for industrial customers
- Recycling integrated in business model
- High reliability, minimal losses

B2C - open – dependant on legislation

- Typical for consumer products & complex residues
- Recycling depends on market supplies → collection!
- Sophisticated processes & large investments

The value chain of metals

200+ materials to close the loop



Refining

Supply - Recyclables

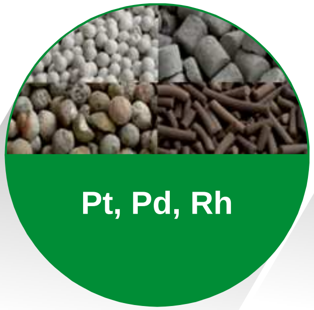
Electronic Scrap

e.g.
- mobile phones
- printed circuit boards

Spent Automotive Catalysts

- end-of-life car catalysts

Spent Industrial Catalysts



- industrial catalysts from oil refining & petrochemical industry

Other precious metal bearing materials

e.g.
- fuel cells
- photographic residues

Heavy non ferrous metals fraction ex-bottom ashes

- fine heavy non ferrous metals fraction, high on precious metals

Economies of scale & sophisticated process

For multi-metals recycling

Umicore Precious Metals Refining plant in Hoboken, Belgium

- Efficient recovery of 17 metals:
  Au, Ag, Pt, Pd, Rh, Ru, Ir, Cu, Pb, Ni, Sn, Bi, Se, Te, In, Sb, As
- 350 000 t/y raw materials – increasing to 500 000 t/y
- In addition, specialized process for recycling of rechargeable batteries recovering Co, Ni, Cu & REE conc.
- Unique, innovative technology; applying world class environmental standards for high metal yields, high energy efficiency and low emissions

Agenda

1

Umicore's approach

2

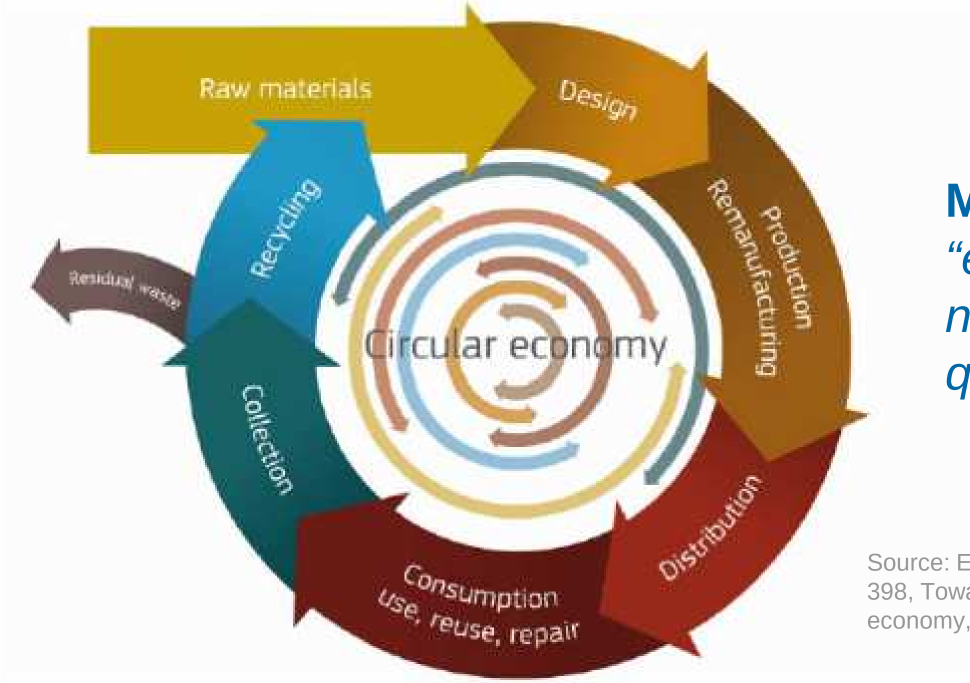
EU circular economy & Case study

3

Conclusions

The Circular Economy Package Proposal

"… where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized… to develop a low carbon, resource efficient and competitive economy" EC Communication 2015 "Closing the loop – An EU action plan for the Circular Economy



Metals are the ideal candidate:
"eternally" recyclable,
no downcycling, no material quality issues…

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

Certain conditions need to be met…

from a metals perspective

➢ Physical: EoL-materials need to find their way into new products

→ *focus on quality & performance of applied recycling processes*

➢ Economical: Revenues need to match costs of entire recycling chain

→ *comprehensive collection, chain optimisation, economies of scale*

→ *special challenge for high quality recycling of complex consumer products*

➢ Recycling – key contributor to resource efficiency

→ *supply side: primary & secondary RM are complementary*

→ *demand side:* resource efficient materials, substitution, product design & resource efficient use

Circular economy = recovering materials **comprehensively** at product EoL, when ever and where ever this will take place → Key role of business models

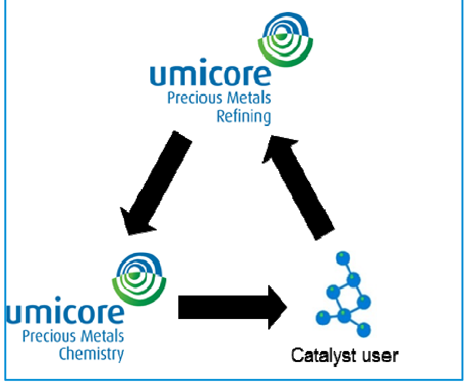
Umicore in product lifecycles

Closing the loop for precious metals bearing functional materials

Jewellery

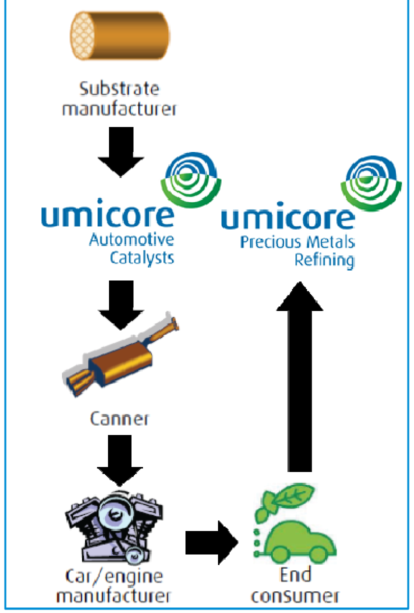
> 90%

Industrial catalysts



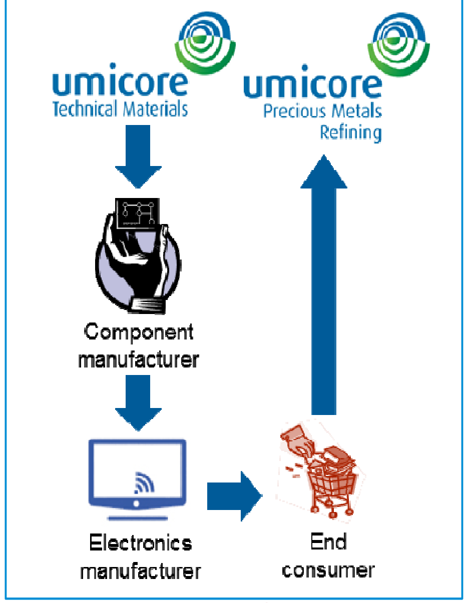
> 90%

Automotive catalysts



60-70%

Electronics



<< 50%

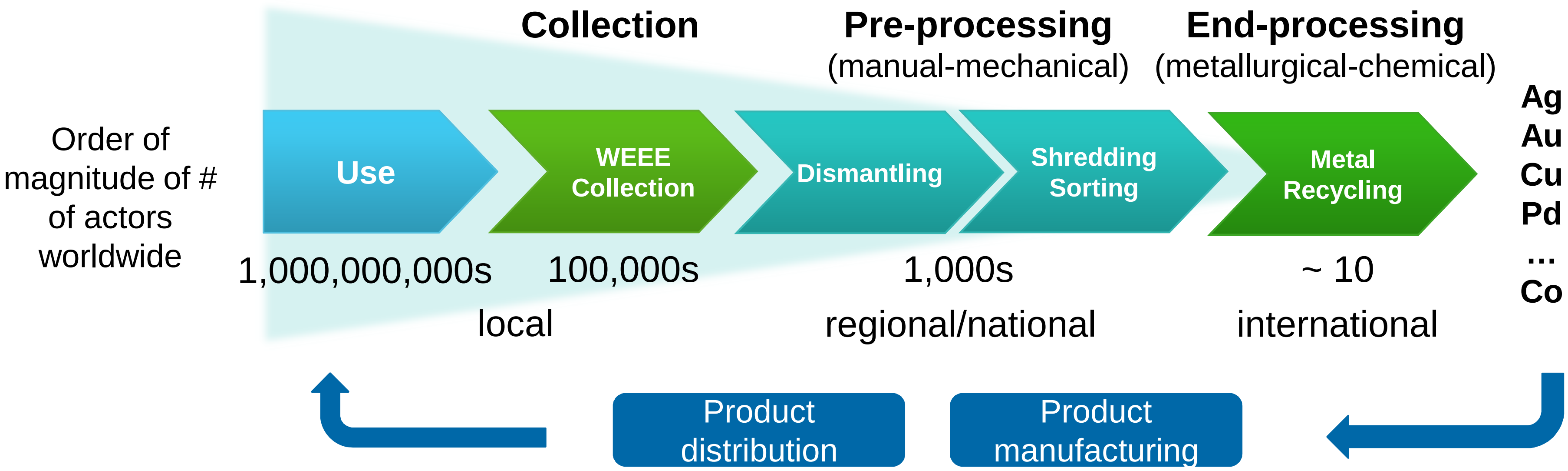
= short, closed loop (B2B)

= long, open loop (mainly B2C)

Umicore process yields: > 95%

The Electronics recycling chain

A funnel with still significant losses



Insufficient collection of EoL devices, illegal waste exports, sub-standard treatment
⇨high metal losses & environmental damage, gold recovery over chain << 50%

Challenges

Logistics & data basis:
→ Comprehensive collection & feeding into appropriate recycling channels, transparency of flows, reliable data

Use of Appropriate processes for (product) sorting, pre-processing and metallurgy
→ Flexible & cost effective high-tech processes for recycling of complex products

- Multi-materials recycling
- Recovery of low grade precious & special metals
- Prevention of hazardous emissions, safe work conditions
- Flexible adaption of recycling technologies to new product designs & compositions

Economic viability: Intrinsic value of EoL device vs. total costs of recycling chain

Stakeholder behaviour & cooperation along the product lifecycle/recycling chain

The need for high quality recycling processes
- technical & environmental performance is key

Standards & certification to secure quality recycling and a level playing field

- For WEEE	waste or fractions of electric & electronic equip.
- Recycling	the entire recycling chain: collection, pre-processing, smelting & refining
- Certification	independent 3rd party audit
- To be implemented	existing Cenelec standard (50625-x)

Agenda

1

Umicore’s approach

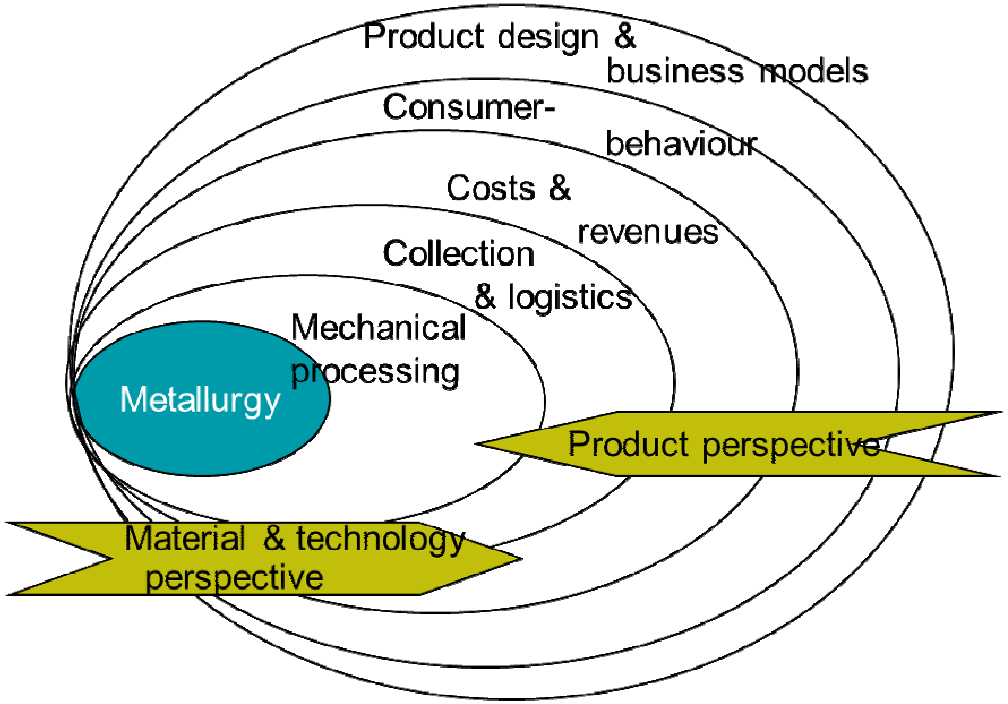
2

EU circular economy & Case studies metals recycling

3

Conclusions

Overall recycling success factors



Prerequisites:

1. Technical recyclability as basic requirement
2. Accessibility of relevant components → product design
3. Economic viability
   intrinsically or externally created
4. Comprehensive collection
5. Transparency of real flows
6. Use of best performing recycling infrastructure
7. Optimal technical-organisational set-up of chain

Impact factors to close the loop

Intrinsic factors:

- Material value
- Complexity / heterogeneity (product composition & design)
- Business model / Lifecycle type (B2C, B2B)
- Product transferability between users

External factors:

- Collection infrastructure
- Legislation / monitoring / enforcement
- External collection incentives (e.g. leasing, deposits, …)
- Stakeholder behavior & motivation
  (consumers/emotional link, OEMs/EPR culture, retailers, recyclers)

The Circular Economy requires a comprehensive system approach

- Development of innovative materials & products;
  $\rightarrow$ consider raw material needs, reparability and recyclability in product design
- Sustainable use concepts & business models
  $\rightarrow$ “use, reuse, repair” + service models advantageous over product ownership
- Comprehensive collection of resource relevant EoL products
  - Ambitious collection targets & landfill ban for recyclable waste
  - Collection infrastructure & incentives, ambitious EPR systems
  - Prevention of illegal/dubious exports
  - Uniform & reliable data collection / documentation
- High quality recycling for pre-processing <u>and</u> metallurgical end-processing
  - Standards* & certification systems as basis for a fair & transparent competition
  - Secure economic viability
  - Facilitate shipment to certified recycling plants (intra EU & imports into EU)
  - Strict monitoring, enforcement and documentation, transparency of material flows
  - Process development & innovation funding in selected areas
- Overarching & long time oriented stakeholder cooperation

*focus complex waste streams: techn. performance, environmental & social standards

“The Circular Economy proposals are an important start to begin capturing the value of European metals. We now call on MEPs and Member States to introduce stronger commitments in crucial areas, with harmonized implementation across Europe”

Eurometaux

Thank you for your attention

contact: christian.hagelueken@eu.umicore.com
Publications: www.researchgate.net/profile/Christian_Hagelueken/contributions

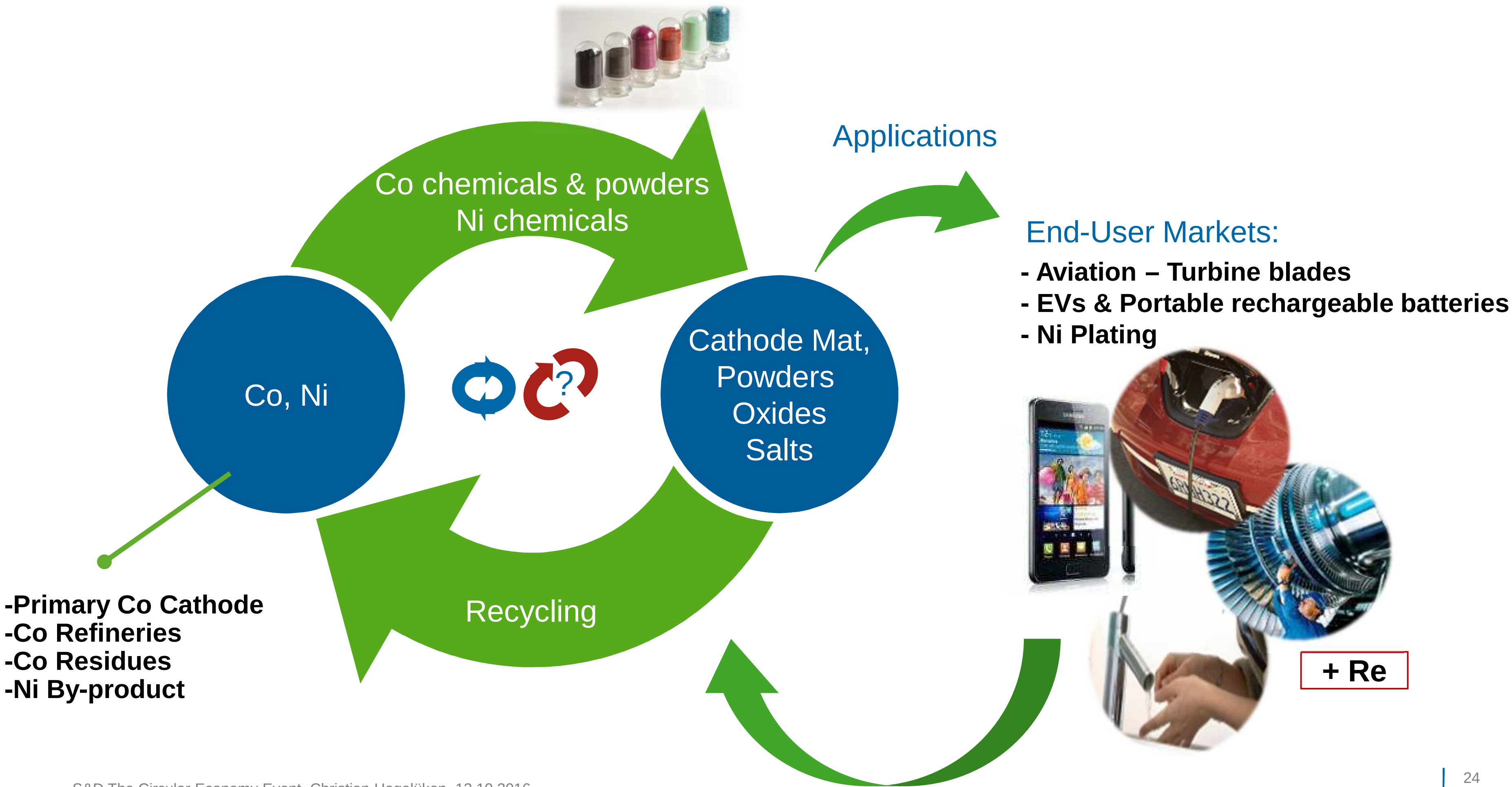
www.umicore.com
www.umicore.de

Annex:

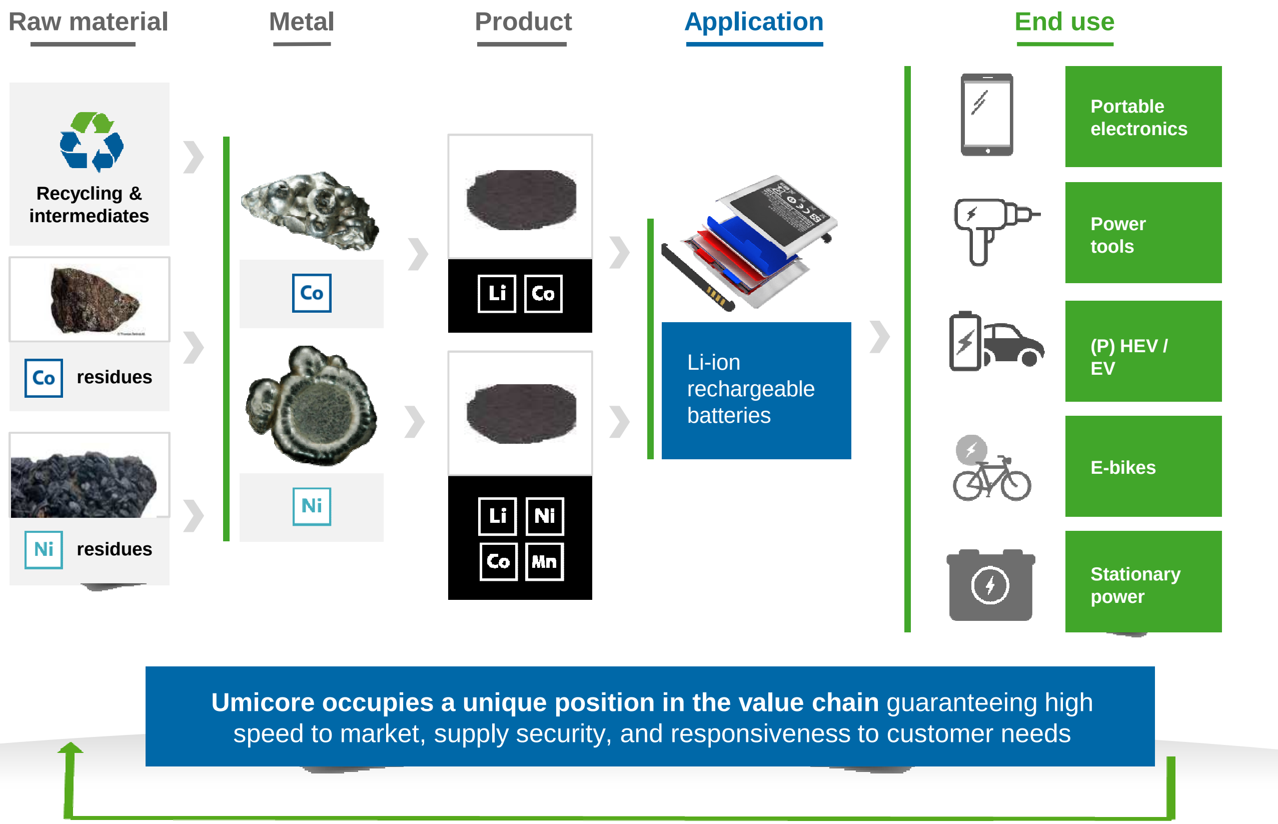
Recycling of rechargeable batteries from portable (electronics) and mobile (electric vehicles) applications

Umicore's Cobalt Loop

umicore



Unique integration in the battery value chain



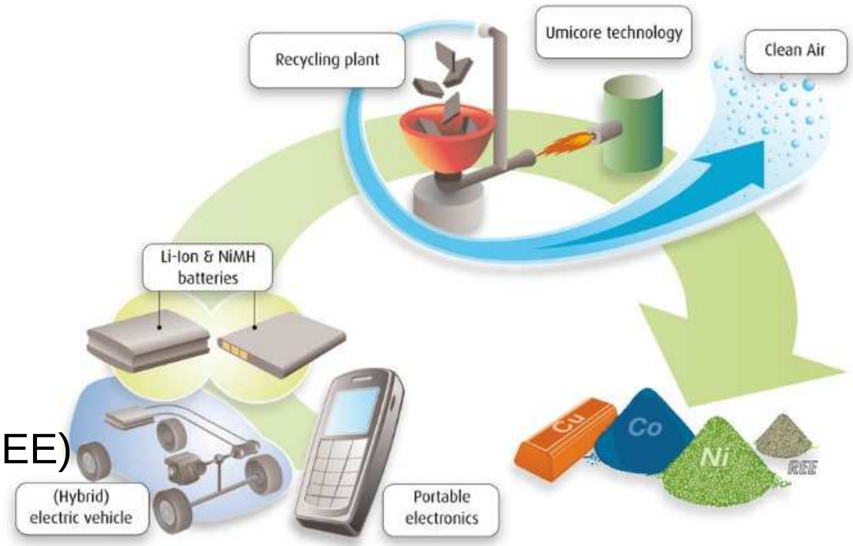
Umicore battery recycling

Capacity: 7,000 mt/yr of NiMH or Li-ion Batteries

± 250 mio mobile phone batteries

± 200,000 HEV's

± 35,000 EV's



Recycling:

Alloy: Cu – Co – Ni

Slag : for Li-Ion: used in construction
for NiMH: rare earth concentrate (REE)

Flue dust: controlled separation of F

Eco-efficient:

Close-to-zero waste

Advanced gas cleaning

Energy of battery used to obtain high temperature (electrolyte, metals, plastics)

Winner of 2012
European Business Awards for the Environment

Battery recycling requirements

Basic technical requirements:

- High effective recycling rates → secondary metals fit for new (LIB-) products
- Environmentally sound & energy efficient recycling processes throughout the chain
- Safe handling of battery systems and recycling materials (→ electric charge, electrolyte)

Economic requirements:

- Cost efficiency & economies of scale
- Handling of mass flows on industrial scale
- Flexibility in handling various battery types and chemical compositions