Outotec committed to sustainability
Outotec ranked 3rd most sustainable company on Global 100 index (World Economic Forum Davos Jan 2014)

We have technology to recover over 60 elements via Outotec technologies

In China ca. 70% Cu production via Outotec technologies

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System Integrated Metal Production
Multi-material process metallurgy thermodynamically non-linearly linked
Rigorous physics based simulation (see A to C)
Technology elements are linked to Cu, Pb etc. in minerals, but also act as solvent during recycling, their relative nobility permits element release during refining.


Rigorous simulation is the basis of designing multi-material processing plants (largest >400,000 tpa Cu)
System Integrated Metal Production
Minerals Centric ≈ Product Centric: Key understanding to “close” loop!

Geological Copper Minerals
>15 minors e.g. Au, Ag, PGMs, Se

Designed Copper “Minerals”
>40 elements complexly linked as alloys, compounds, materials

Geological Linkages
Various copper sulphide minerals on quartz and calcite

Product Design & Material Combinations create new “Minerals”

Functional Material Connections

Multi-material particles

Outotec technology for recyclates & residues
Techno-economic reality, a selection of over 30 Outotec applications

Dowata (Japan): PCBs, Cu, residues

Boliden Rönnvik (Sweden): Kabo for eWaste

Recycent (Germany): Lead Battery, Pb residues

GEM – Danyang Smelter (S. Korea): Cu scrap, residues etc.

Young Poong Corporation (S. Korea): Pb/Zn
Copper recycling – A complete refining infrastructure required to capture maximum value from recyclates

Digitalization requires physics to describe systems
Minerals Centric ≈ Product Centric: Key understanding to “close” the loop
Recycling system’s techno-economic limits
Detailed simulation tools are required to assess resource efficiency

Processes, Plants or Systems

Fundamental Process and System Benchmark
Techno-economic (& thus physics) based

New Process/System Benchmark
Technology and Systemic Innovation (Digitalization)

Present
Time (Years)

The ultimate benchmark of industry sector

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System’s techno-economic limits
Simulation/design tools pre-requisite to improve environmental analysis

Rigorous Simulation
Environmental Footprinting

BAT, Flow Sheets & Recycling System Maximizing
Resource Efficiency – Benchmarks

Environmental Indicators based on BAT
Driving Benchmarks of Industry

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Linking CAD to simulation key to quantification of RE
We can now link product "mineralogy" to recycling rate

Some LED recyclate materials
Linking CAD to simulation key to quantification of RE
Simulation of physical and metallurgical recycling

HSC Sim recycling system simulation

DfR ≈ Design for Recyclate quality & economic value
Recycling rates of 4 different LED lamp designs
Linking LCA to simulation to obtain impact

Easily possible, weakness of LCA databases is revealed but opens up a transparent discussion to improve this situation

Environmental assessment (GaBi & HSC)

Leveling the global playing field

Quantified sustainability: attract the bright, entrepreneurial & innovative

- KIC and other EU projects on recycling
- “Wheels of Metals” MOOC @ Leiden ca.5,000 students:
  - https://www.coursera.org/course/metal
  - Explore the opportunities, limits and infrastructure for metal recycling – a free textbook – reaching 40,000 downloads after 1 year after publication in April 2013.
  - Gives detail how to increase metal recycling rates.
- Promote a Product-Centric Recycling engineering design based approach.
Any solution requires a holistic value chain approach.