

COMBINED COMPETENCE UNDER ONE ROOF

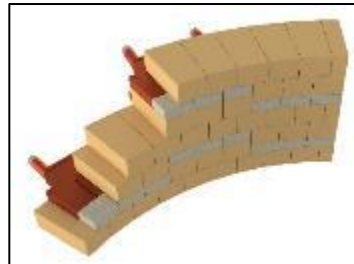
Development of Advanced E-waste Recycling Facilities

60th Conference of Metallurgists

August 17-19, 2021

Karl Büchner

OVERVIEW PRODUCTS AND SERVICES



Research & Development & Innovation

DigMet



Non-ferrous metals units

- ◆ TBRC
- ◆ HENRI[®]
- ◆ Gas Purging Systems
- ◆ Coolers



Refractories non-ferrous

- ◆ 3D Engineering + supply
- ◆ CFD modeling
- ◆ HT-calculations
- ◆ EXP-calculations

UrbanGold Metal Recycling

- 🔄 Process Design & Engineering
- 🔄 Technical Project Management
- 🔄 Consulting
- 🔄 UG Technologies

Tankhouse technology

- ◆ METTOP-BRX[®] Technology
- ◆ Cathode spacers
- ◆ Complete Tankhouse

ILTEC for vessel cooling

- ◆ IL-B2001[©]
- ◆ Ionic Liquid Technology for vessel cooling
- ◆ Furnace integrity optimization

Overall Process & Technology Consulting

Field Studies & Trainings

Process and 3D Plant Engineering

YOUR PARTNER FOR METAL RECYCLING



PROCESS DESIGN & ENGINEERING

- 🔄 Technical & Economical & Environmental Feasibility
- 🔄 Process Development
- 🔄 Process Modelling
- 🔄 Process Engineering



TECHNICAL PROJECT MANAGEMENT

- 🔄 Engineering Services
- 🔄 Interface Management
- 🔄 Technical Advice & Coaching
- 🔄 Ramp Up Support



CONSULTING SERVICES

- 🔄 Fitness Check
- 🔄 Recycling Process Optimization
- 🔄 Metallurgical Advice & Coaching
- 🔄 Studies



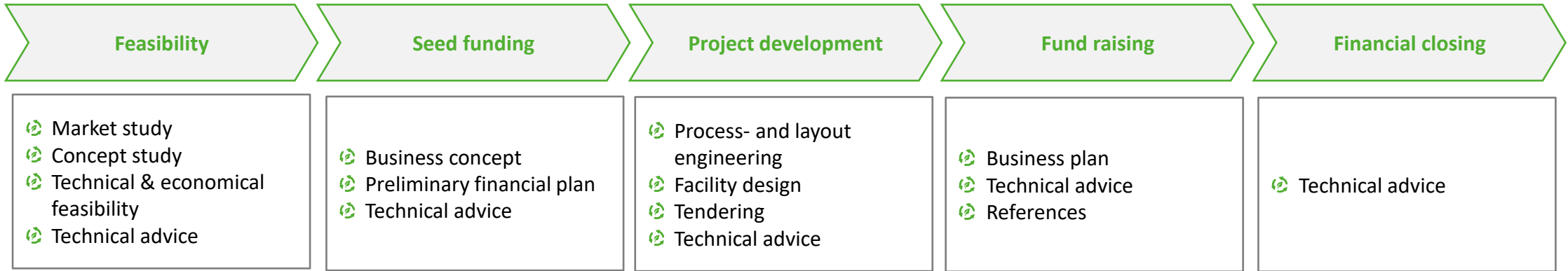
URBANGOLD TECHNOLOGIES

- 🔄 UrbanGold HENRI
- 🔄 UrbanGold Flex
- 🔄 UrbanGold Compact

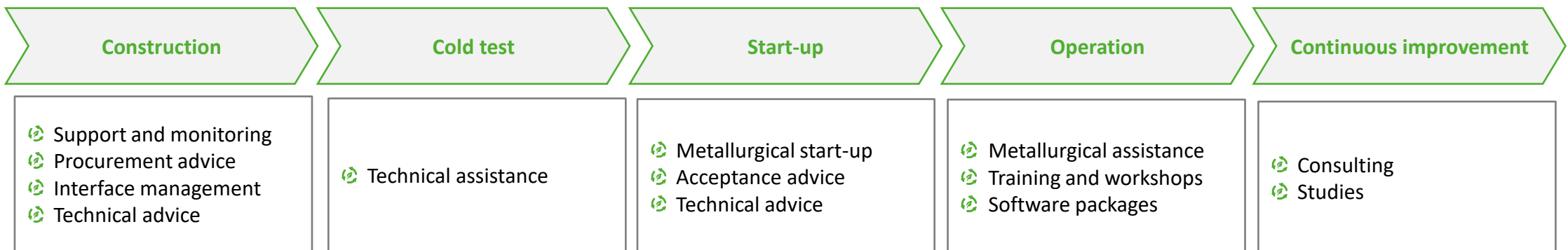


OUR SERVICES SUPPORTING YOUR PROJECT

Planning phase



Realisation phase



THE KING'S CLASS OF RECYCLING

End of Life Vehicles



E-Waste & PCB scrap



Catalysts



29
Cu

46
Pd

47
Ag

82
Pb

50
Sn

30
Zn

78
Pt

and many more

We are your partner for
any kind of metal
containing secondary raw
material

Slags, skimmings & dusts



Photovoltaic Systems



Batteries (e.g. Lithium Ion)



Metallic scrap
Alloy scrap
Cable scrap



79
Au

28
Ni

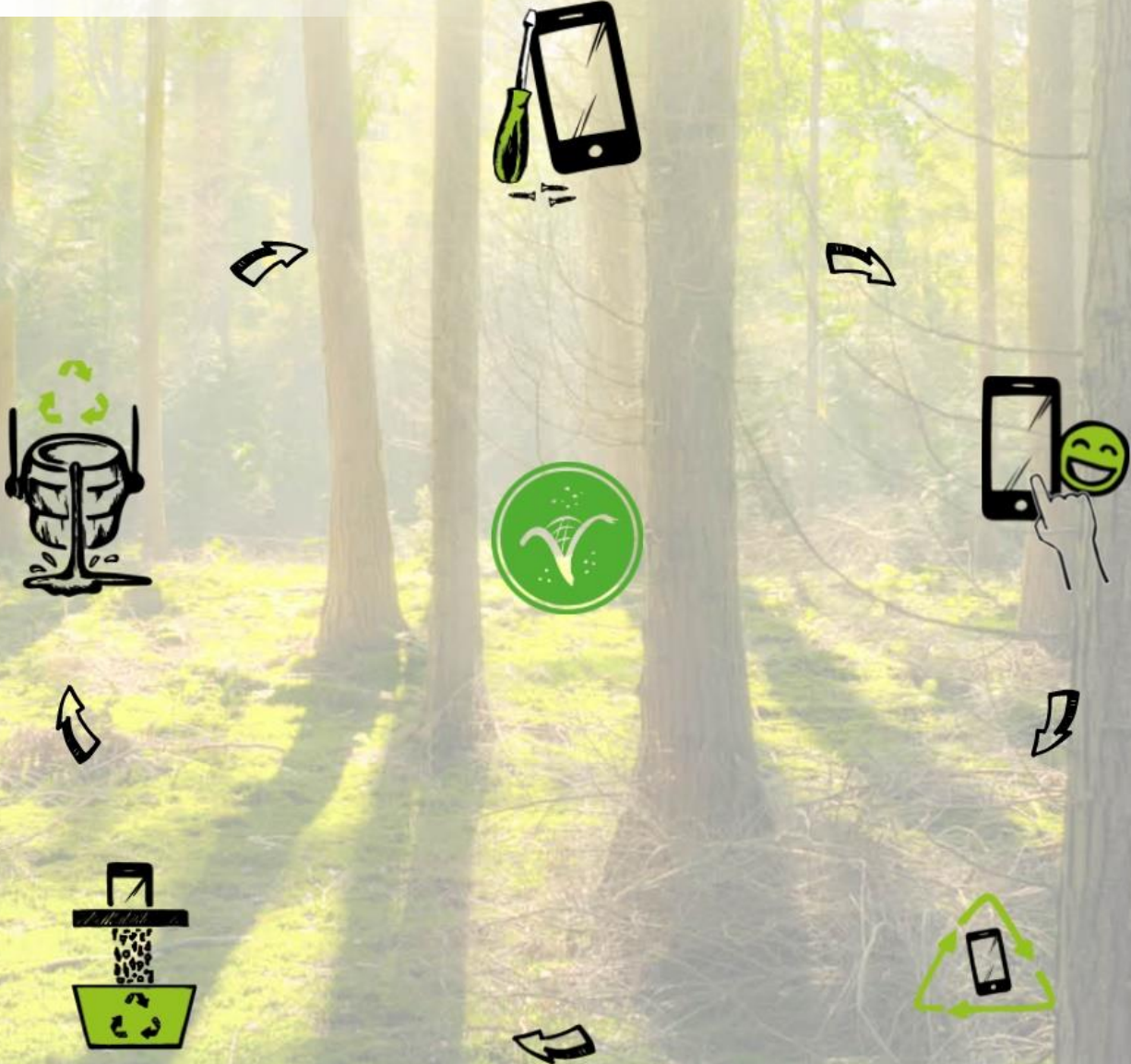
3
Li

26
Fe

13
Al


Development of advanced e-waste recycling facilities

Circular Economy



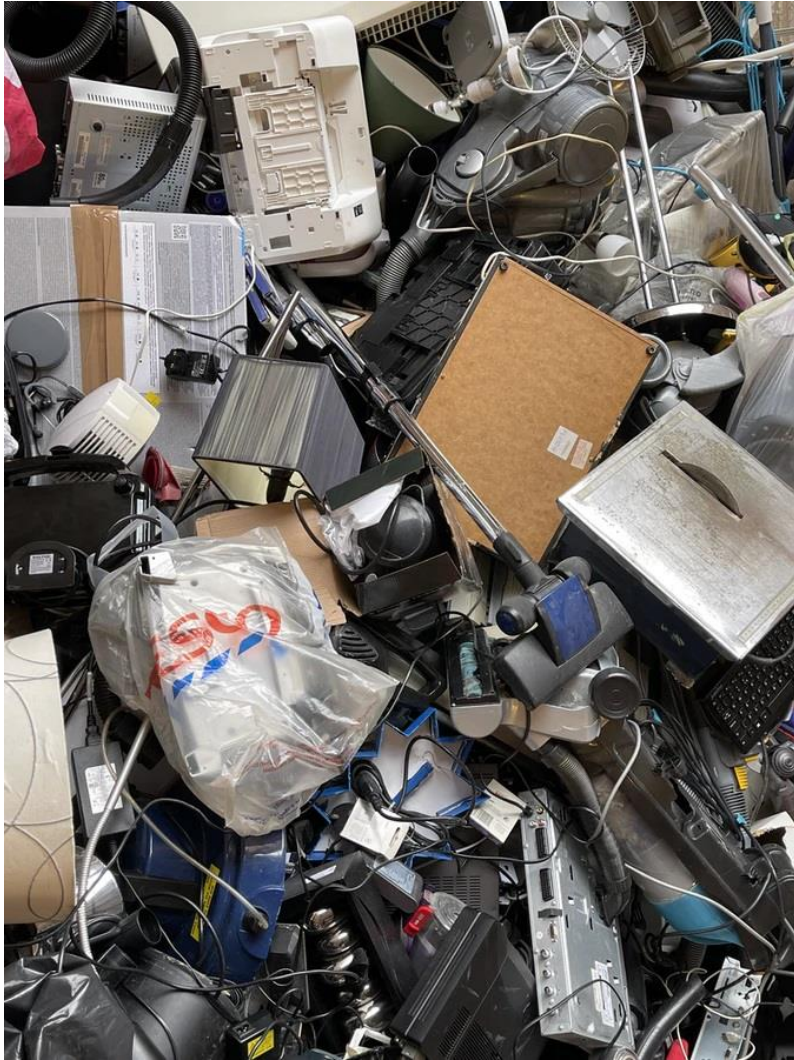
E-waste - Quantities

- 🔄 E-waste / WEEE = equipment working with electric currents or fields (WEEE = Waste of Electrical and Electronic Equipment)
- 🔄 Quantities:

WEEE	Year	Generated	Collected	Coll. rate
America (n, c, s)	2019	13.1 Mt	1.2 Mt	9.2%
Canada	2019	0.76 Mt	0.10 Mt	13.2%
Europe	2019	12.0 Mt	5.1 Mt	42.5%
Asia	2019	24.9 Mt	2.9 Mt	11.6%
Global	2019	53.6 Mt	9.3 Mt	17.4%
Global	2030	74.7 Mt	18.7 Mt ? 	25% ?

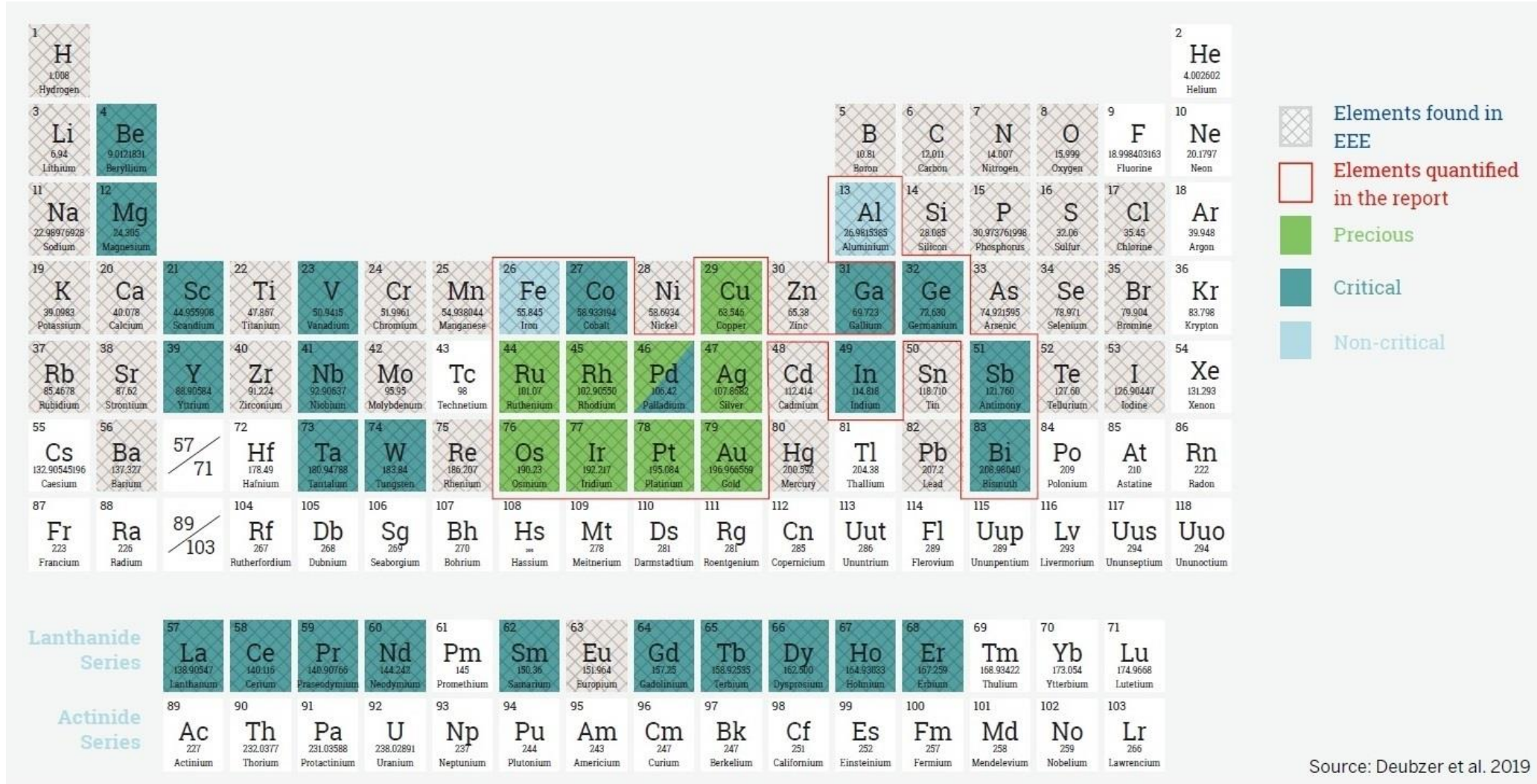
Source: The Global E-Waste Monitor 2020, United Nations University

E-waste - Examples



Sources: free stock photos under „Creative Commons Zero License“

E-waste - Composition






Source: The Global E-Waste Monitor 2020, United Nations University

E-waste - Composition

- ♻️ Substances in e-waste: (examples only)
 - ♻️ Precious metals:
Ag, Au, Pd, PGMs
 - ♻️ Valuable metals:
Cu, Ni, Pb, Sn, Zn, Fe, Al
 - ♻️ Valuable substances:
glass, wood, plastics
 - ♻️ Hazardous substances:
heavy metals (Cd, Hg, Pb,...), halogens, organic halogen compounds
(e.g. PCB: polychlorinated biphenyls), toner powders, asbestos, ...

E-waste - Informal recycling

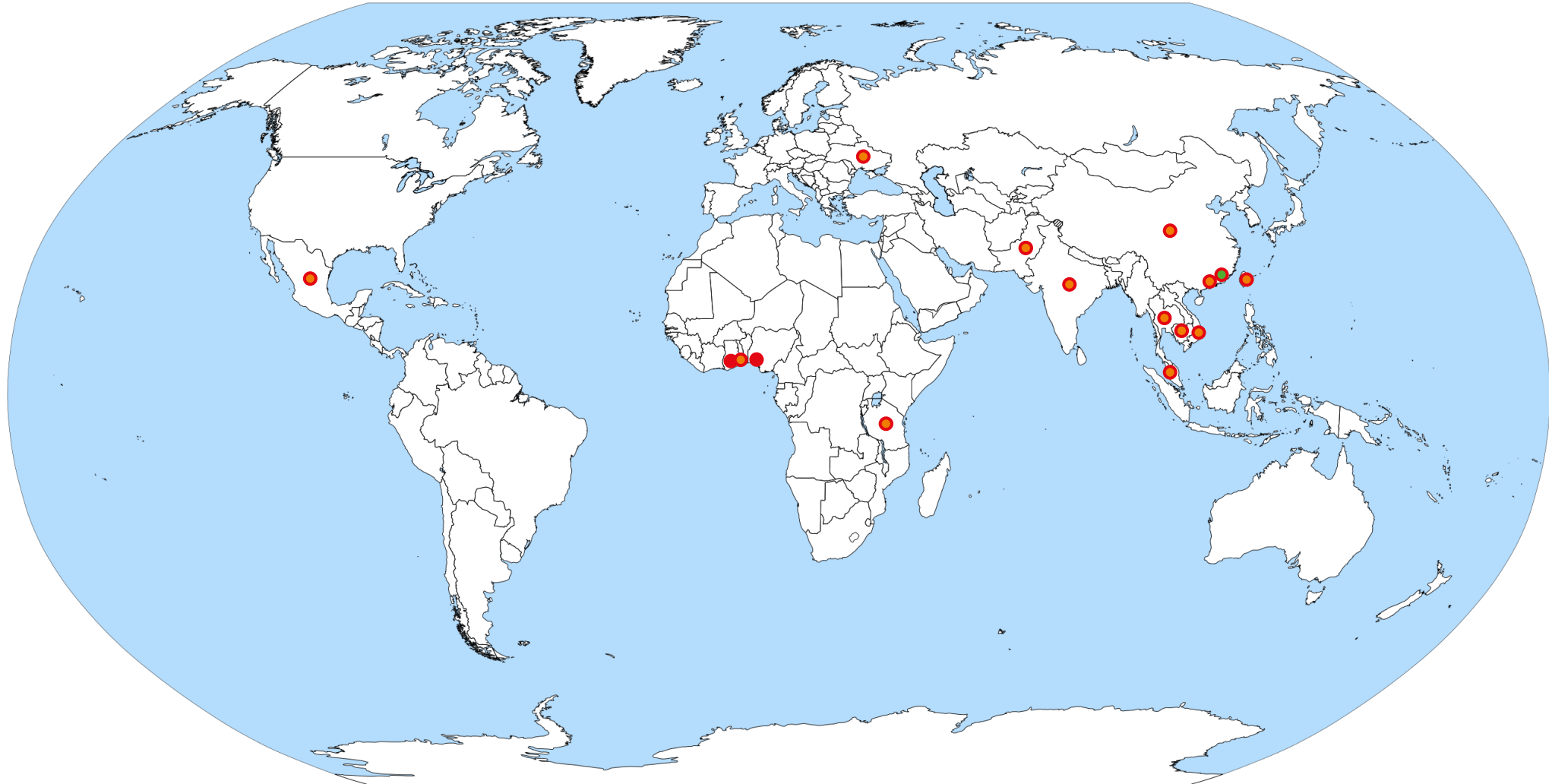
Larger known spots in:

-  Agbogbloshie, Accra, Ghana
-  Alaba Market, Lagos, Nigeria
-  Guiyu, Guangdong, China
(now: Guiyu National Circular Economy Industrial Park)

Smaller / less known spots in:

-  Cambodia, China , Hong Kong, India, Malaysia, Mexico, Pakistan, Taiwan, Tanzania, Thailand, Togo Ukraine, Vietnam (Hanoi)

E-waste - Informal recycling













Sources: *Environmental Justice Atlas*, ejatlas.org; *Basel Action Network*; *MoniTour E-Trash Transparency Project*

E-waste - Formal recycling

 Collection!

 Mechanical pre-treatment:

-  Removal of hazardous substances
-  Manual dismantling / automated shredding
-  Sorting and separation of shredded fractions, e.g.
 -  Iron + steel
 -  Aluminium
 -  Wood
 -  Glass
 -  Plastics
 -  Light shredder fractions (fluff)
 -  Copper

E-waste - Formal recycling

🔄 Copper-bearing shredder fractions 1/3



High metal content, coarse, approx. 70% Cu



High metal content, fine, approx. 65% Cu

E-waste - Formal recycling

🔄 Copper-bearing shredder fractions 2/3



High oxidic content, fine, approx. 15% Cu



Light shredder fraction, approx. 10% Cu

E-waste - Formal recycling

🔄 Copper-bearing shredder fractions 3/3









Printed circuit boards (PCBs), shredded, approx. 9% Cu






“Pellets”,
approx. 1.3% Cu

Developing an e-waste smelter

Limitations in processing e-waste

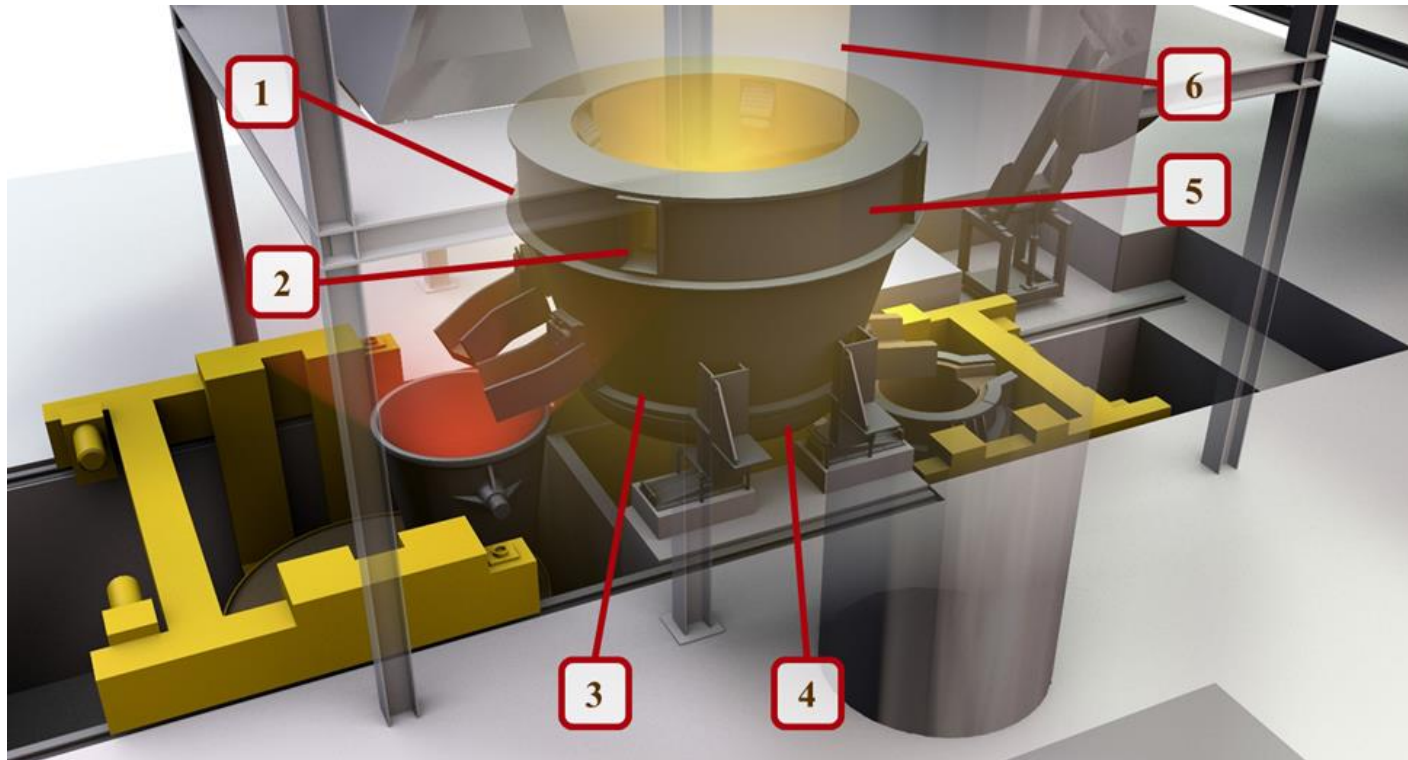
-  High plastics content
 -  Excess heat, up to overheating & possible breakthrough
 -  Large off-gas volumes
-  Complex off-gas composition
 -  Halogens, also dioxins / furans (PCDD / PCDF)
 -  All substances that went into the furnace

History of development:

-  Lab scale
-  Technical scale
-  Pilot scale

Developing an e-waste smelter

🔄 Components fully equipped HENRI:



No.	Unique feature
1	Fast changeable vessel
2	Supersonic burner and injector
3	H ₂ /N ₂ bottom gas purging
4	Safe cooling below bath level with ILTEC
5	CFM copper cooling elements
6	Waste heat recovery

Developing an e-waste smelter

- 🔄 Demonstration tests:
 - 🔄 Semi-industrial vessel, 0.9 m³

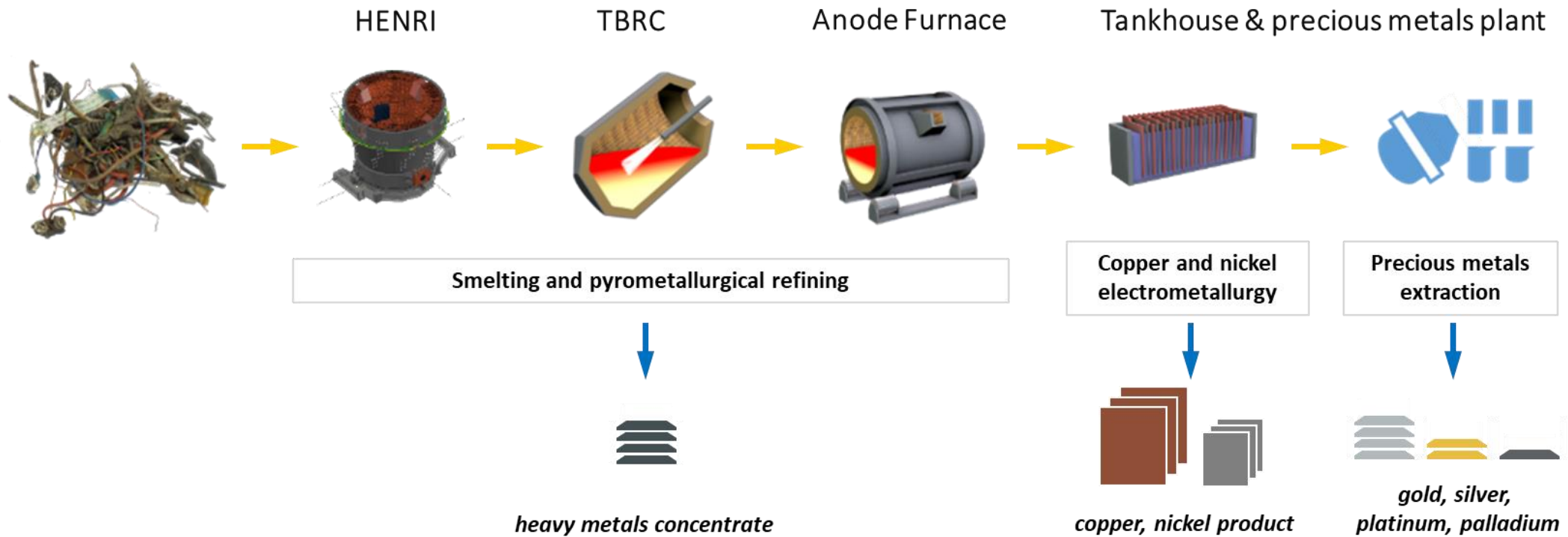
 - 🔄 Implemented modules:
 - 🔄 Supersonic burner / injector
 - 🔄 Gas purging unit
 - 🔄 Final vessel geometry
 - 🔄 Charging options

 - 🔄 Smelting of e-waste shredder fractions
 - 🔄 6 qualities, 20+ metric tons
 - 🔄 3 different slag systems



Advanced e-waste recycling





♻️ Advanced e-waste recycling facility:







Advanced e-waste recycling

Further development

Main furnace & process:

-  Hydrogen as
 -  Burner fuel, for heat input
 -  Reduction gas, to reduce [O] in the melt
-  NO_x optimized post combustion

Auxiliary units & processes to serve the main process:

-  Automated logistics and sampling
-  Safety: cooling with ILTEC
-  Slags: full of technology metals
-  Optimization in Electrolysis: BRX, ESCD



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Thank you for your attention!