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Horizon2020 SC5-14 project

NEMO

Near-zero-waste recycling of low-grade sulphidic mining waste for critical-metal, mineral and construction raw-material production in a circular economy

Lieven Machiels, Mika Paajanen, Peter Tom Jones, Koen Binnemans

2nd EU Critical Raw Materials Event - November 19, 2018, Brussels

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NEMO – which Critical Elements?

2017 CRMs (27)

Antimony	Fluorspar	LREEs	Phosphorus
Baryte	Gallium	Magnesium	Scandium
Beryllium	Germanium	Natural graphite	Silicon metal
Bismuth	Hafnium	Natural rubber	Tantalum
Borate	Helium	Niobium	Tungsten
Cobalt	HREEs	PGMs	Vanadium
Coking coal	Indium	Phosphate rock	

NEMO – where do we obtain these metals from?

Żelazny Most tailing pond, Poland Source: https://pawel-litwin.net/

A lot of (critical) metals are “lost” in mining waste

The challenge is to find economically feasible methods to recover these metals

Sulphidic mining waste?

What?

- Residues from mining and processing of sulphidic ores for the production of Cu, Pb, Zn, Ni, Co, Au,..

Quantities

- 600-900 Mtonne/yr produced in EU
- historic stockpile 28 000 Mtonne
- One of the largest volumes of extractive waste in the EU

Current treatment/opportunities

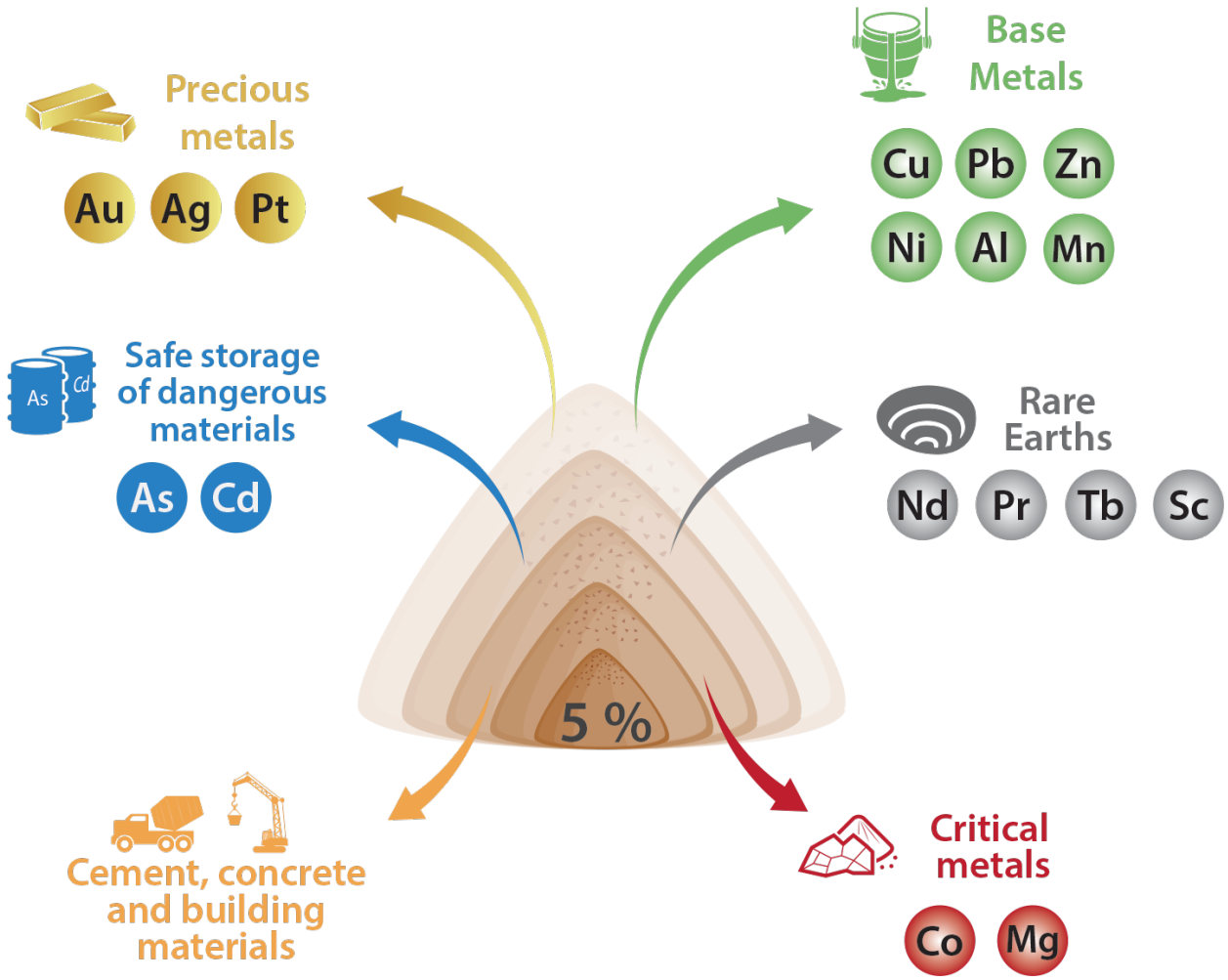
- Deposited in tailings ponds/dry stacked/back-filling in mine
- Stock of (critical) metals and minerals?

Source pictures: http://tailings.info

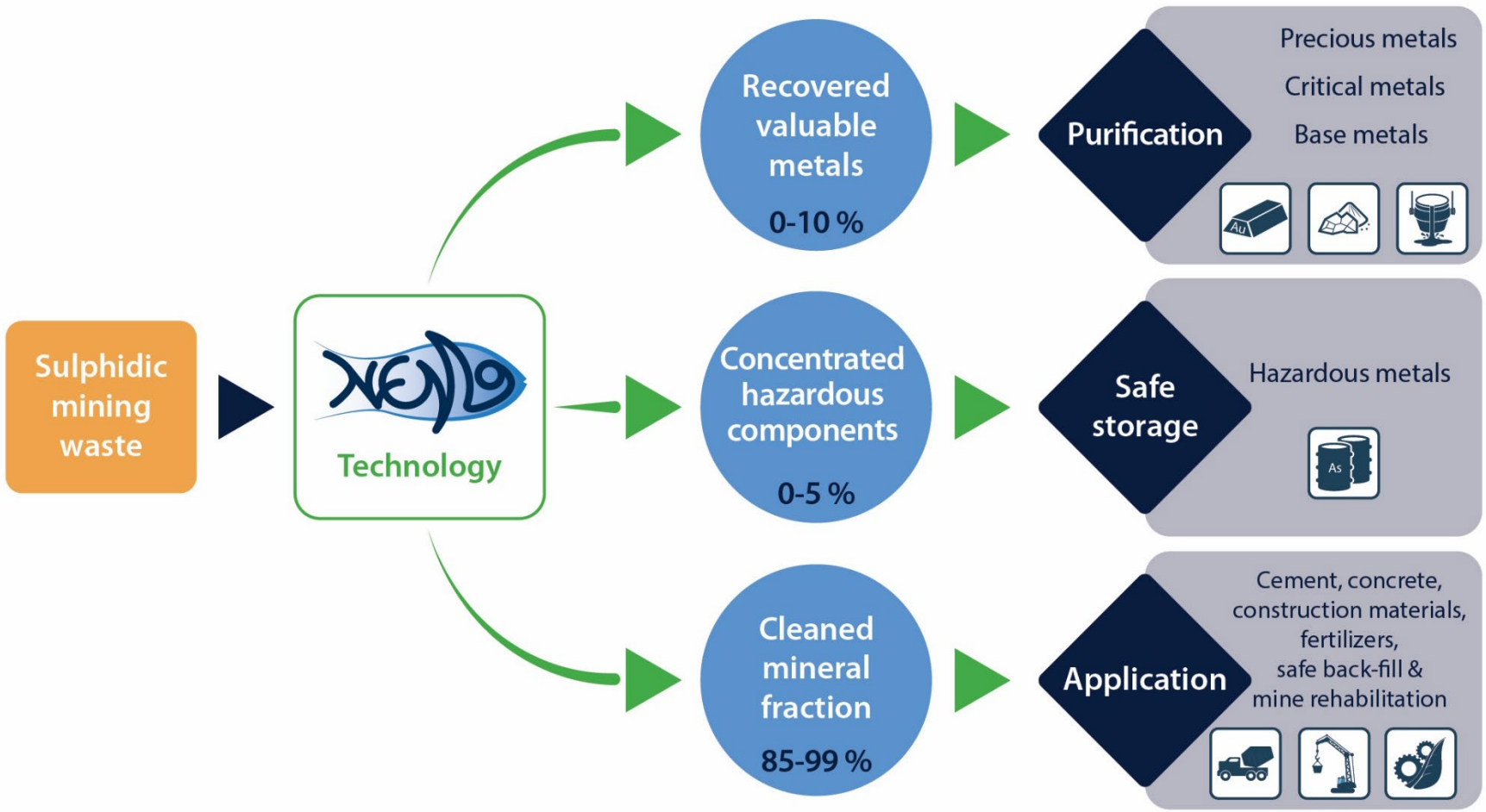
The NEMO concept?

Evolution:

- Recovery of a few g/tonne of ore (e.g. Au)
- Recovery of associated elements (e.g. Cu, Pb, Zn)
- NEMO: aiming at integral valorisation of the ore



The NEMO concept?



The NEMO concept?

Positive side effects NEMO concept..

- Waste can be reduced **upto 5% of original volume**
- Residues are clean, assuring long term environmental stability
  - Hazardous elements (As, Cd) concentrated and safely stored
  - Full removal of sulphides – no acid mine drainage

1 [VTT]

2 [VITO]

3 [IDENER]

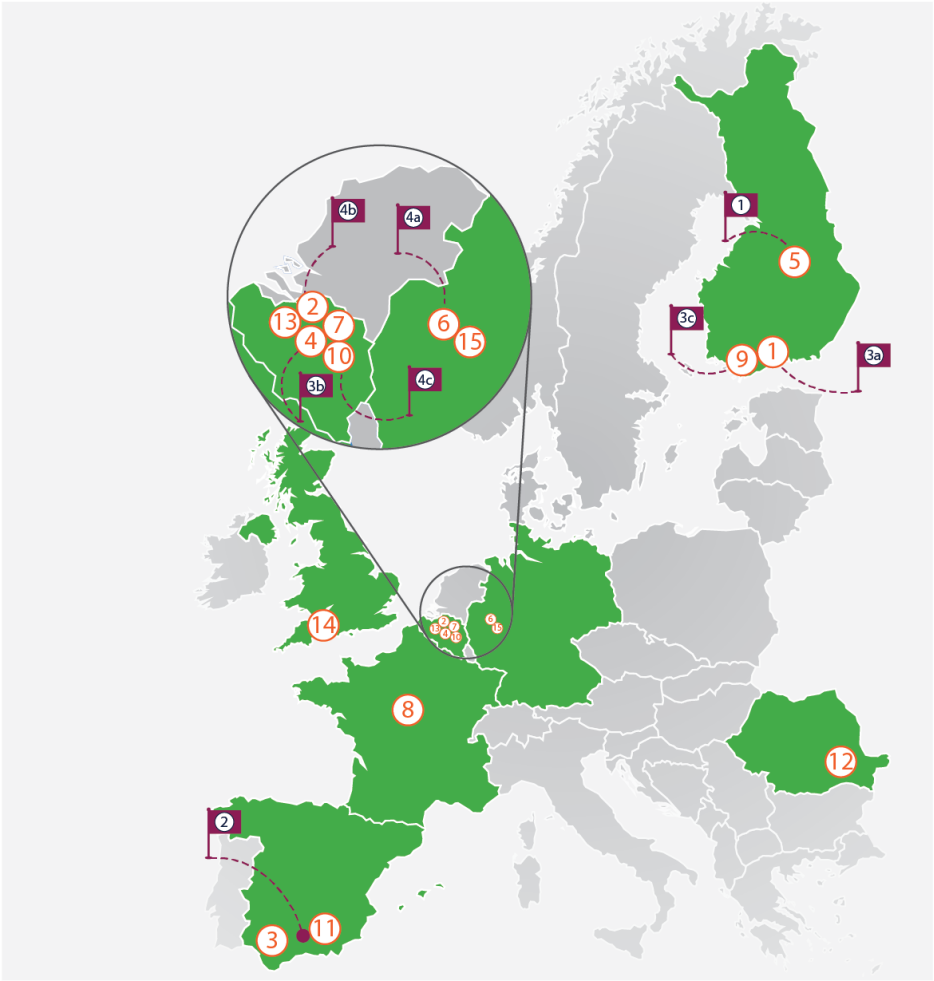
4 [KU Leuven]

5 [Terrafame]

6 [Thyssenkrupp]

7 [Resourcefull]

8 [BRGM]



9 [Skyscape Oy]

10 [Jacobs]

11 [Cobre Las Cruces]

12 [IMNR]

13 [CATAPA]

14 [UNEXE]

15 [DMT]

1–16 Partner organisations

University

Small and medium-sized enterprise (SME)

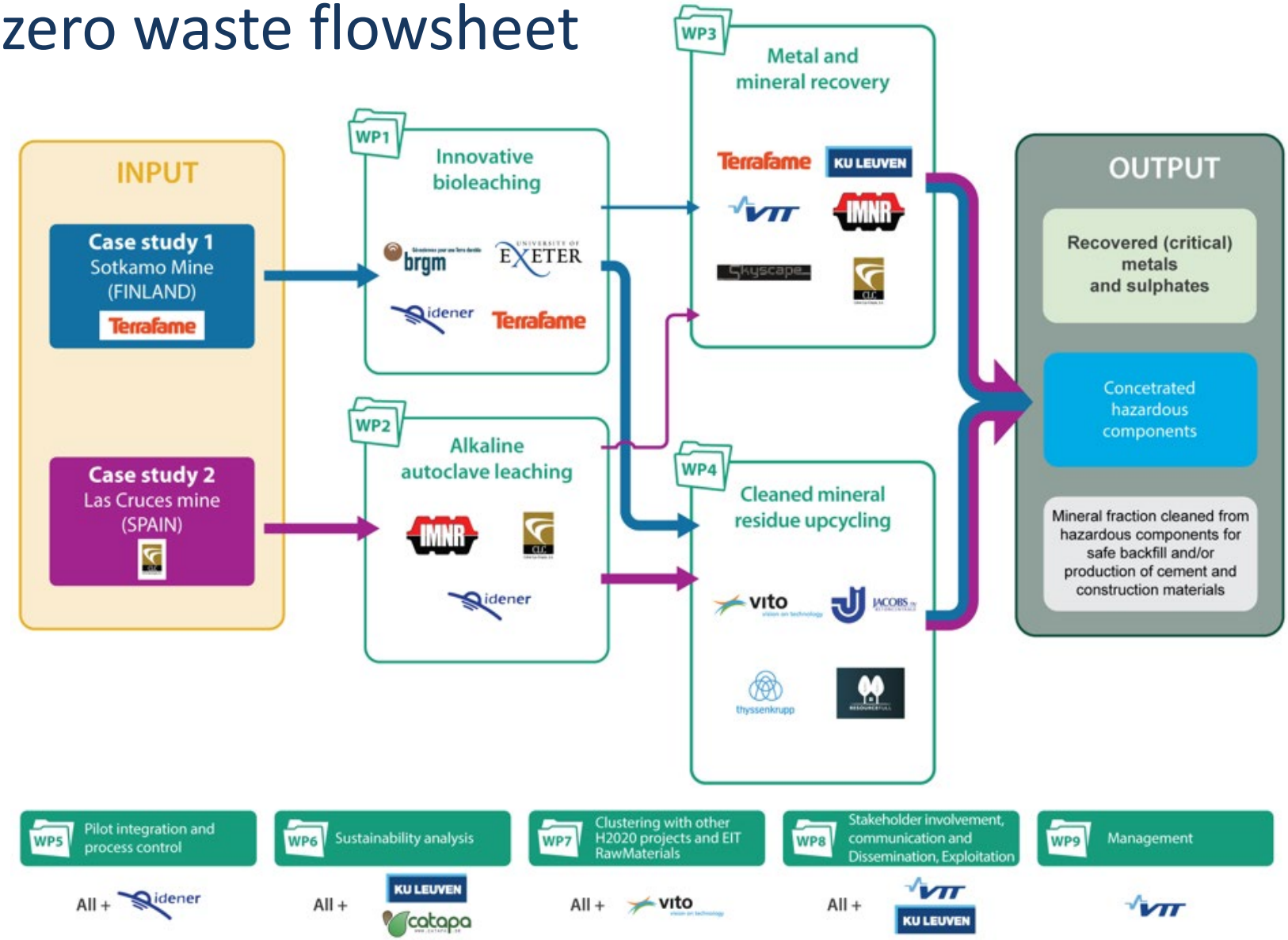
Research organisation

Civil Society

Large company

Pilots

The NEMO concept – 4 pilots creating a near-zero waste flowsheet



Case study 1: Sotkamo Ni-Co mine, Finland

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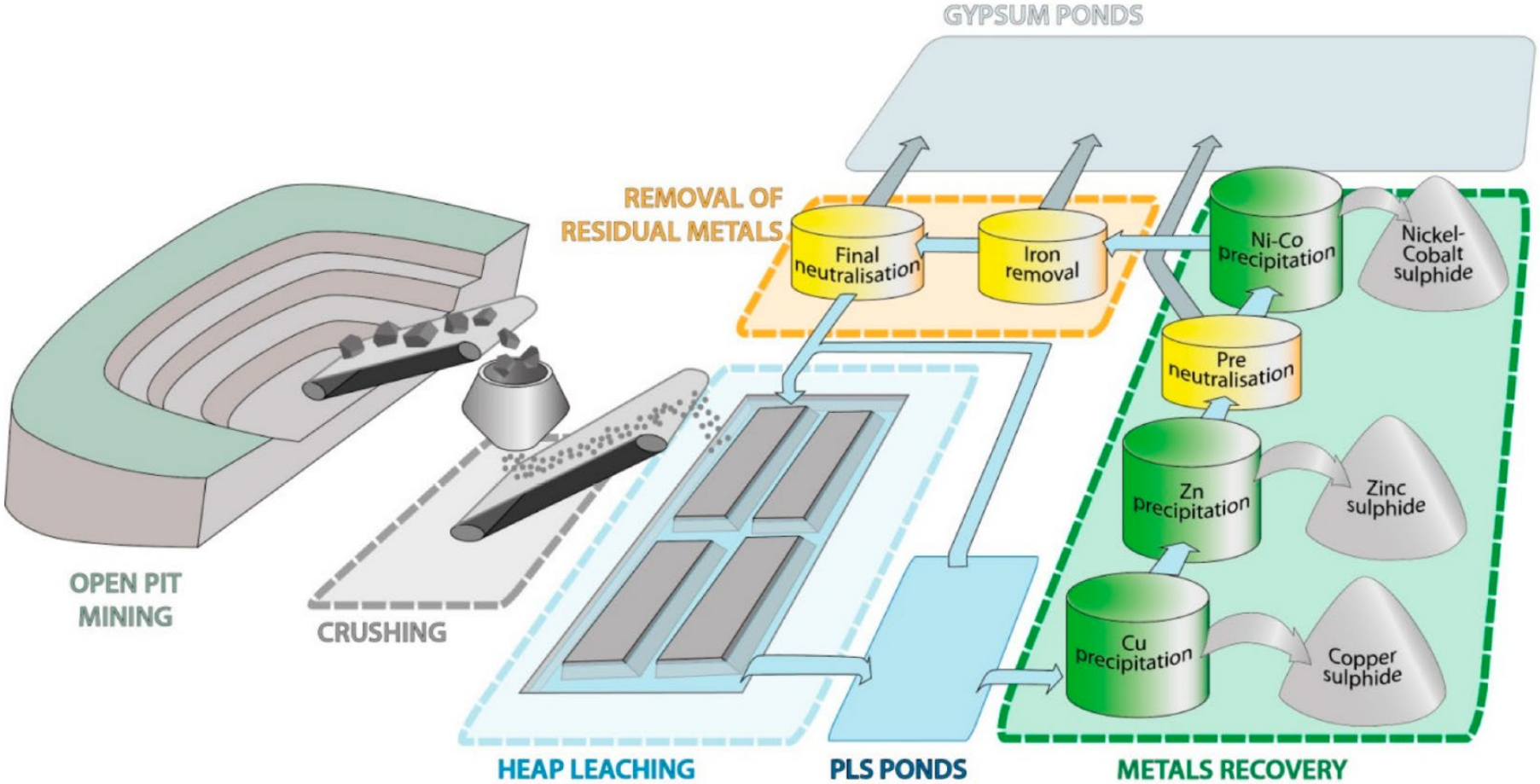

Source: Geosciences **2018**, 8, 66; doi:10.3390/geosciences8020066

Case study 1: Sotkamo Ni-Co mine, Finland

Green: critical elements

Current products:

- (Co,Ni)S, ZnS, by-product CuS

NEMO objectives:

- Additional metal recovery from leach solution (metals currently ending up in waste precipitates): Mn, Mg, REE, Sc, V, Al, Fe
- Mg-sulphates => fertilizers
- Cleaned mineral fraction: heaps remain in place after leaching = final storage of mineral fraction // alternative: valorisation in building products (no business case as mine is located very remotely)

Case study 2: Las Cruces Cu mine, Spain

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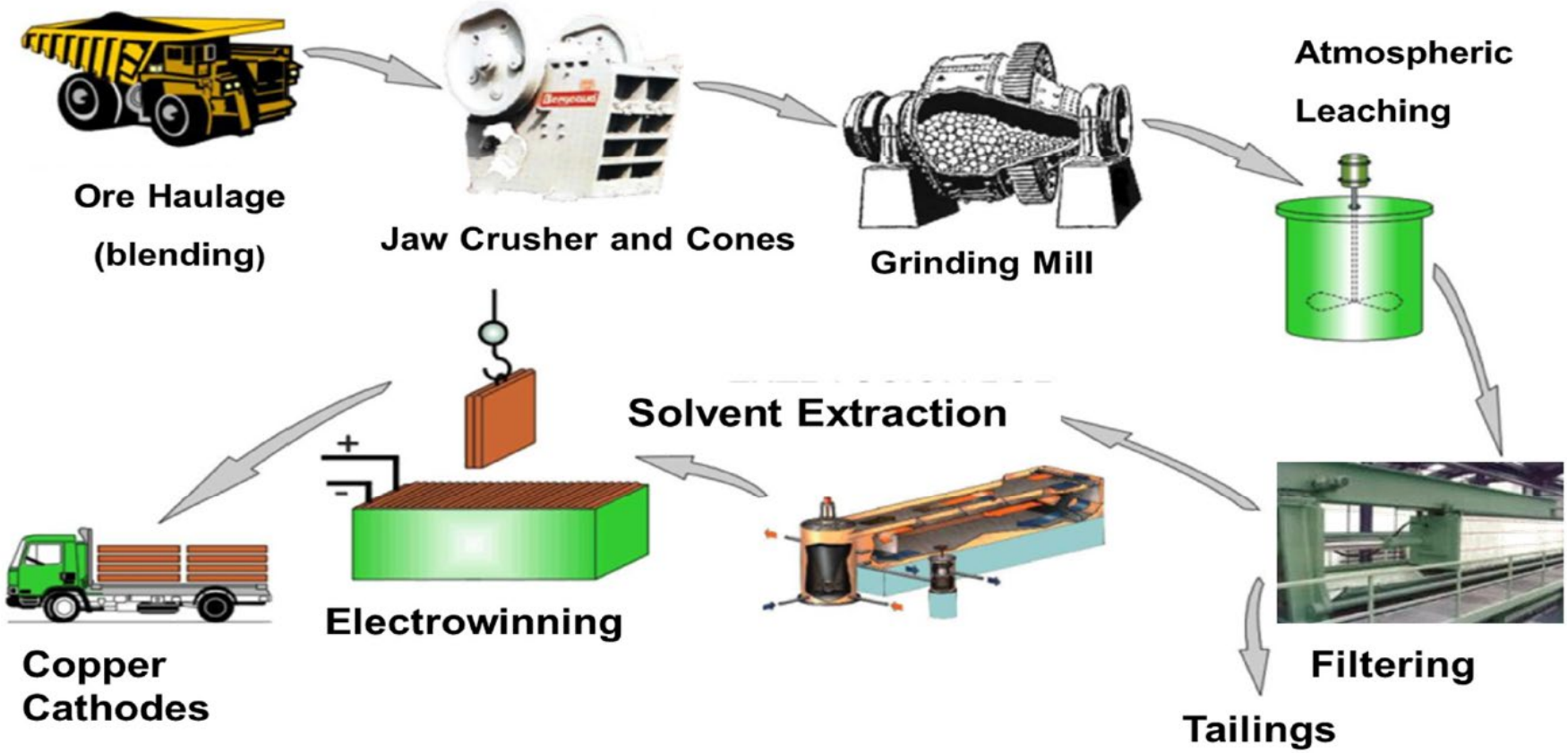

Source: https://s1.q4cdn.com/857957299/files/doc_presentations/2017/may/Presentation-Analyst-15May17-CLC.PDF

Case study 2: Las Cruces Cu mine, Spain

Green: critical elements

Current products:

- Cu cathodes (99.999 % pure)

Future:

- Underground mine. Change in ore type: Cu + Zn + Ag + Pb
- Recovery of Zn, Pb, Ag, Sb

NEMO objectives:

Conversion of pyrite tailings (50-95% pyrite)

- Conversion of pyrite to iron oxides => steel industry or component for cement
- Recovery of sulphates as fertilizers or detergents

The future?

We are looking for 3 additional mines to assess the feasibility of the NEMO concept

KU Leuven SIM^2 mining waste research programme

https://h2020-nemo.eu/

https://etn-sultan.eu/home/

http://www.sim-flanders.be/project/smart-sbo

Sustainable Inorganic Materials Management

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