«What is SULTAN project, actually?» An environmental assessment perspective

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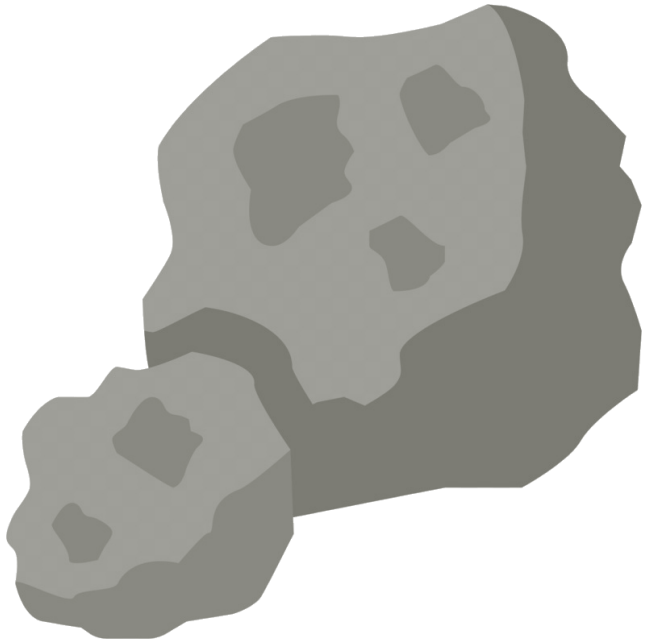
ESR 15 SULTAN

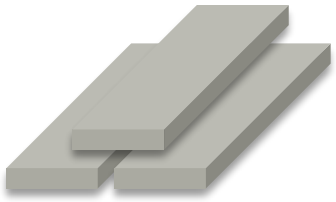
How much should we remove to get the product?

100 kg



Metal ores

1 kg*



Metal plates

Ore Density (Mudd, 2010)

Cu	0.5 – 2%
Pb	5 – 10%
Au	1 – 10 g/ tonne

Agenda

- Framework
- Context and scope
- Environmental Assessment
  1) Existing and *2) new processes*
- Summary and outlook

Framework SULTAN

MSCA-ETN
SULTAN

European Training Network for the Remediation and Reprocessing of Sulfidic Mining Waste Sites

Mine **wastes** → **resource** recovery – opportunity

8 Universities and research institutes + **7** Partners

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What mine wastes are we talking about?

Raw Ore → Fine ore → Concentrate

EXCAVATION | **COMMINUTION** | **FLOTATION** | **REFINING**

Environmental Burden

Waste rock (overburden)	Dust, noise	Tailings	Slag, Waste water

The input material (tailings) streams: 3 case studies

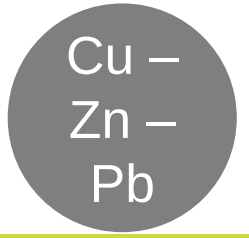
41.2 Mt + 3.1 Mt/ year

Neves Corvo, Portugal

11.4 Mt

Plombières, Belgium

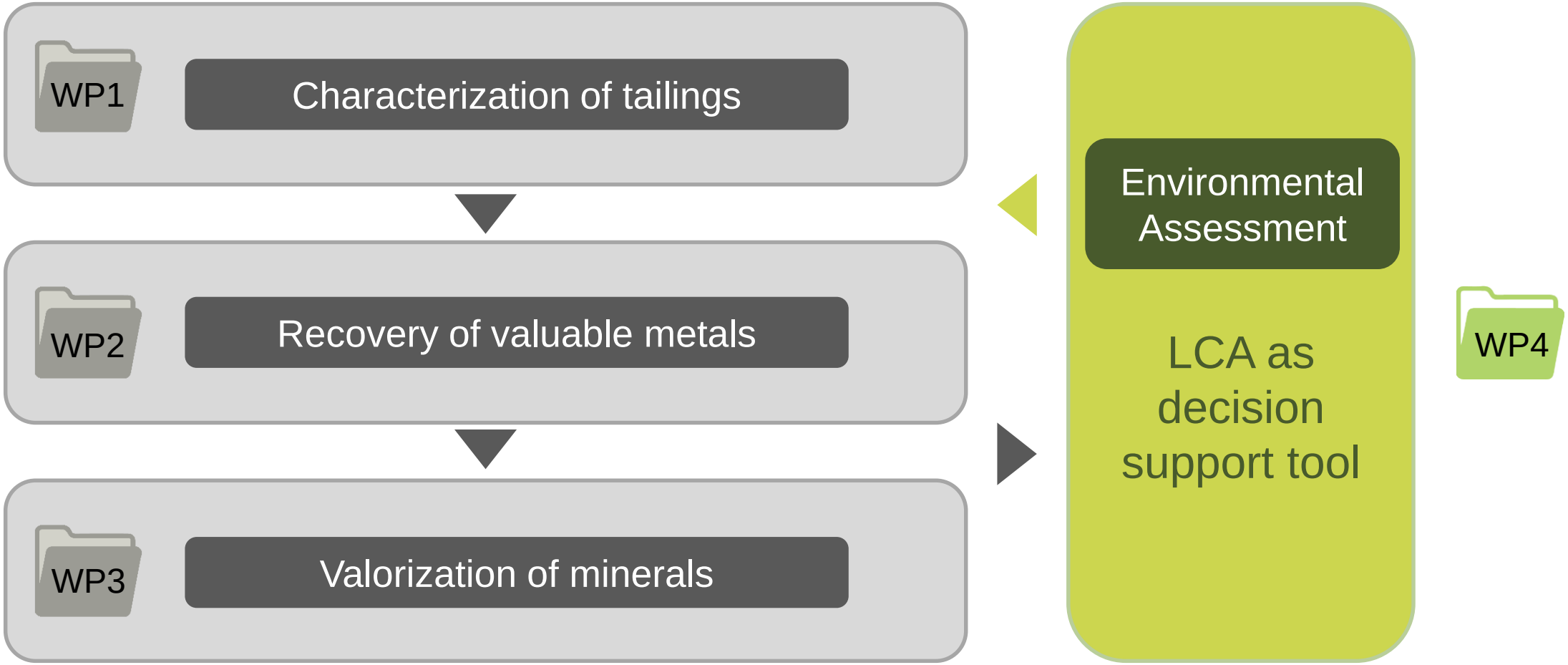
1.5 Mt



Freiberg, Gemany

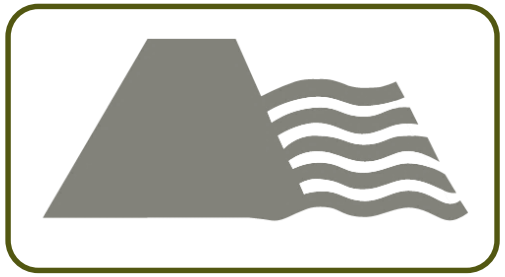
Different characteristics
(metals and minerals content)

How to deal with those tailings? Sultan Workflow



Our question: how sustainable are they?

Sulfidic Tailings



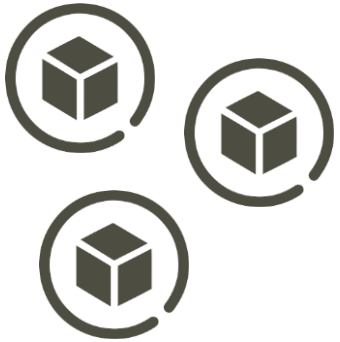
Storage

As secondary resources

STATUS QUO

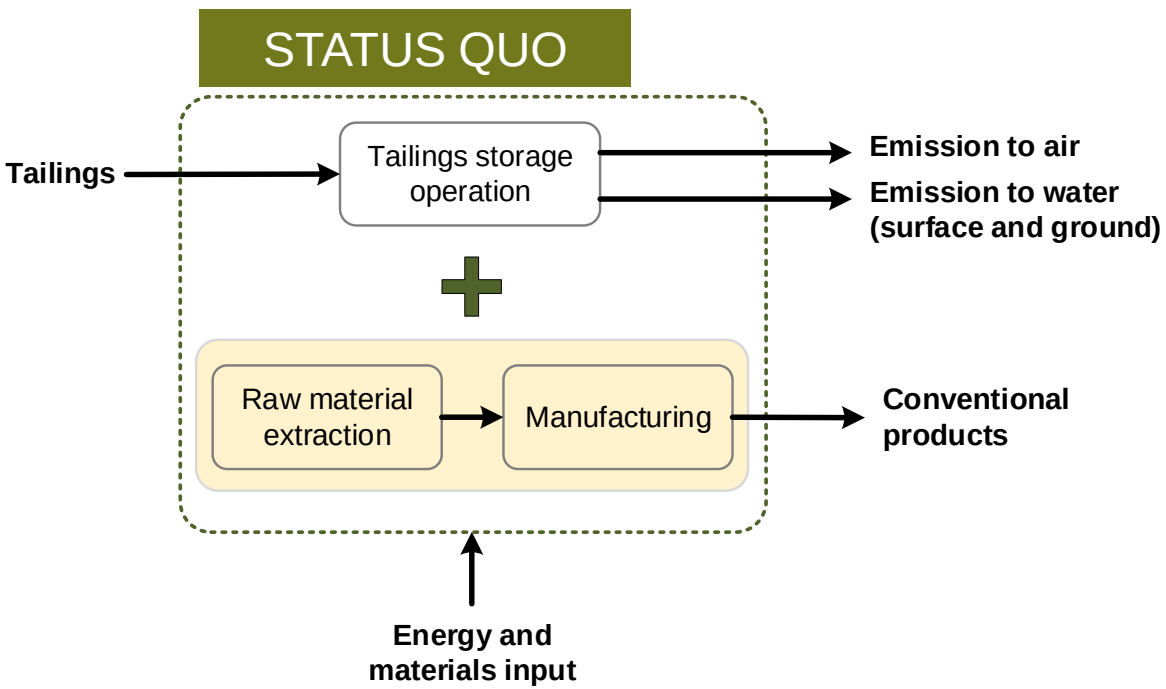
Dispose as usual

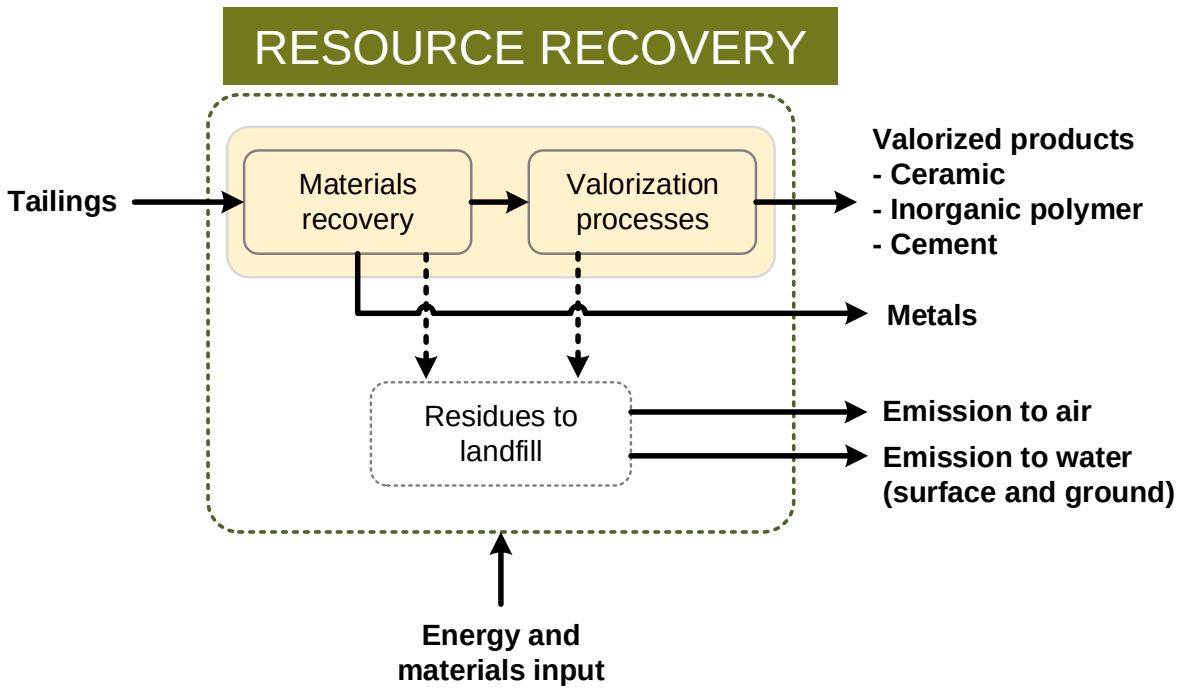
RESOURCE RECOVERY



Which products?
What processes?

Simplified conceptual flowsheet





Legend: System Boundary

Reducing wastes **volume** and replacing **materials** (Park *et al*, 2019)

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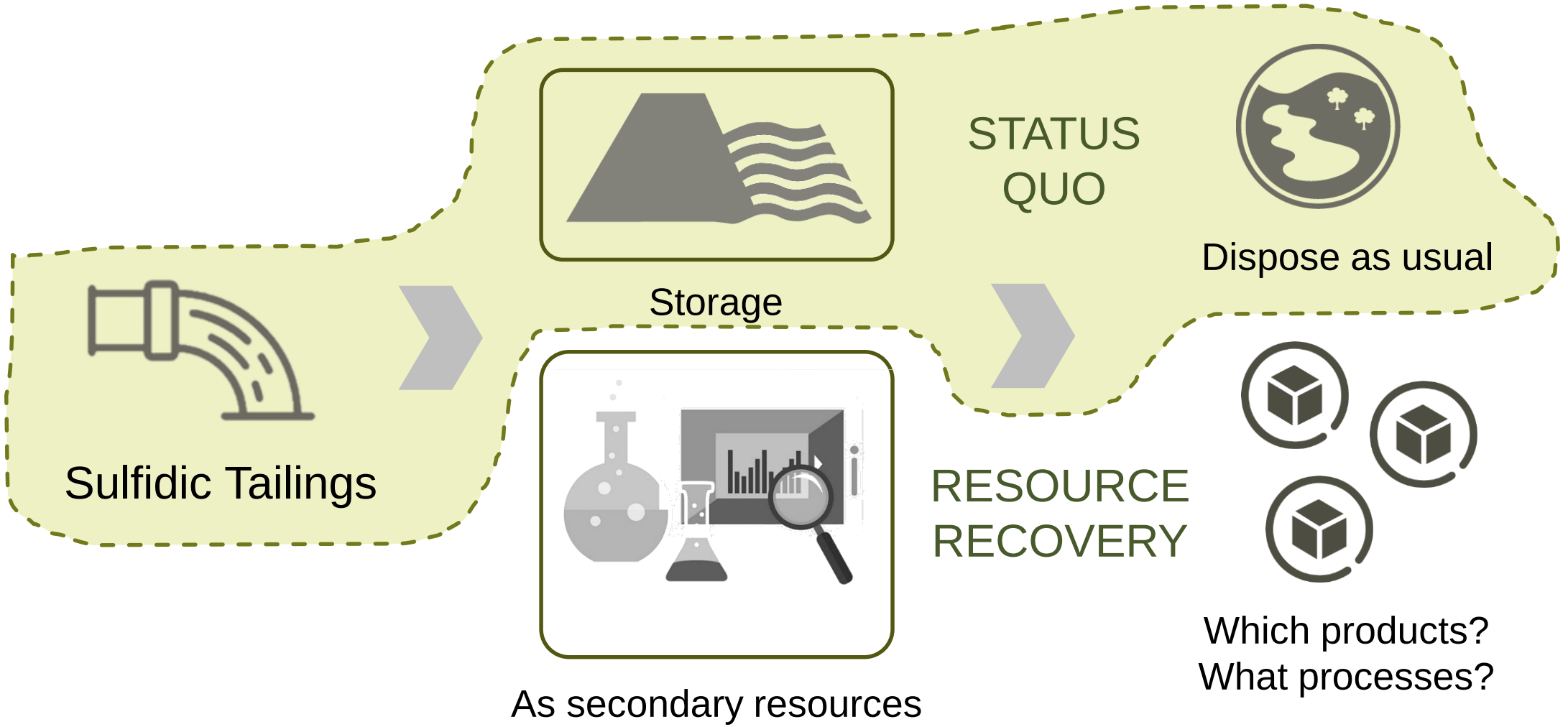
System 1: managing tailings in the storage

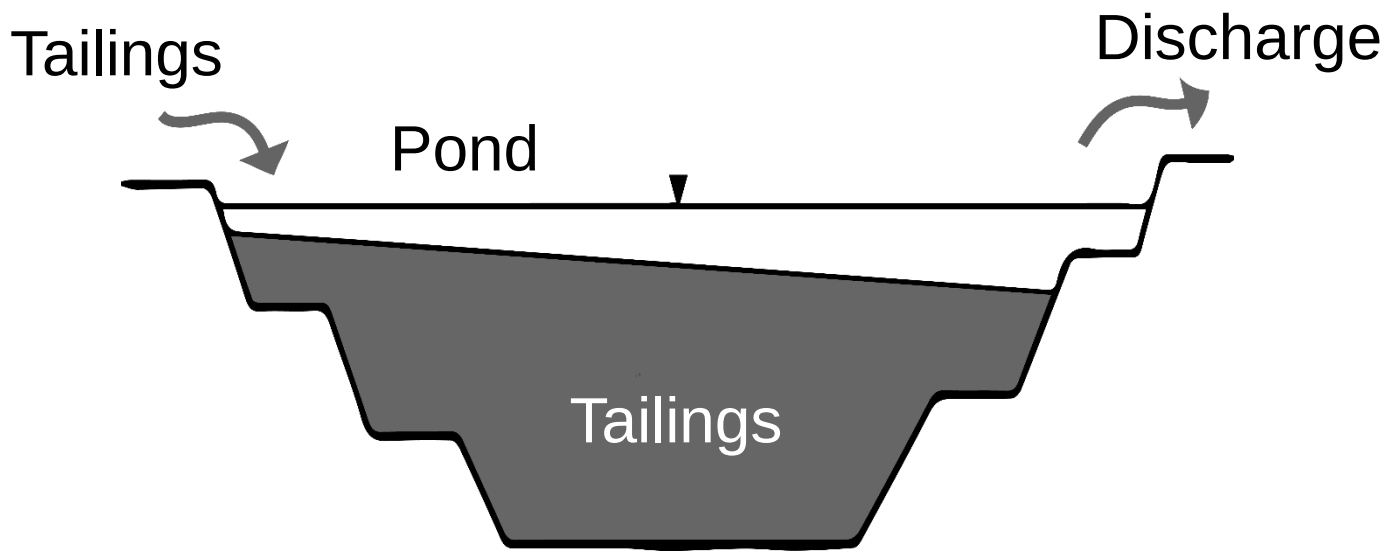


Status quo: common operation nowadays

Sulfidic Tailings

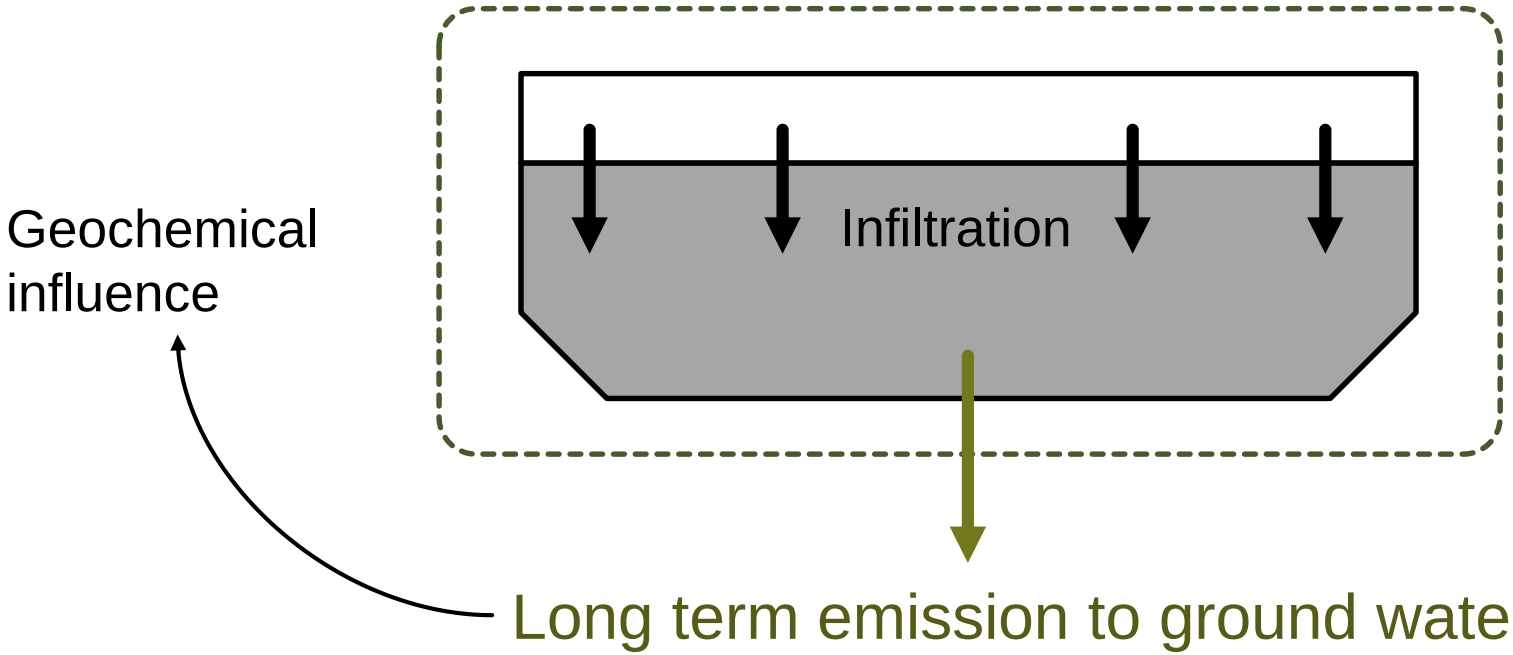
Storage

Dispose as usual



Model of the tailings storage (time & site specific)

- Objective: To include spatial & temporal conditions
  - Climate information (precipitation, evaporation, etc.)

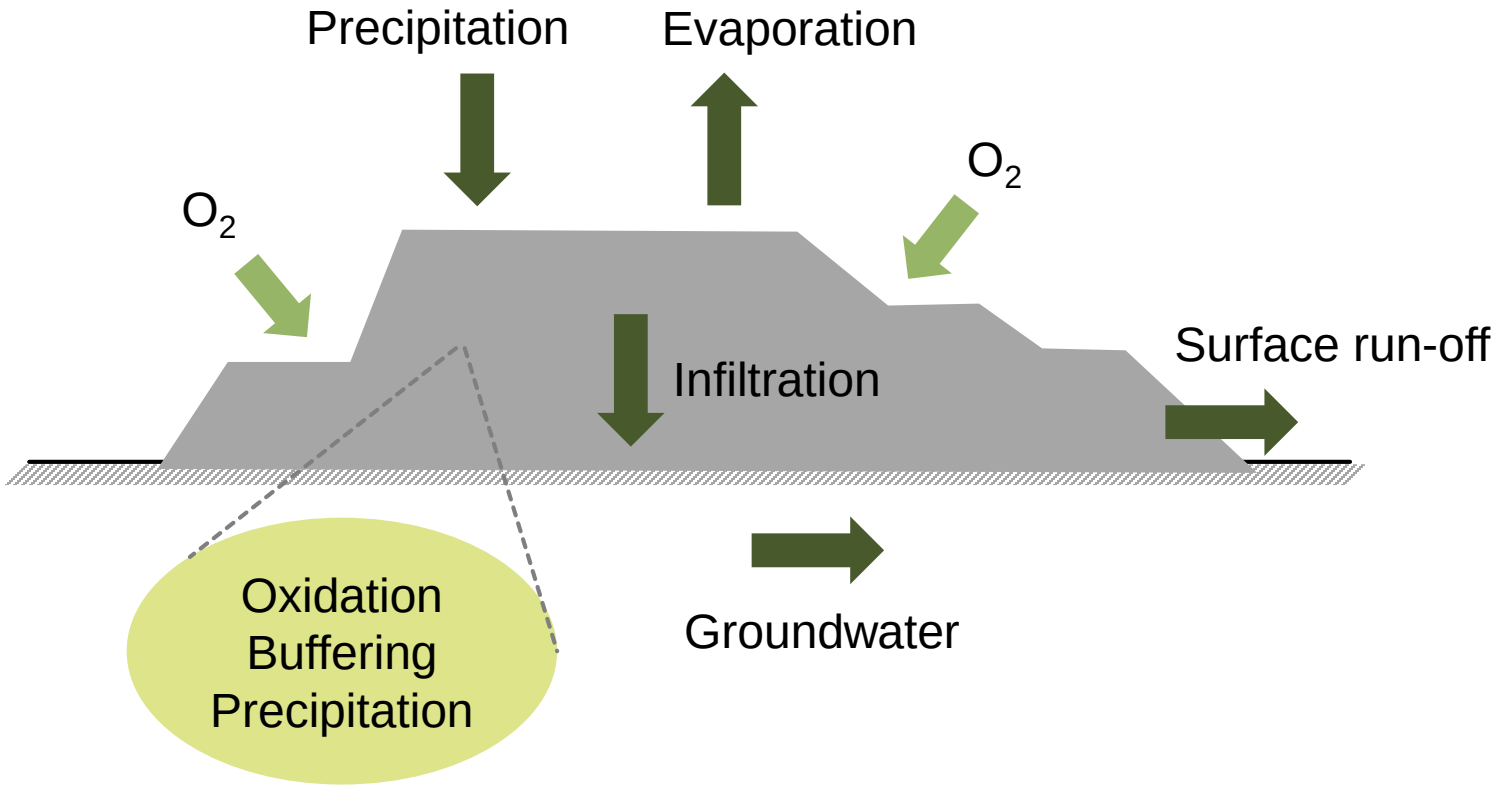


Non – linear behavior (Hellweg, 2001; Muniruzzaman, 2017)

Predictive modelling of tailings emission – Acid mine drainage

- Intention:

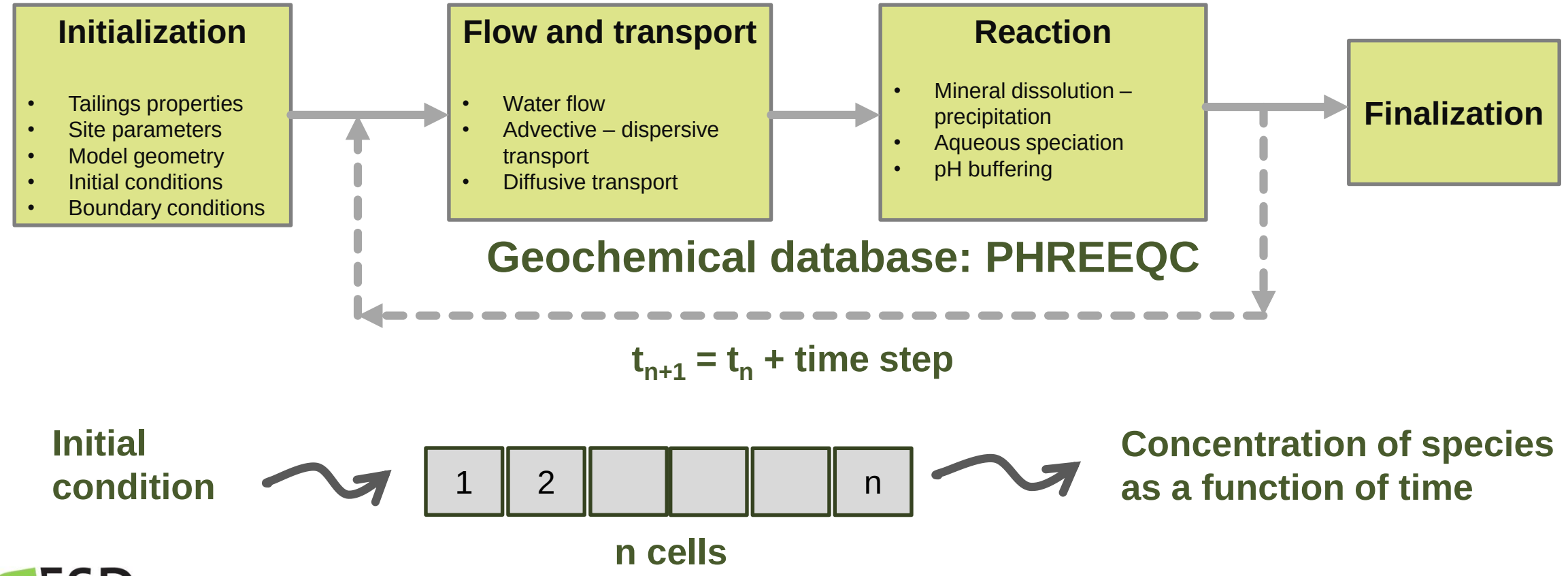
  Capturing important processes in AMD



Adapted from European Commission, 2010

Reactive transport modelling (RTM) approach

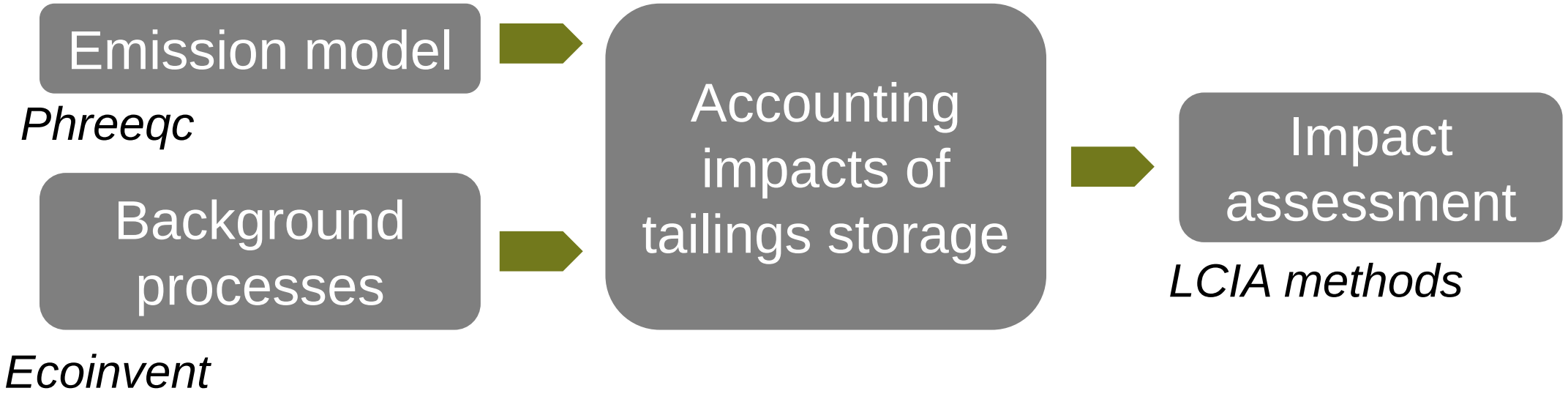
- Coupling of flow, solute transport, and geochemical reactions



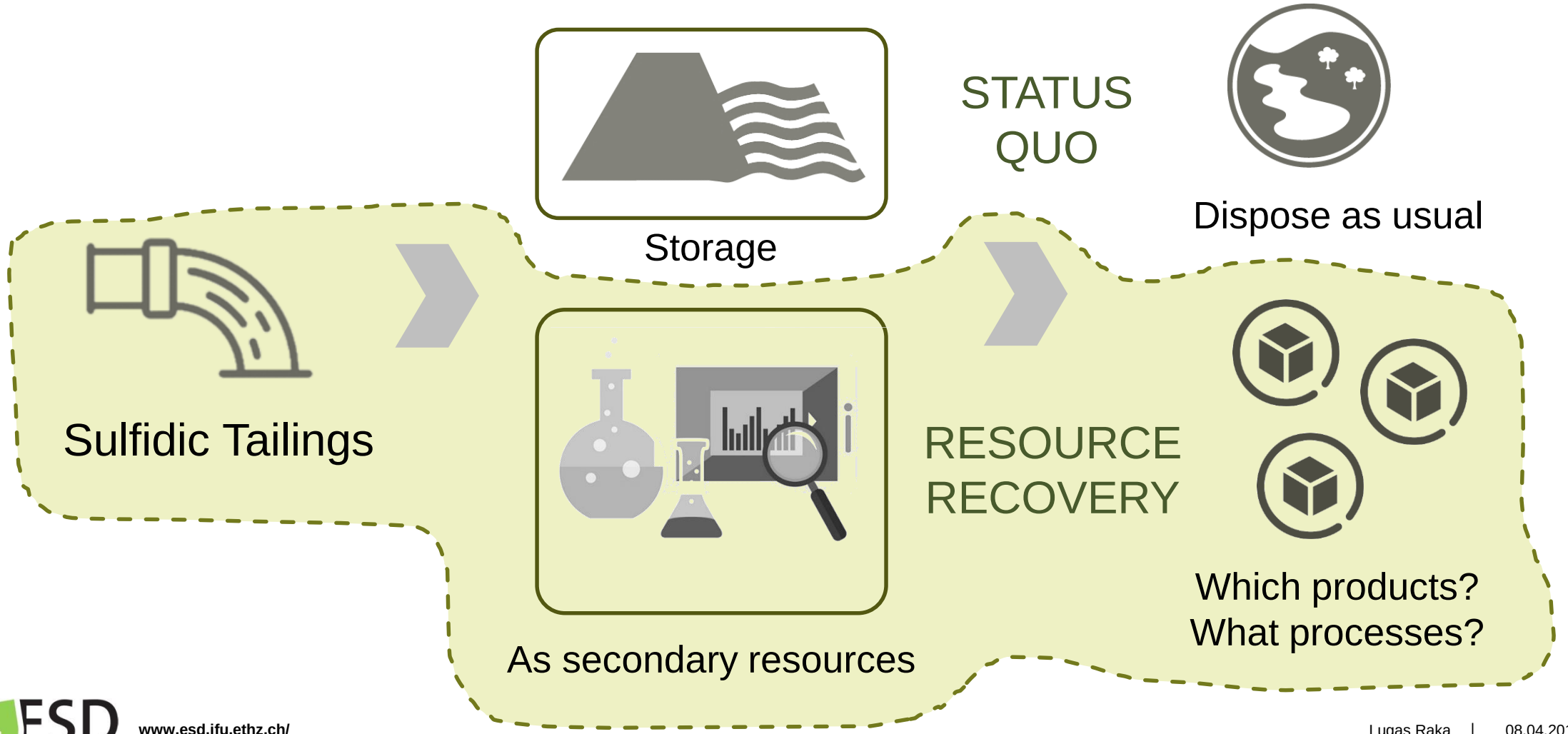
Goal: tailings operation environmental impact

Expected results:

- Emission inventory
- LCIA of tailings operation and expanded boundary



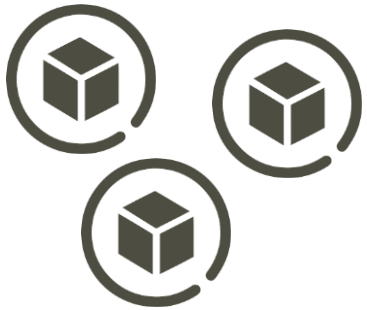
System 2: recovery and valorization route



Resource–recovery: sustainability of metallurgical processes

Sulfidic Tailings

As secondary resources



Metals and valorized products

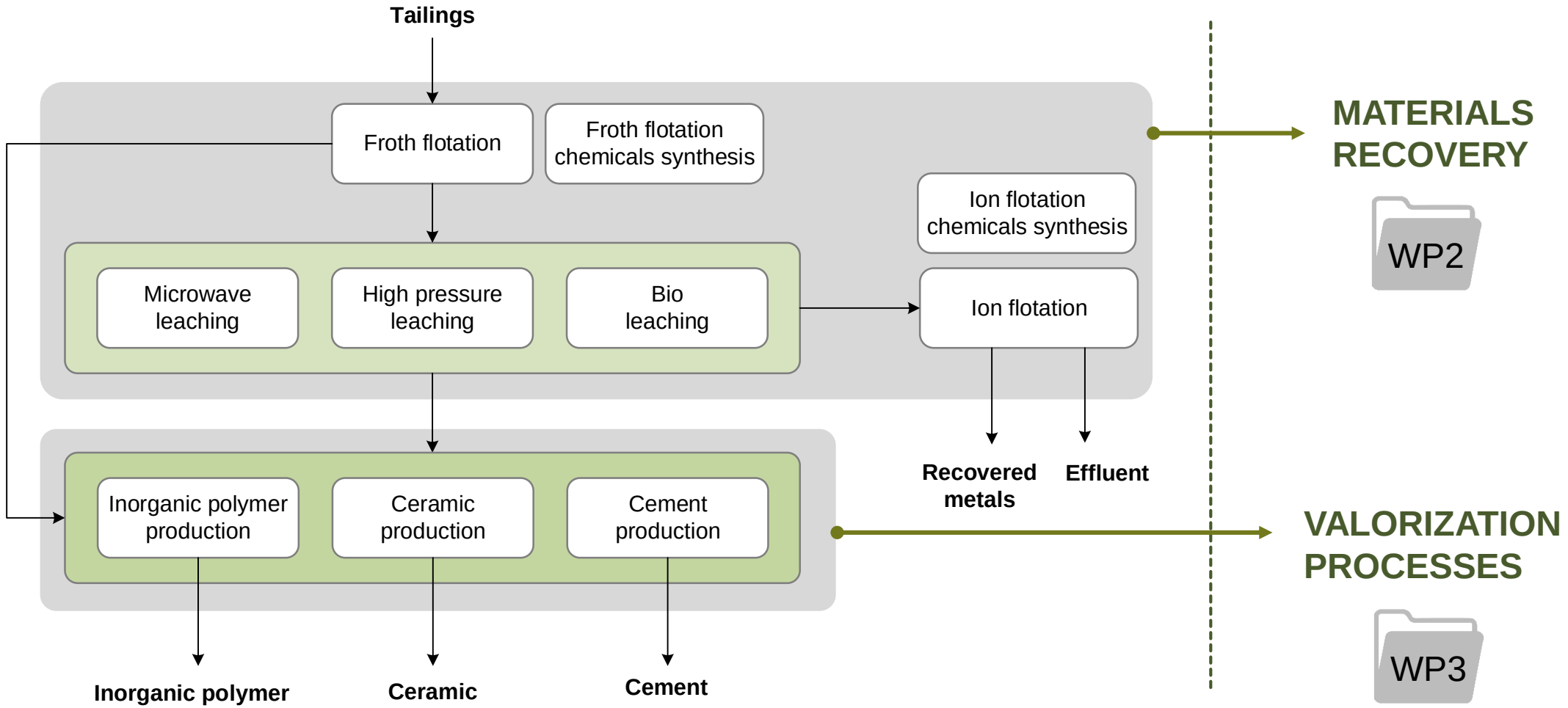
Cu Zn Pb others

Mining from tailings

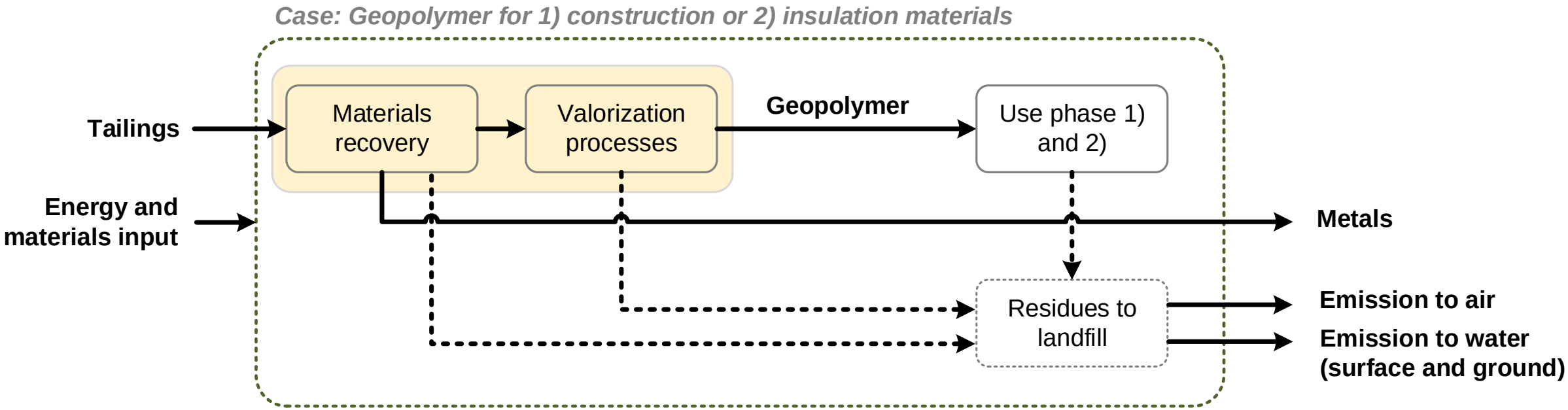
Application of upcycled minerals

1. Inorganic polymer
2. Ceramic
3. Cement

Metallurgical processes involved in SULTAN project



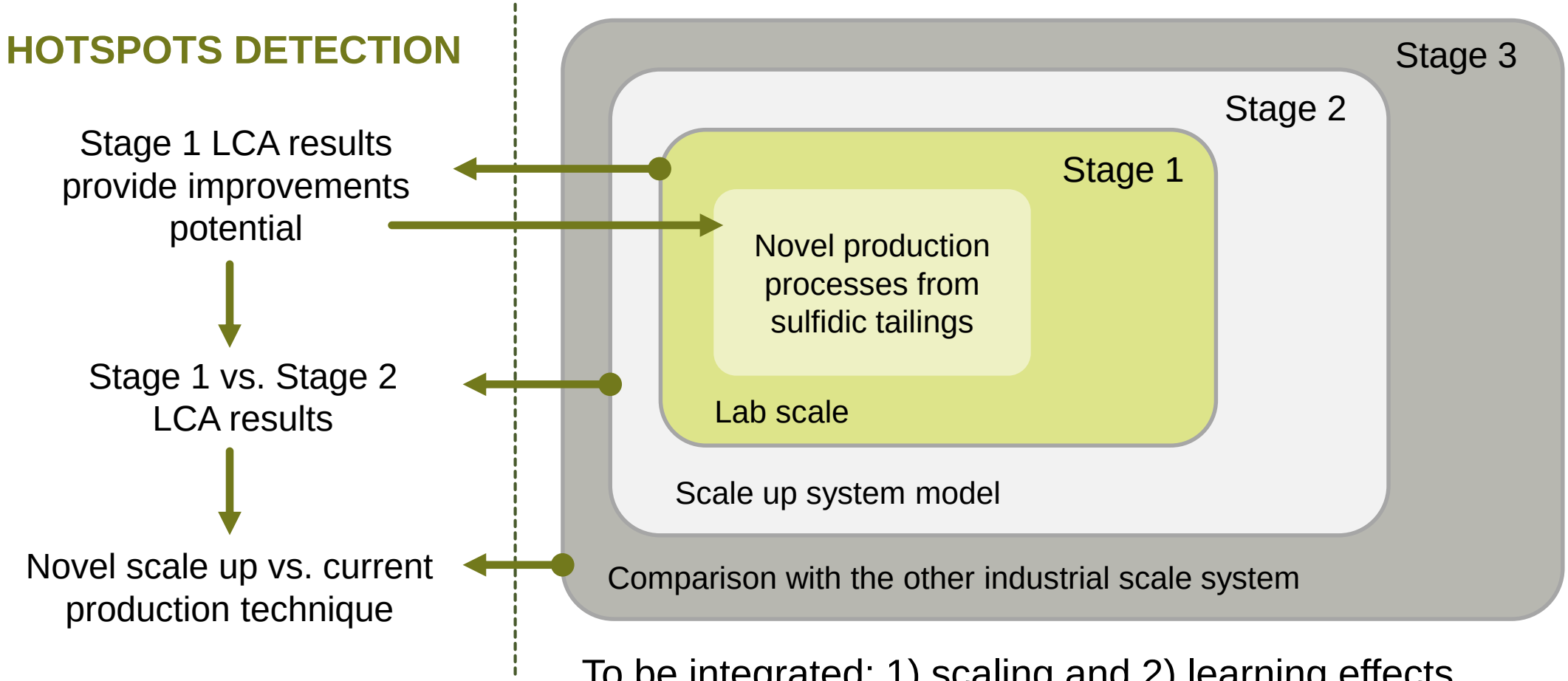
Example of route: geopolymer manufacturing



Possible scenarios:

1. Tailings to building construction material (cement replacement)
2. Tailings to insulation material (brick)

Upscaling – Prospective LCA



To be integrated: 1) scaling and 2) learning effects (Caduff, 2013)

Goal: inventory of each metallurgical process (input – output)

Expected results:

- Detection of hotspots to direct improvements in process design

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Summary and outlook

- Constructing tailings emission model
  - Site and tailings characteristics

- Fate transport model of tailings emission
- Selection of LCIA methods
- How to include uncertainty in LCA

Your inputs are welcome

ETH zürich

Thank you, ESD

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