CEReS -Co-processing of Coal Mine & Electronic Wastes: Novel Resources for a Sustainable Future

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CEReS
Novel Resources for a Sustainable Future

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CEReS: Co-processing of Coal Mine and Electronic Wastes

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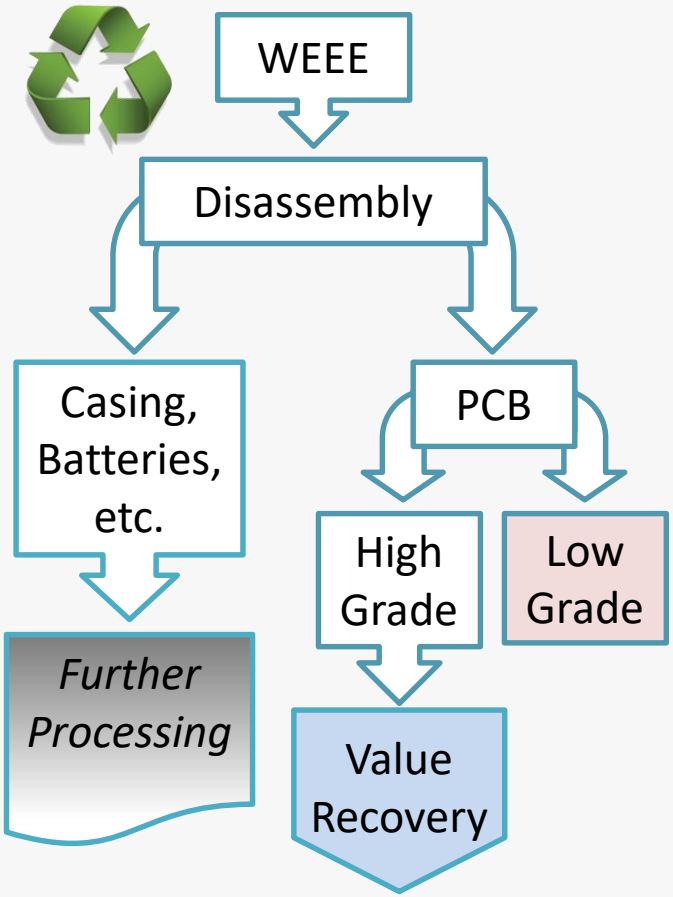
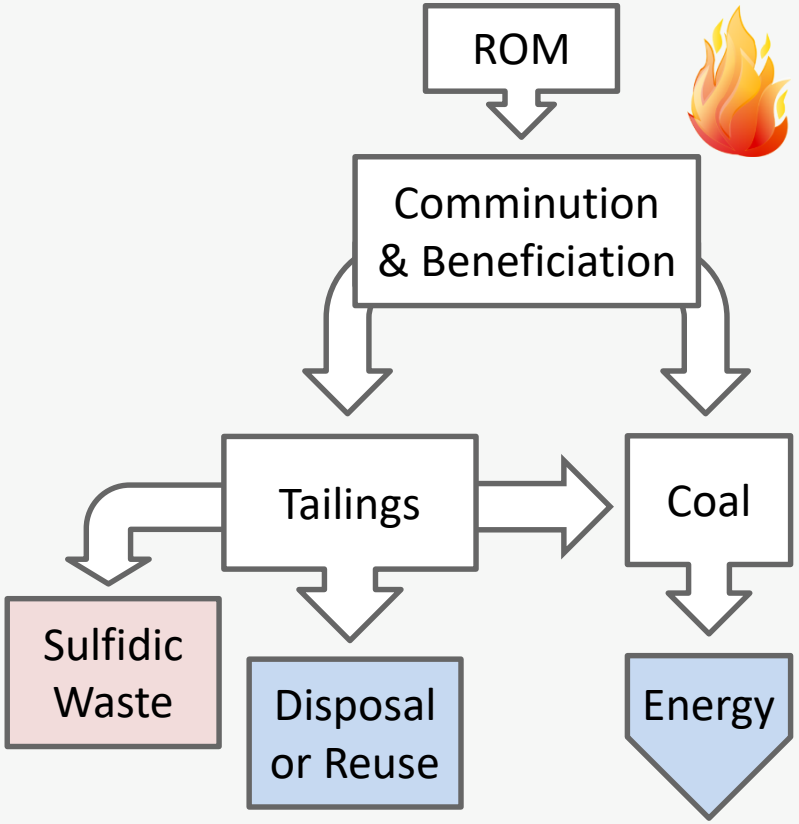
Research Fund for Coal & Steel

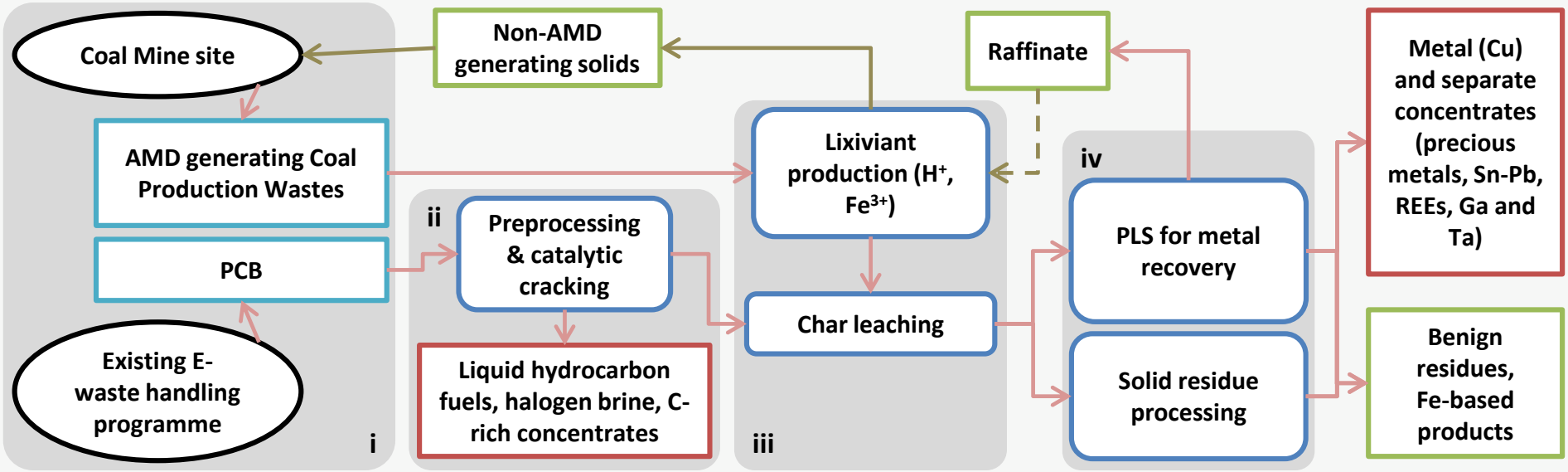
University of Exeter · brgm Geoscience for a sustainable Earth · GeMMe Université de Liège · GIG · TAURON Wydobycie · Caspeo · comet traitements · University of Cape Town · Universiteit van Pretoria · University of York

Industrial Ecology & Symbiosis





Integrated Process



Key Details

- Received funding from the Research Fund for Coal and Steel (RFCS)

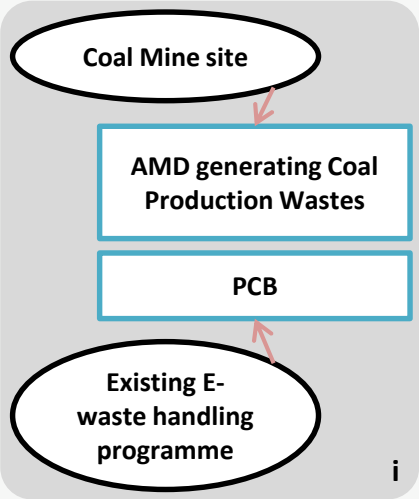
- Three-year R&D project from June 2016; project budget ~3.2M€

- Eight partners from five countries
  - University of Exeter (Coordinator) UK
  - BRGM; Caspeo FR
  - Université de Liège; Comet Traitements BE
  - GIG; TAURON Wydobycie PL
  - University of Cape Town RSA

Key Details

- Use Poland as case study region
- Prove technical feasibility of individual unit processes
  - At (mini) pilot-scale
- Integrate through modelling and simulation
  - Demonstrate viability of concept
  - Include economic assessment
- Evaluate environmental benefit vs “do nothing” scenario
  - LCA

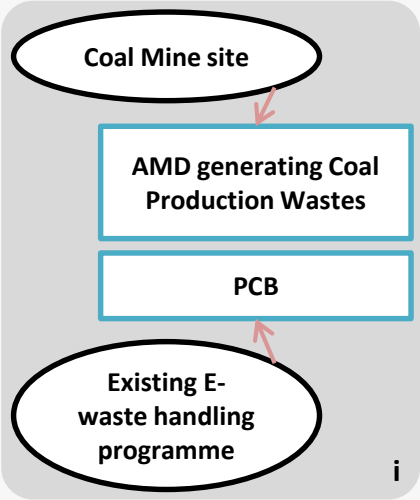
Raw Materials



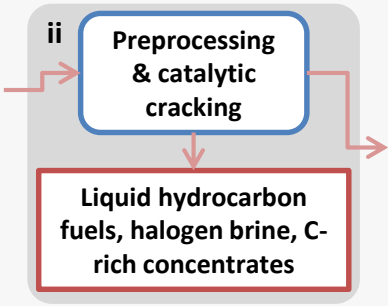
- Analysed four coal waste streams
  - Selected Janina Spiral Tails (~12% Py)
  - Detailed mineralogical characterisation
- Bioprospecting
  - Two bioleaching consortia (30°C & 48°C)
  - Microbial ecology of Janina waste dump (NGS)
- Characterised AMD-generating potential
  - “Missing Acid” question…

Raw Materials

- Analysed WEEE processing in Poland
  - Three PCB categories; selected low-grade
- Not as required; ~35% PCB
  - use Comet own stock
- Detailed characterisation & analysis
  - Metal/value breakdown
  - Au and PM highest values; Cu significant.
- Produced database and cross-map.



Catalytic Cracking



- Adaption of Comet's pyrolysis process to PCB
  - Initial orientative bench-scale tests
  - Pilot scale tests – Phoenix reactor
- Produced and characterised char and hydrocarbon outputs
  - ***Hydrocarbon*** – 18% original mass; requires removal of Si prior to use in co-generation engine
  - ***Char*** – four size categories: +8 mm; 2-8 mm; 75 µm-2 mm; -75 µm
  - ***Bromine*** – 74% recovered in quench water
- >90% Ag, Au and Cu concentrated in two fractions
  - ~47% input; concentration factor ~2

Catal

-
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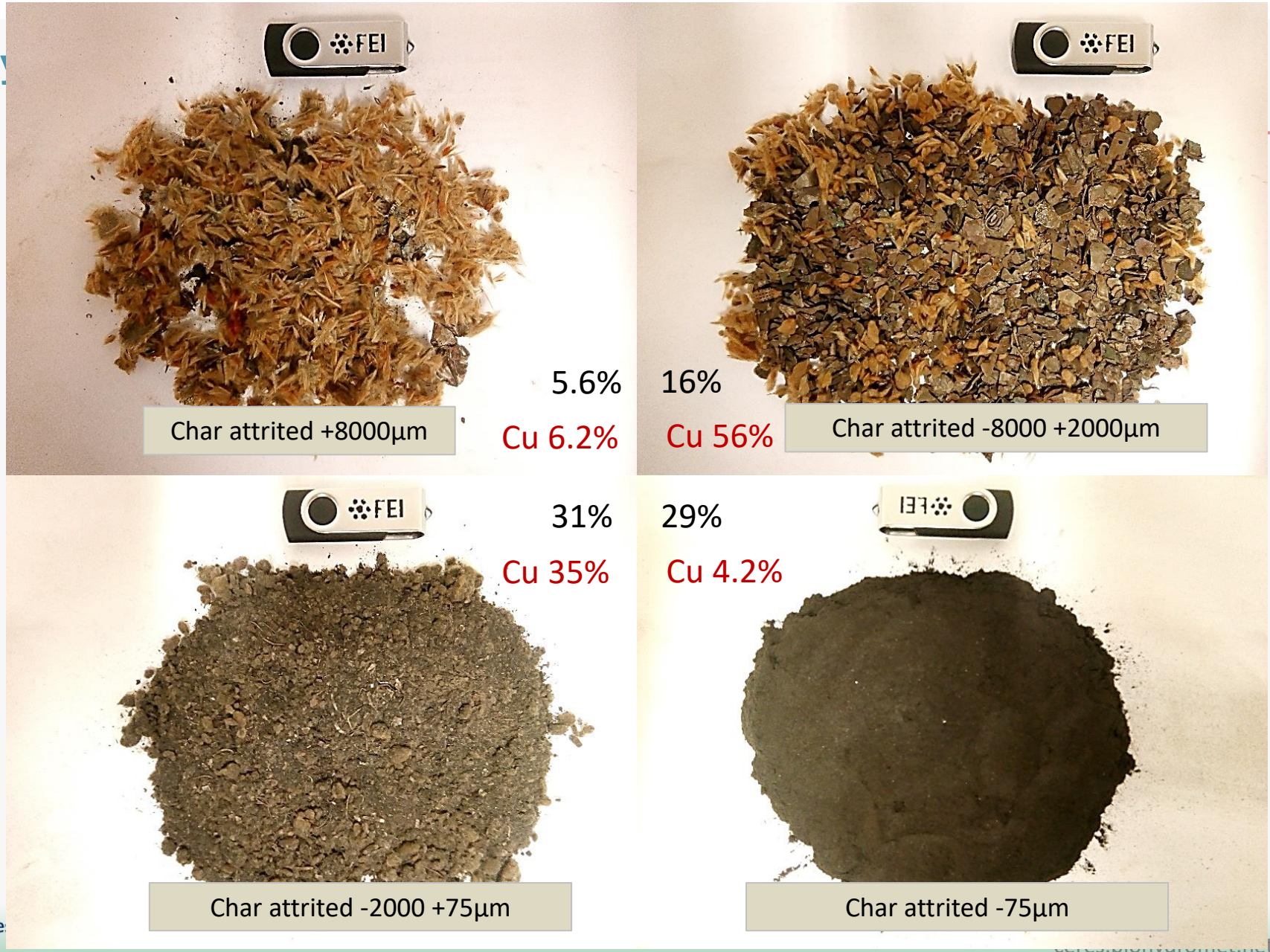
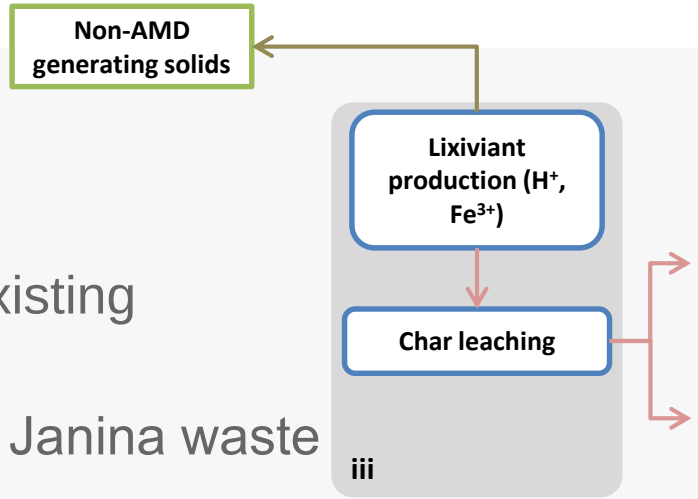
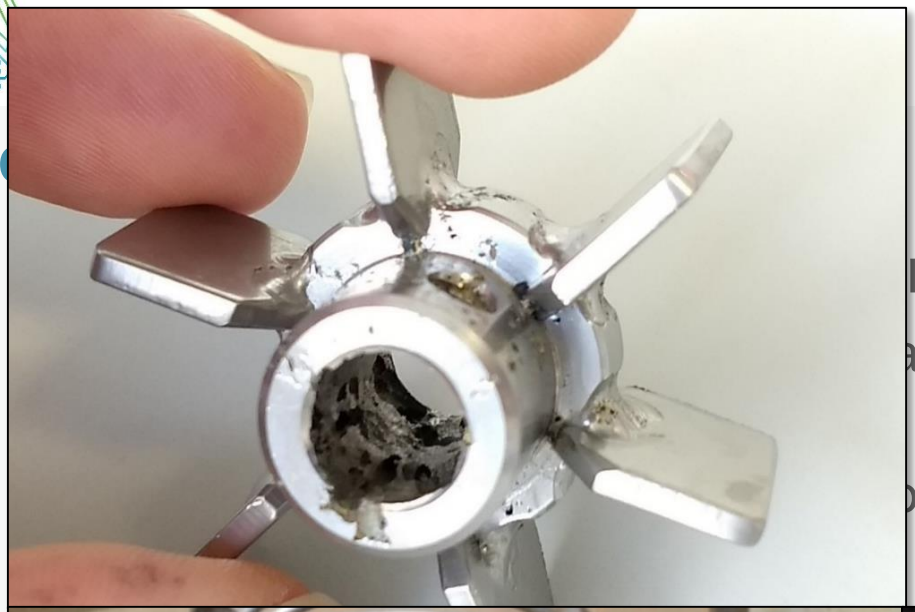

5.6%
Cu 6.2%
Char attrited +8000µm
16%
Cu 56%
Char attrited -8000 +2000µm
31%
Cu 35%
Char attrited -2000 +75µm
29%
Cu 4.2%
Char attrited -75µm

Coal Waste & Char Leaching



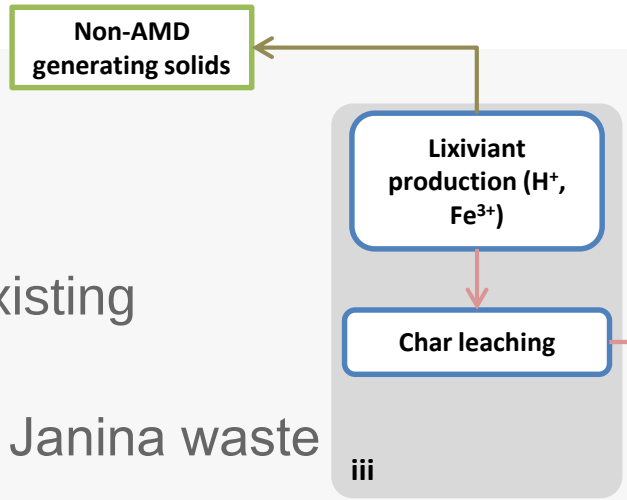
- Selection of bioleaching consortia
  - Two enriched from Janina waste, two existing bioleaching consortia
  - Selected 48°C “TW48” consortium from Janina waste
- Biolixiviant capable of leaching char
- Huge problem with corrosion
  - caused by Cl content of waste…
- Decide on appropriate strategy
  - washing or using different waste?



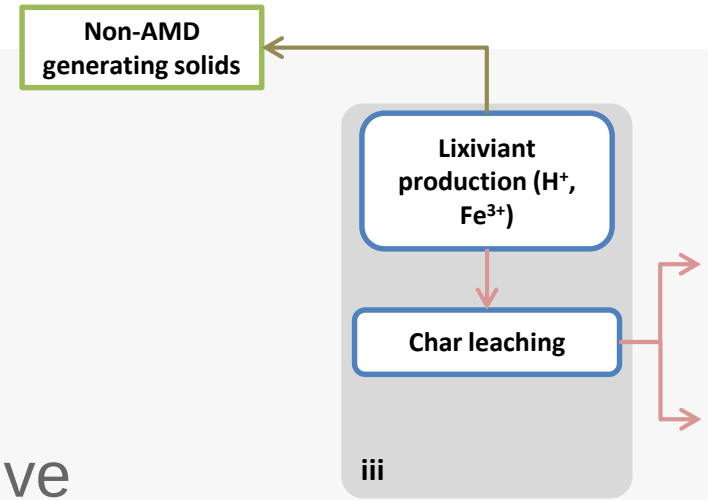
nsortia

aste, two existing

ortium from Janina waste



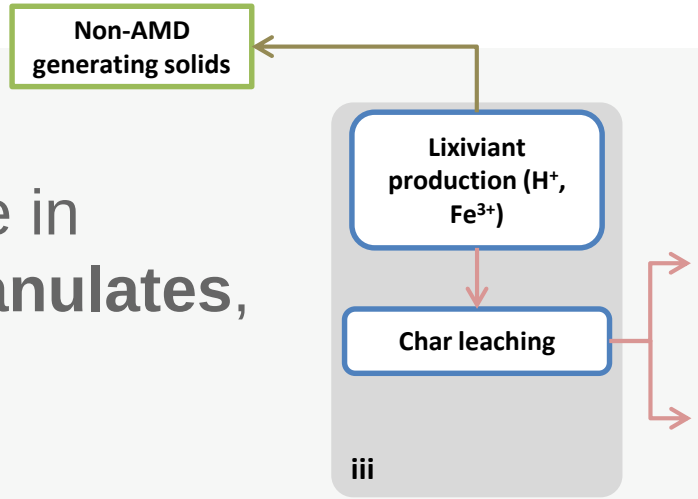
Coal Waste & Char Leaching



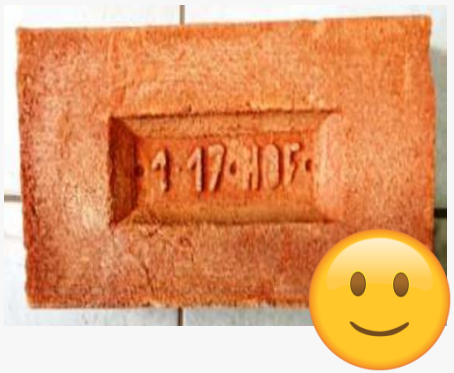
- Improved environmental stability of bioleached coal waste
- Geochemical modelling + Quantitative mineralogy to investigate “missing acid” phenomenon
  - Biokinetic AMD test provides useful additional information
- Potential issue of latent acidity…

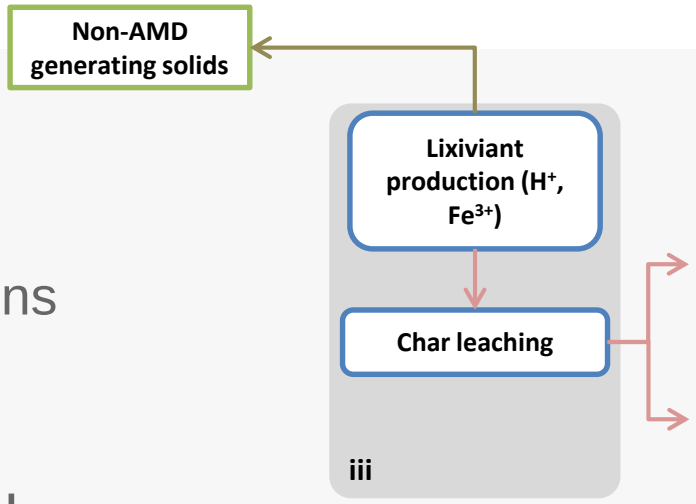
Coal Waste & Char Leaching

- Possible reuse of fine-grained waste in production of **ceramic** products, **granulates**, **concrete** products



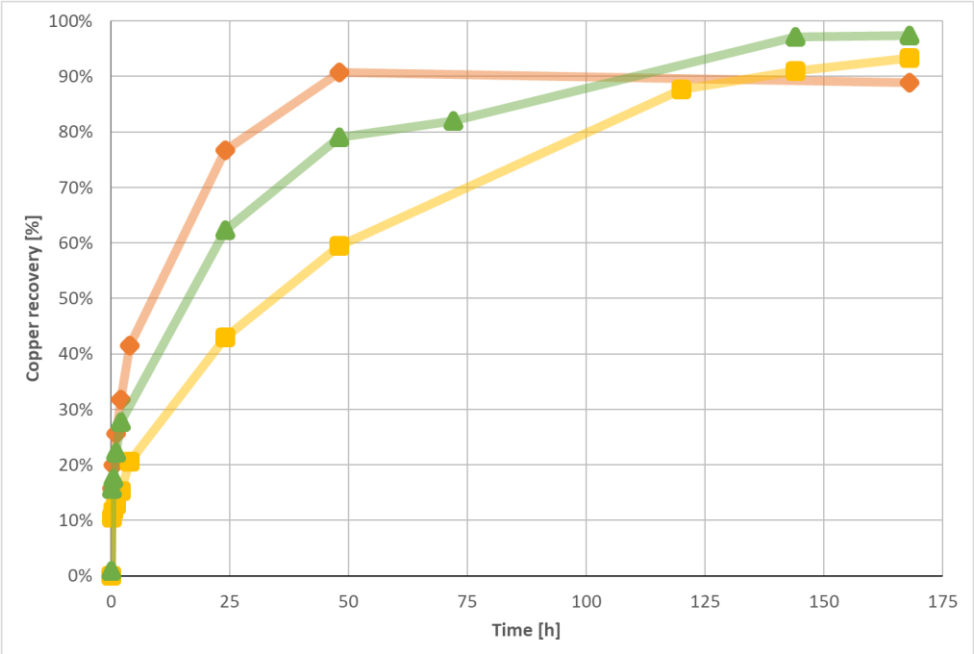
ceramic products	*production of granulates*	*concrete products*	*polymerconcrete*





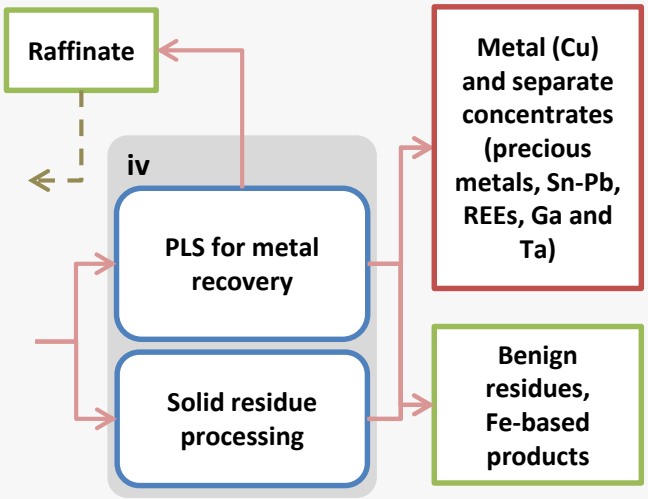
Coal Waste & Char Leaching

- Char leaching options tested
  - Reactor type, design, operating conditions
  - Char pre-processing
- Char leaching can result in 100% Cu dissolution
  - Colonisation of char leaching reactor possibly beneficial
  - Bi-phasic…



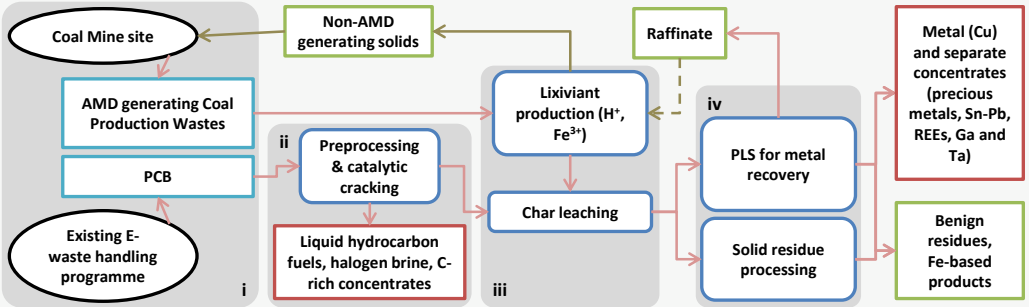
Refining of Products

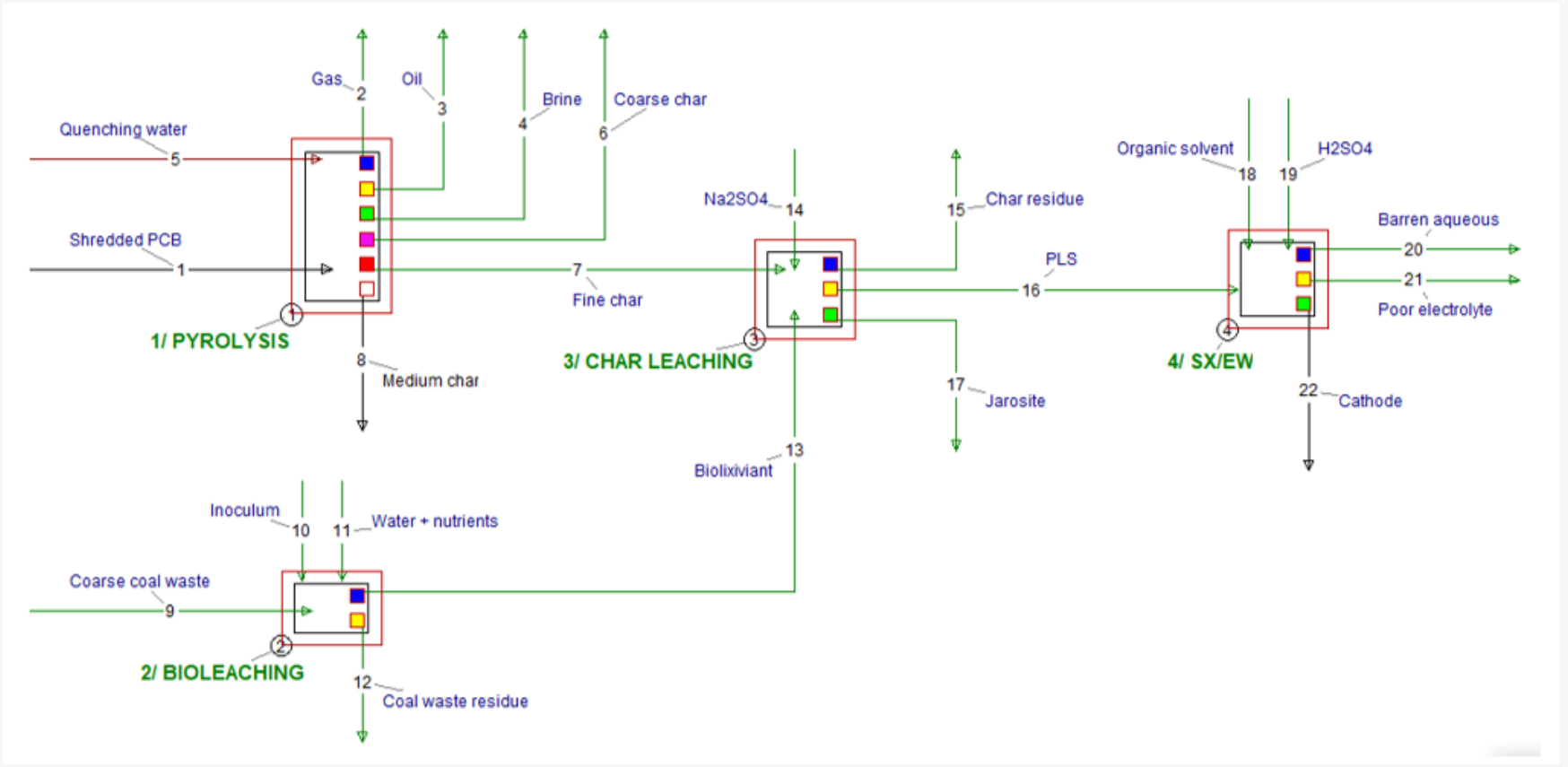
- Selected Acorga for SX due to high selectivity
- Iron management possible via precipitation of jarosite and conversion to hematite
- Only able to valorise Cu within the scope of the project
  - Work required to recover PM



Process Integration

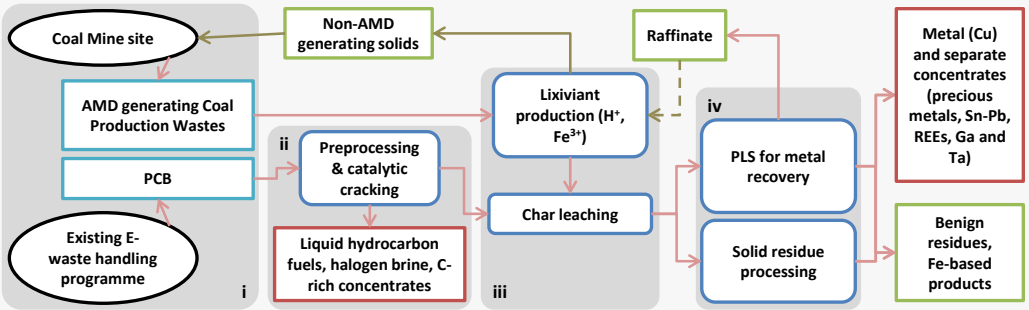
- Process simulator compiled in USIM PAC

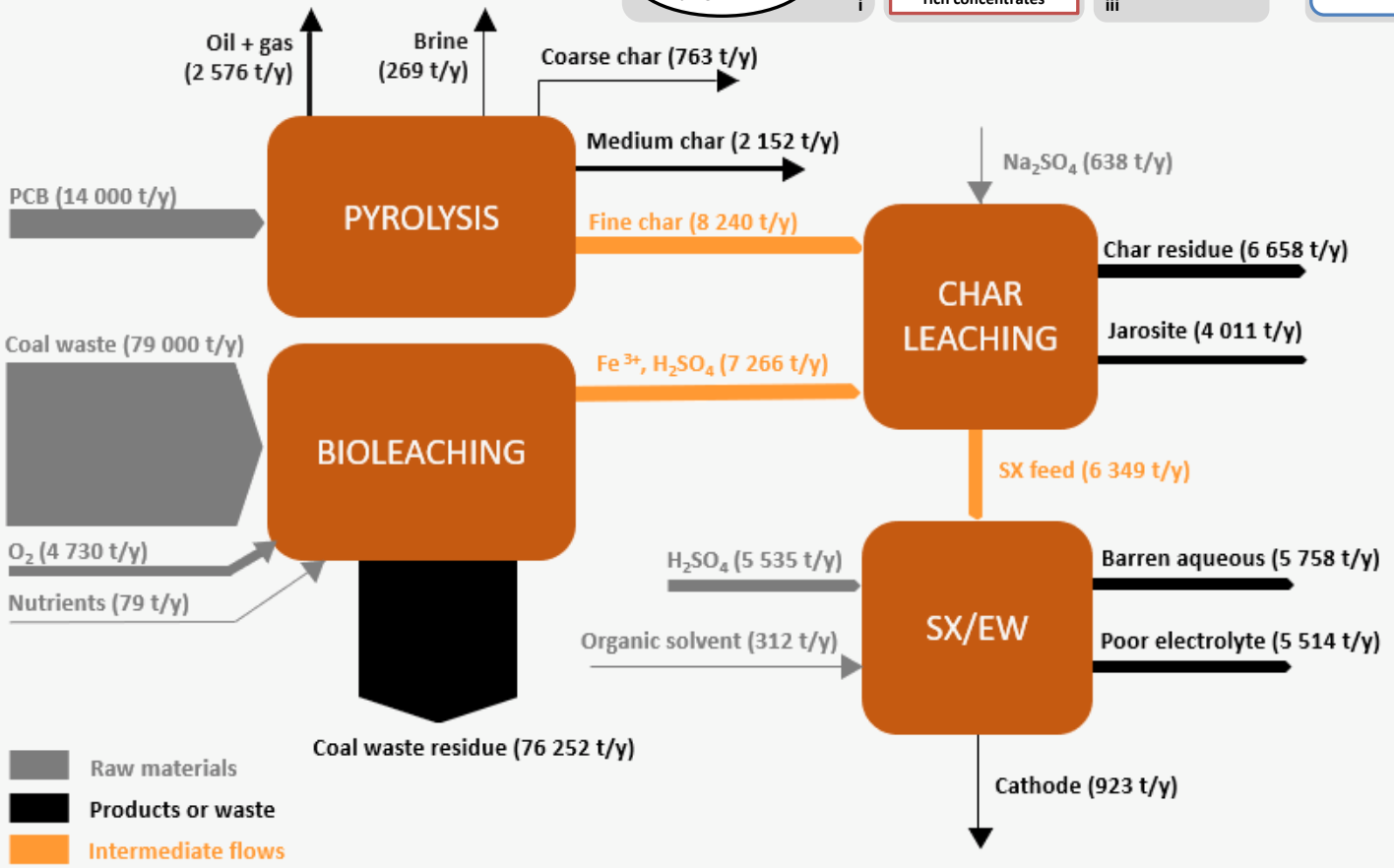




Process Integration

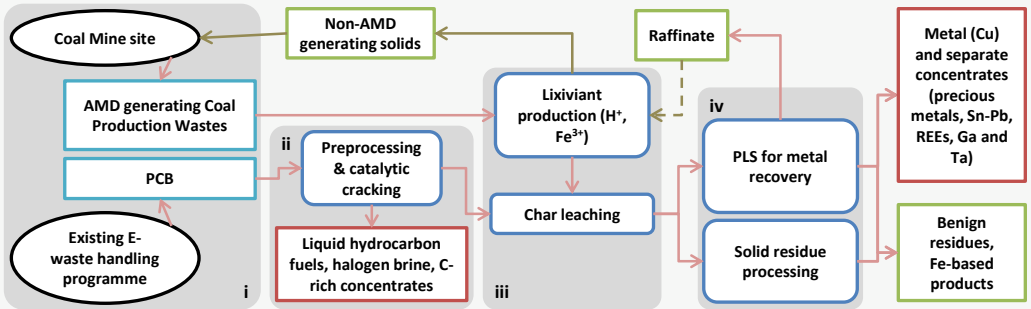
- Evaluate & compare different scenarios





Process Integration

- CEReS does not make money ***if***…



- Cost of PCBs based on market value (Umicore)
- Coal waste cost-neutral
- Stabilised (bioleached) coal waste has no value

BUT…

- LCA analysis shows significant benefit of CEReS process over the do nothing (business as usual) scenario (for majority of impact categories)

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ありがとう
Thank You, Merci, Dziękuję, Dankie

ceres.biohydromet.net

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