CHROMIC

This project received funding from the European Union's **Horizon 2020 Research and Innovation** program under **Grant Agreement n° 730471**

Efficient mineral processing and hydrometallurgical recovery of by-product metals from low-grade metal containing secondary raw materials

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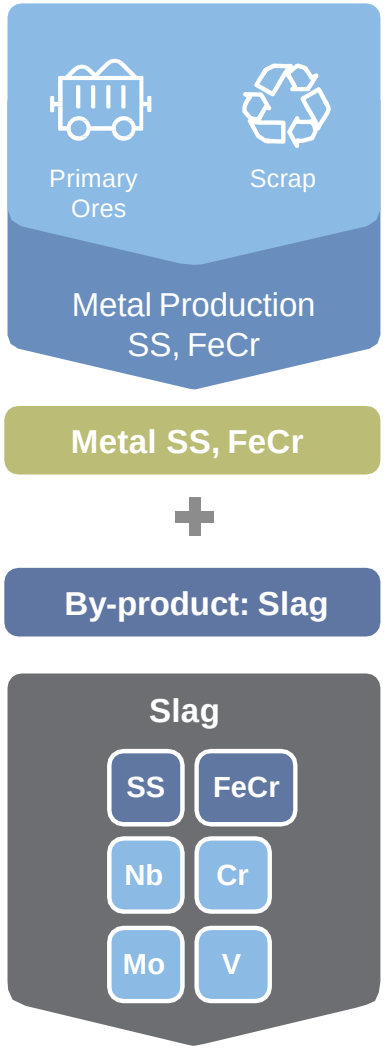
VITO NV

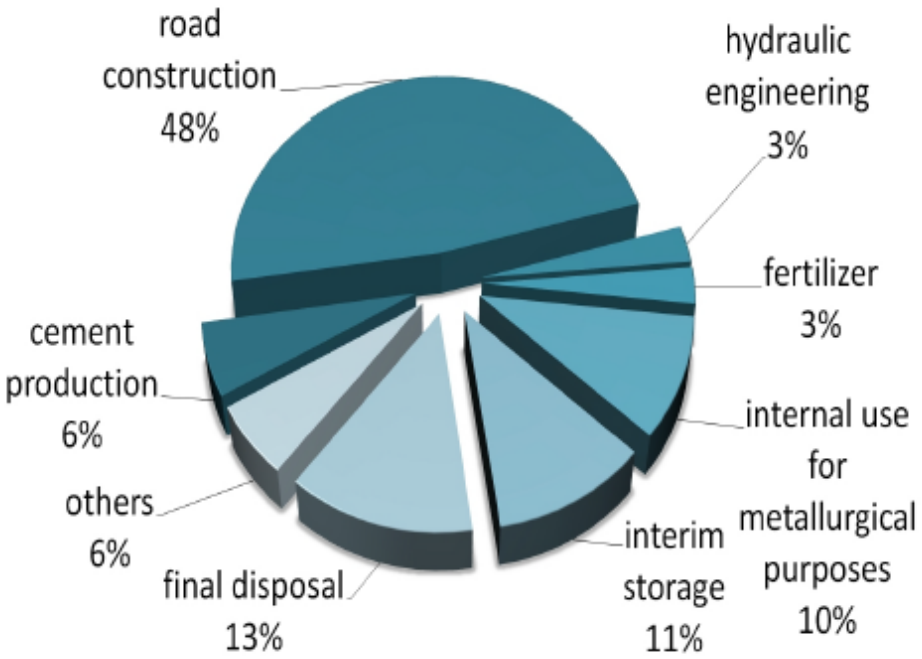
Introduction

Current System



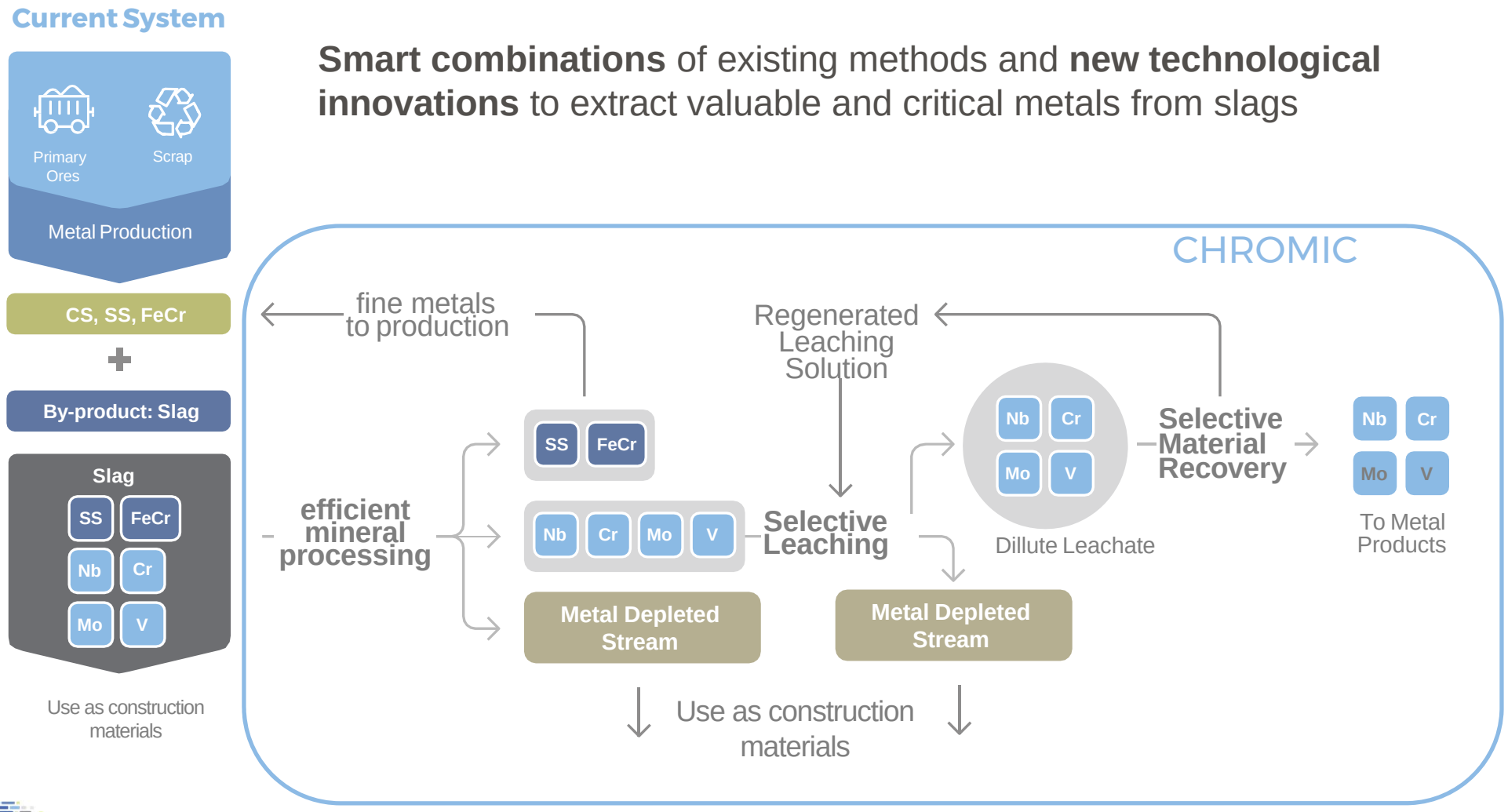
	Production Europe	Metal content
Stainless steel slags	1.8 Mt/y	1-2 wt% Cr + 100- 500 ppm V, Mo, Nb
LC + HC ferrochrome slags	~6 Mt/y	2-10 wt% Cr
Carbon steel slags	~20 Mt/y	1-3 wt% Cr + 100- 500 ppm V, Mo, Nb

Metal value currently lost!



Use of steel slags. Source: Euroslag, Statistics 2010

New recovery processes for critical and valuable metals



Smart combinations of existing methods and **new technological innovations** to extract valuable and critical metals from slags

CHROMIC

effiCient mineral processing and Hydrometallurgical RecOvery of by-product Metals from low-grade metal contaIning seCondary raw materials

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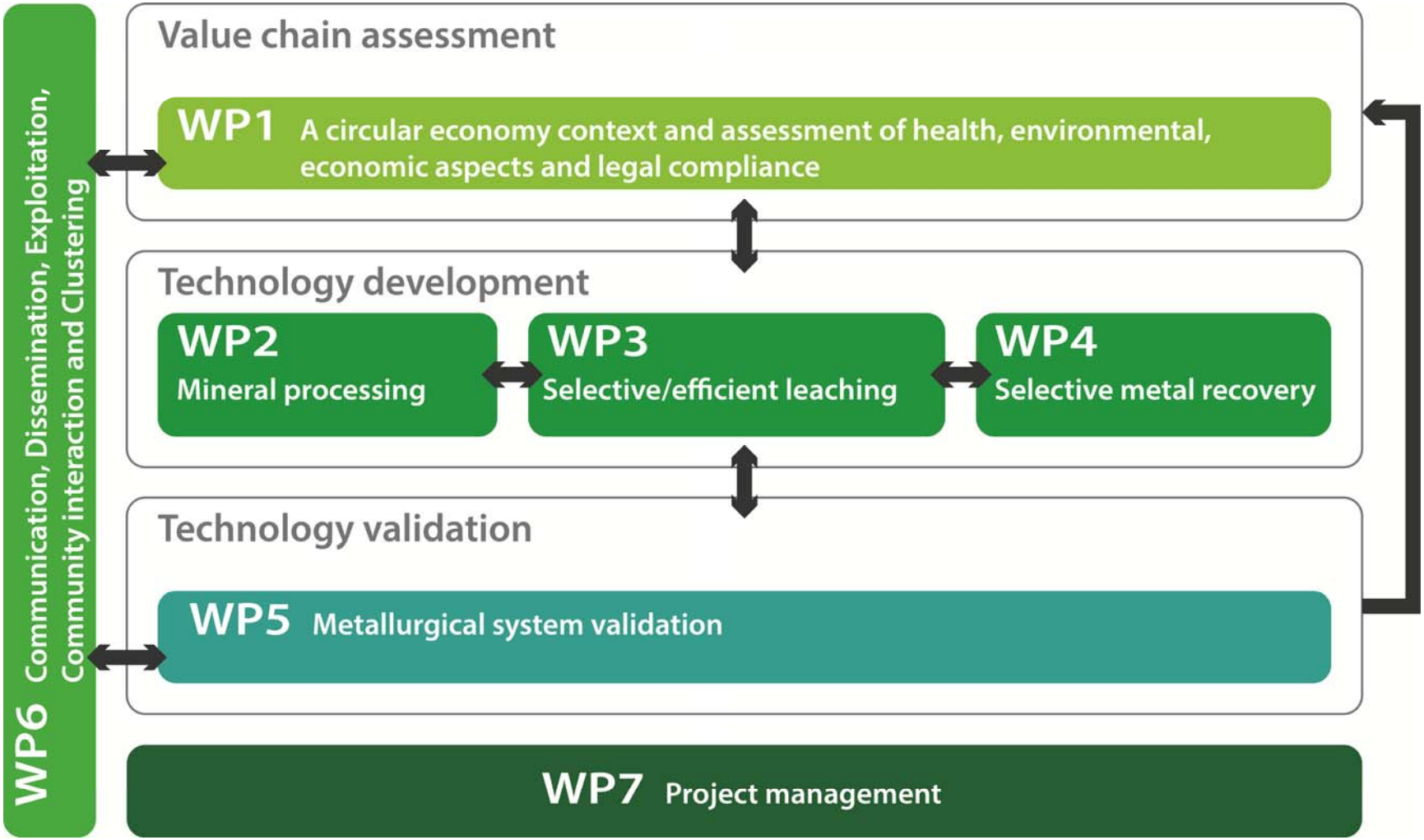
Type: H2020 RIA (Grant Agreement No. 730471)
Duration: 1 November 2016 – 31 October 2020
Budget: 4.8 M Euro

Coordination:

Liesbeth Horckmans, *VITO NV, Mol - Belgium*

CHROMIC work plan



CHROMIC materials

Three model streams

Carbon steel EAF slags
- 0-5 mm (photo)
- 20-40 mm
- 40-185 mm

LC ferrochrome slags
Crushed and sieved
to 4-9 mm

Stainless steel slags
< 0.5 mm

Potential for replication to other streams

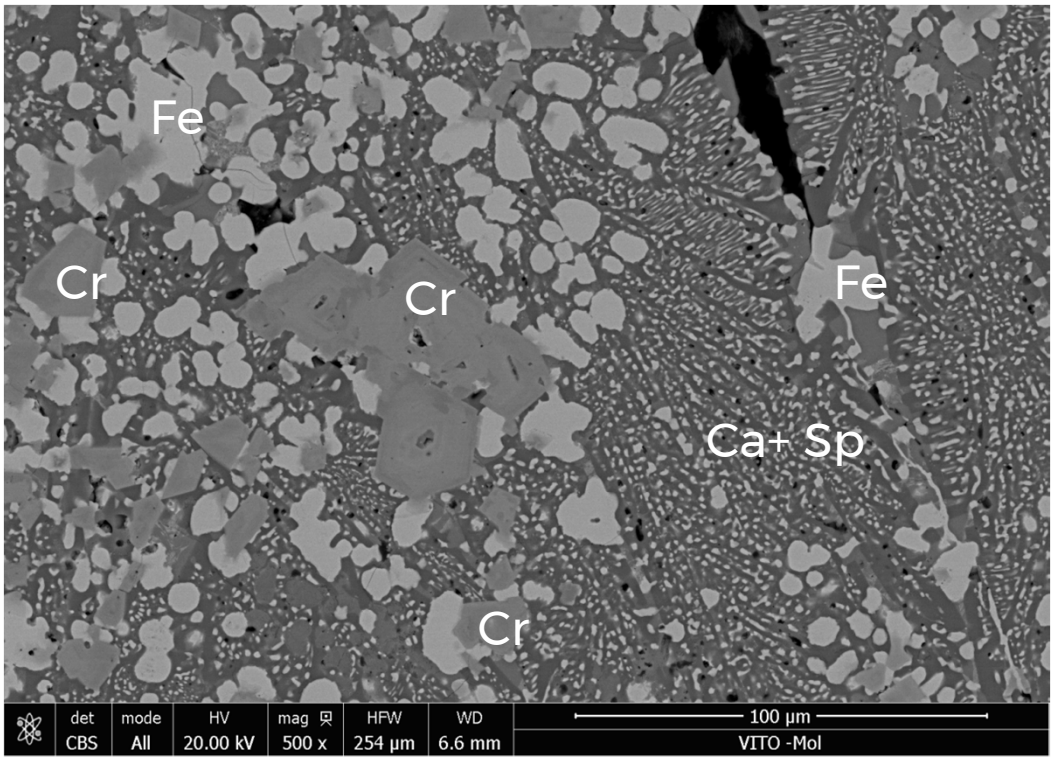
CHROMIC materials - Mineralogy

Challenge: metals (mainly Cr) present in stable phases

Material	Main minerals	Cr-rich phases
Carbon steel EAF slags	Ca-silicates (larnite, gehlenite), Fe-oxides (wuestite), spinel (Fe_3O_4, $MgFe_2O_4$)	Spinel ($MgCr_2O_4$)
Ferrochrome slags	Ca-silicates (merwinite, bredigite, larnite, gehlenite), spinel ($MgAl_2O_4$; $MgCr_2O_4$)	Ferrochrome particles, spinel $MgCr_2O_4$
Stainless steel slags	Ca-silicates (merwinite, bredigite, gehlenite, cuspidine), calcite	Spinel ($MgCr_2O_4$)

CHROMIC materials - Mineral liberation (SEM)

Challenge: complex matrix, small particle size



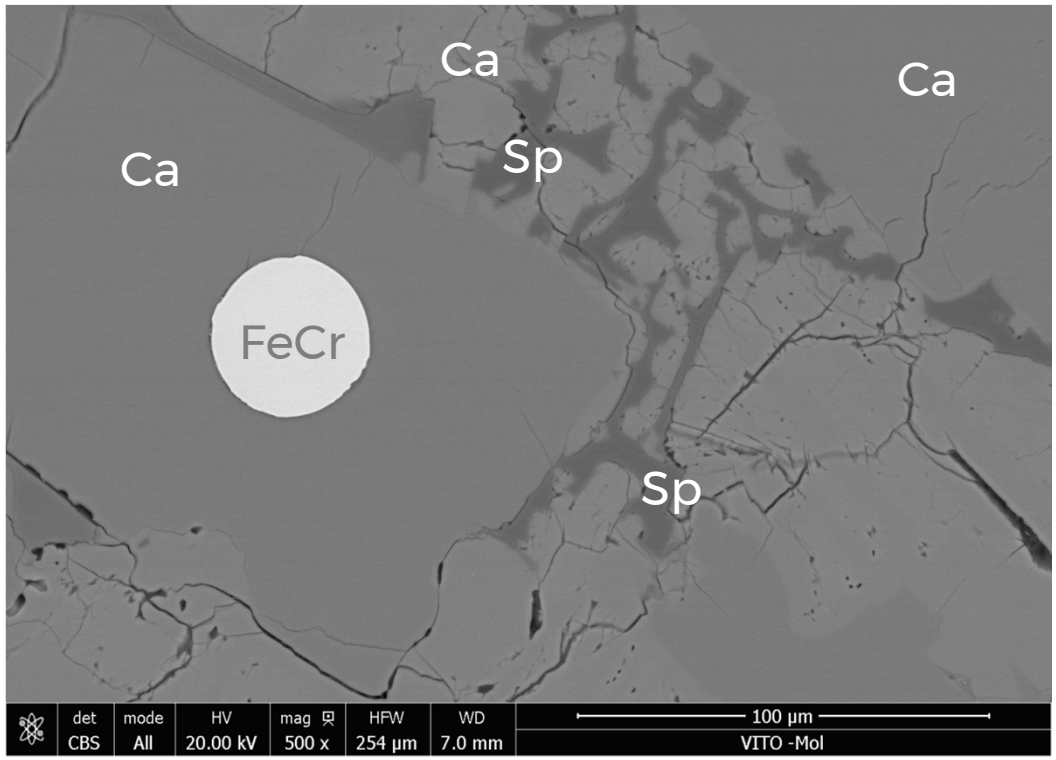
CS EAF slags

F: Fe-oxides
Ca: Ca-silicates
Cr: Cr-rich spinels
Sp: Al-spinels

Minerals intertwined at small scale (< 100 µm)
Distinct Cr-rich spinels present (10-100 µm)

CHROMIC materials - Mineral liberation (SEM)

Challenge: complex matrix, small particle size



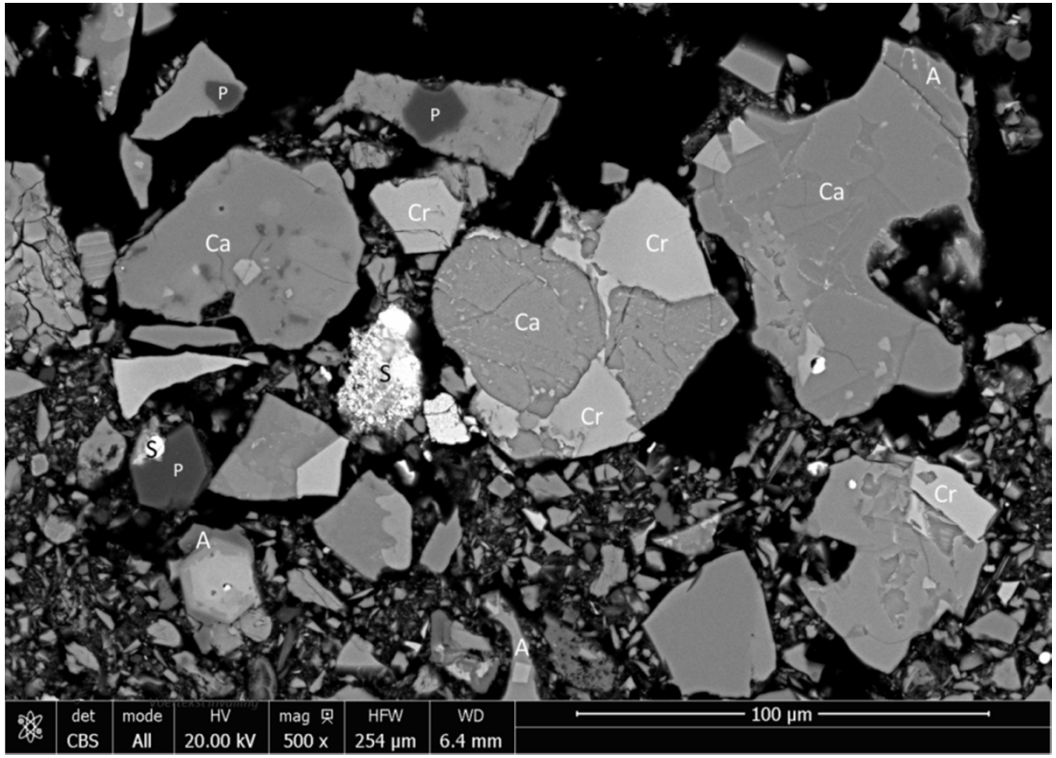
Ferrochrome slags

FeCr: ferrochrome metal
Ca: Ca-silicates
Sp: spinels containing Cr

Small metallic particles (20-40 µm) present in matrix of Ca-silicates and with intermingled spinels

CHROMIC materials - Mineral liberation (SEM)

Challenge: complex matrix, small particle size

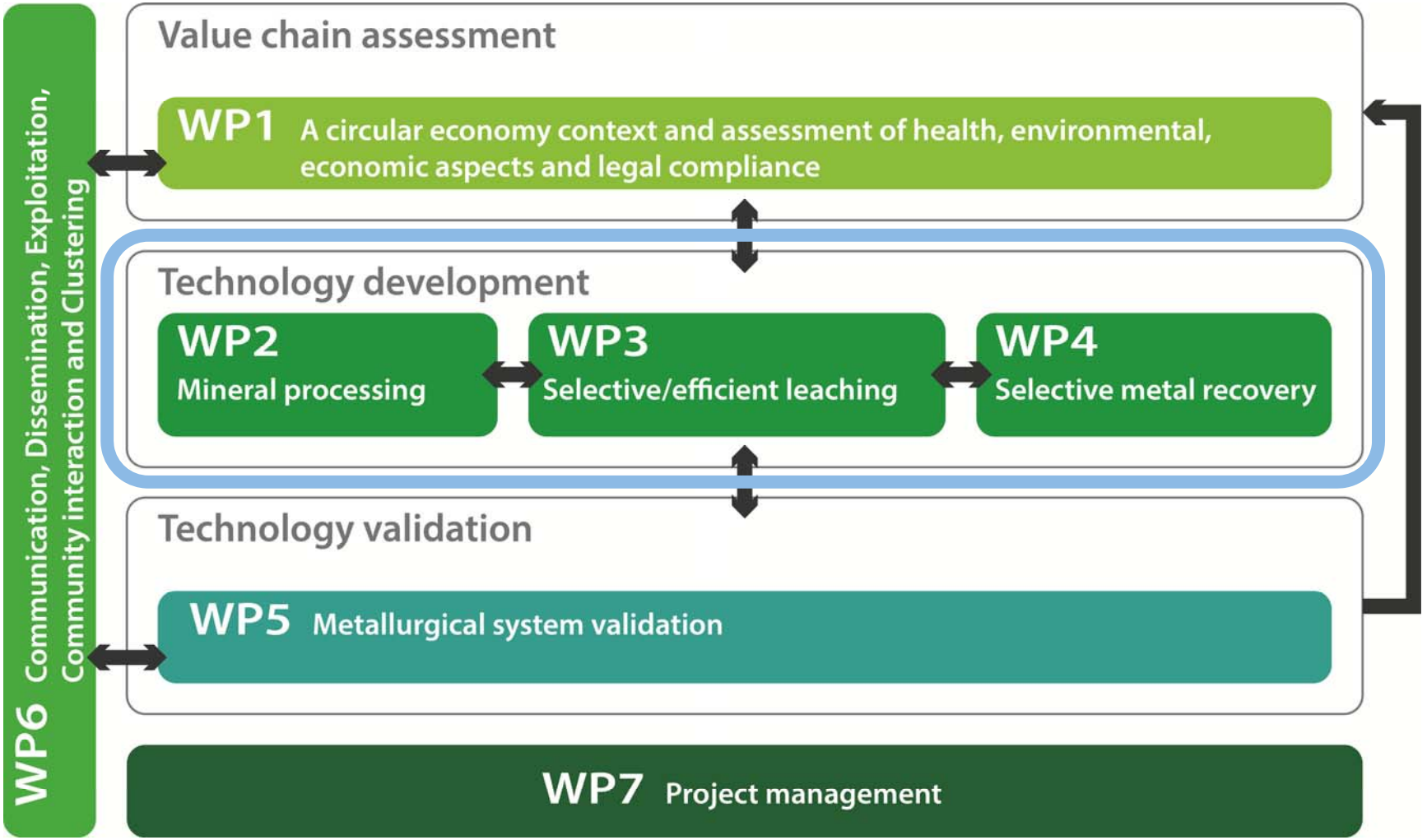


SS slags

S: SS metal
Ca: Ca-silicates
Cr: Cr-rich spinels
P: periclase
A: CaMg-silicates

Very small metallic particles (1-10 µm) present in matrix of Ca-silicates and with intermingled spinels

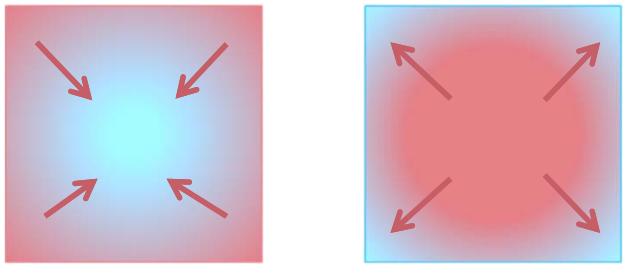
CHROMIC work plan



Technology development: Mineral processing

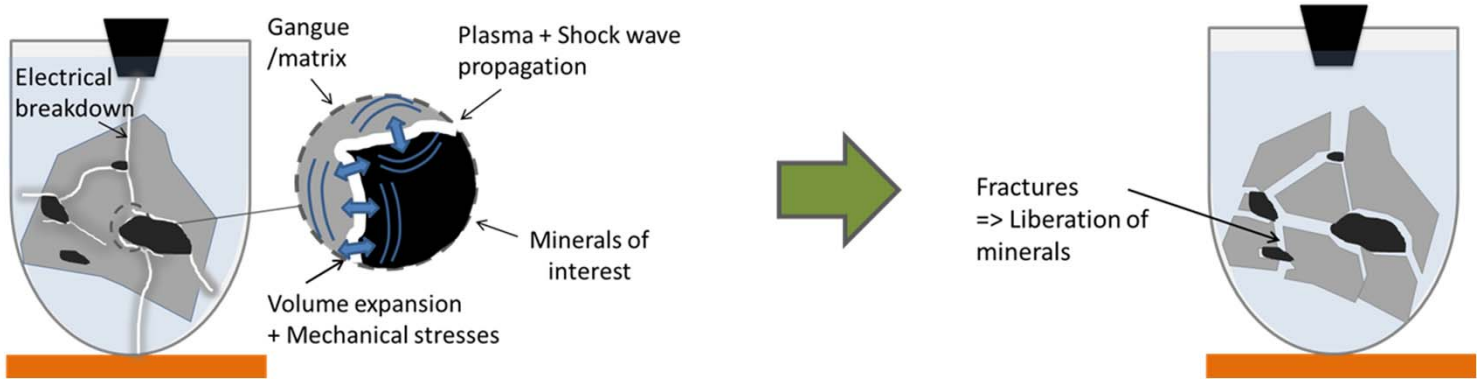
Cost-efficient, selective comminution and pre-concentration

- Microwave-induced cracking



Conventional vs. MW heating

- Electrodynamic fragmentation



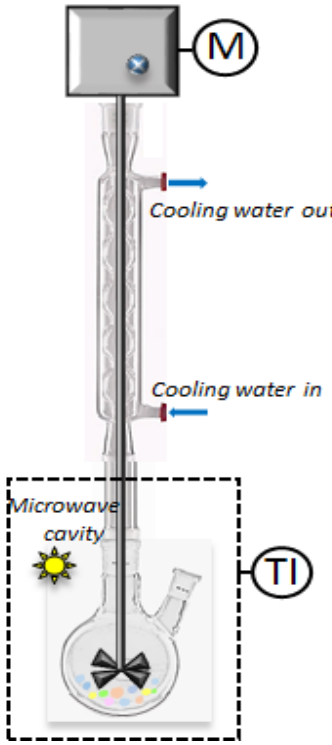
- Electrostatic, magnetic, enhanced gravimetric separation
- Flotation

Technology development: Selective leaching

Efficient recovery of target metals with minimal matrix dissolution

- Microwave/radiowave assisted leaching
- Traditional/MW roasting
- Ultrasound assisted leaching
- Atmospheric/ozonation leaching

Roasting oven

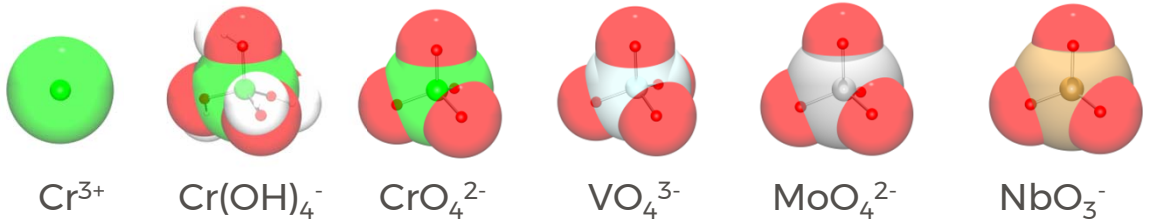


Microwave

Ultrasonic reactor

Technology development: Selective metal recovery

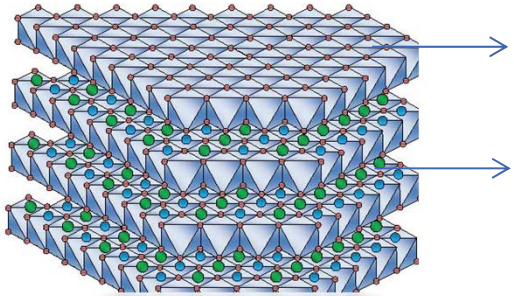
Efficient recovery of separate target metals from mixed solution



Selective precipitation

Novel sorbents

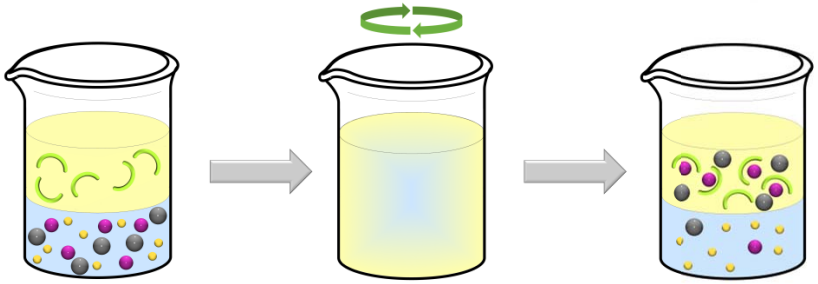
- Layered double hydroxides

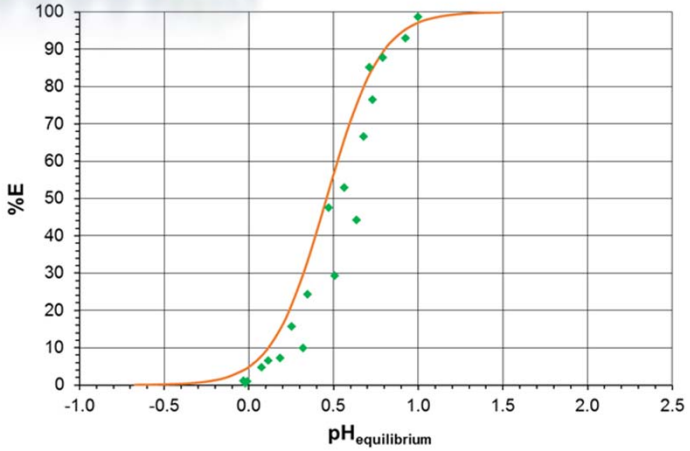


Layer: MgAl-, ZnAl-, MgFe- … LDHs;
Cationic ratio (Me^{II}/Me^{III} = 2, 3, 4…)

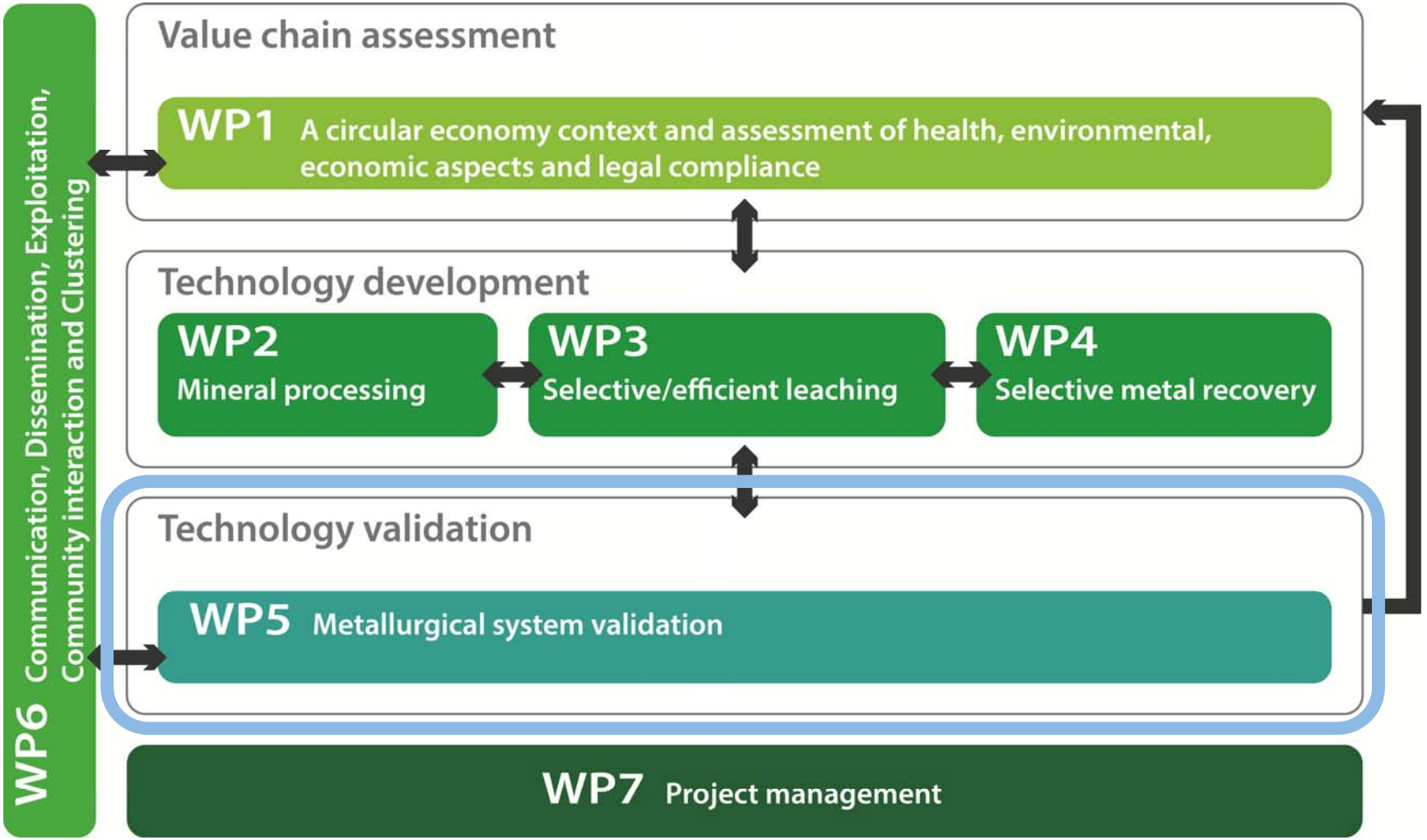
Interlayer exchangeable anions

Solvent extraction





CHROMIC work plan



CHROMIC – Metallurgical system validation

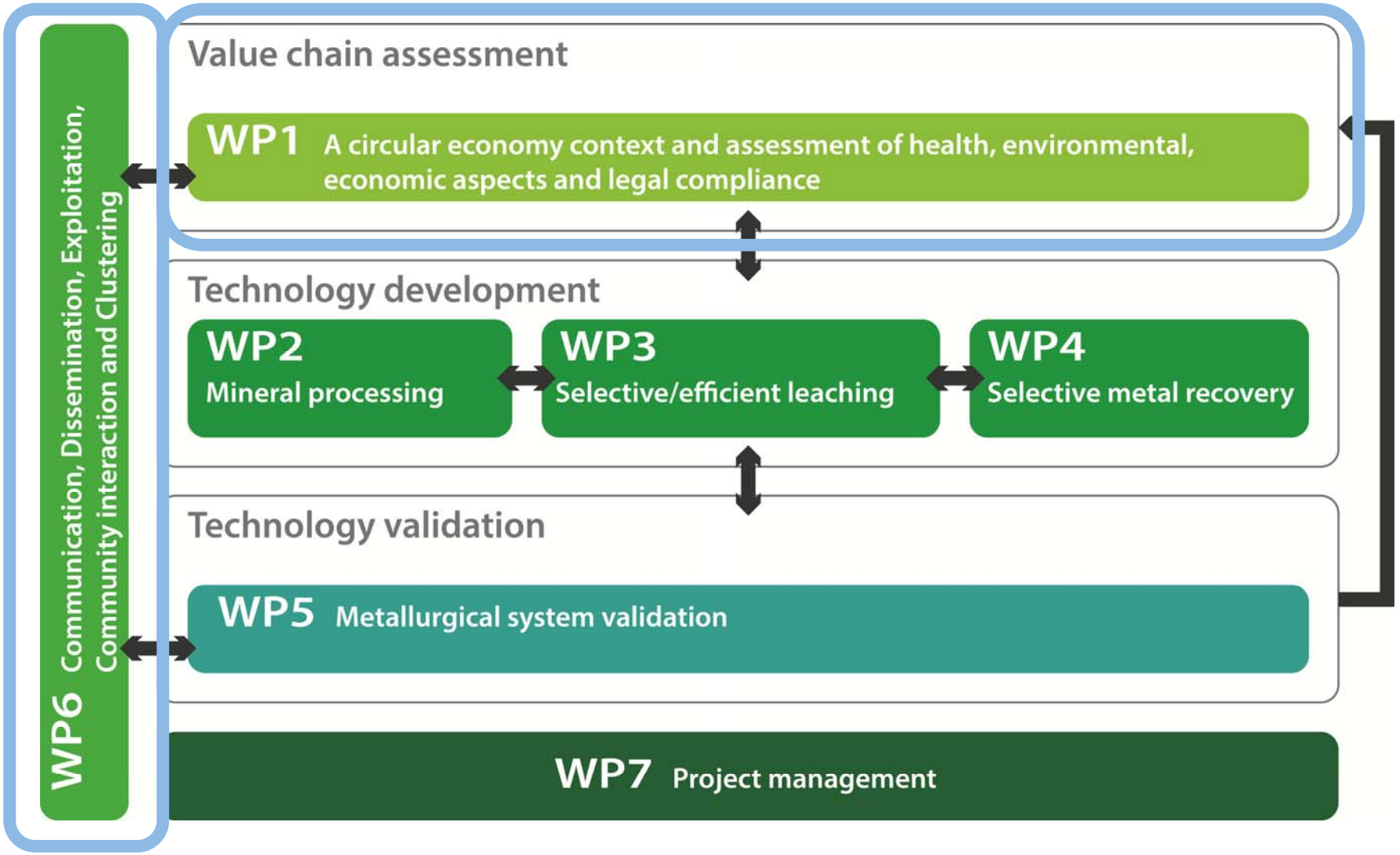
Upscaling + valorisation of solid residues

Carbonation

Briquetting

Pelletising

CHROMIC work plan

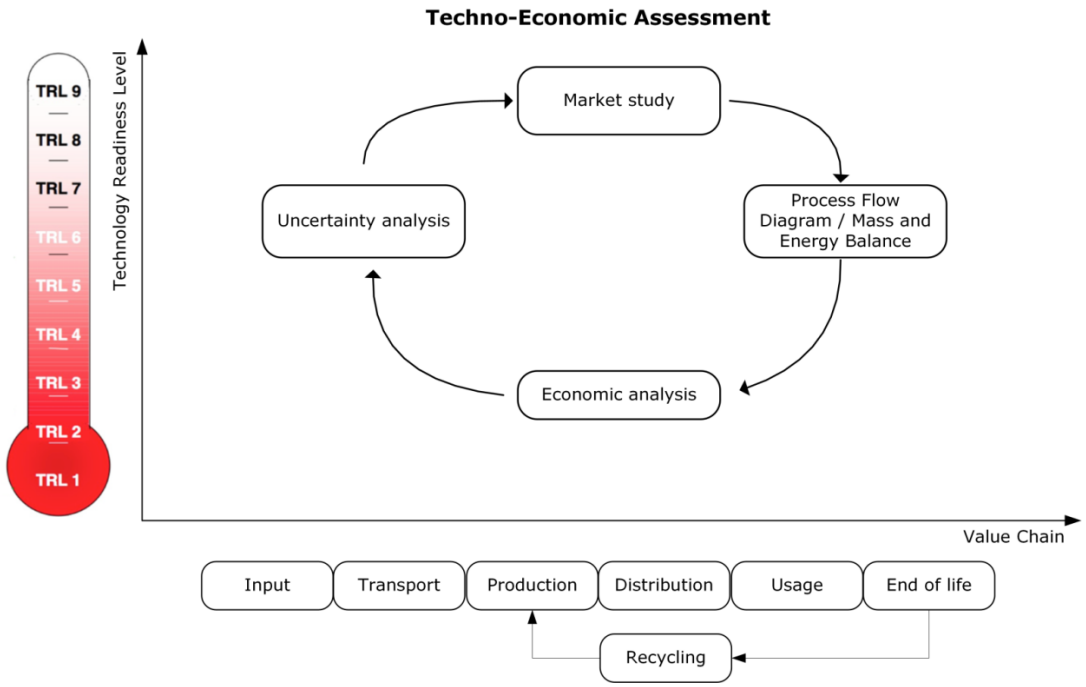


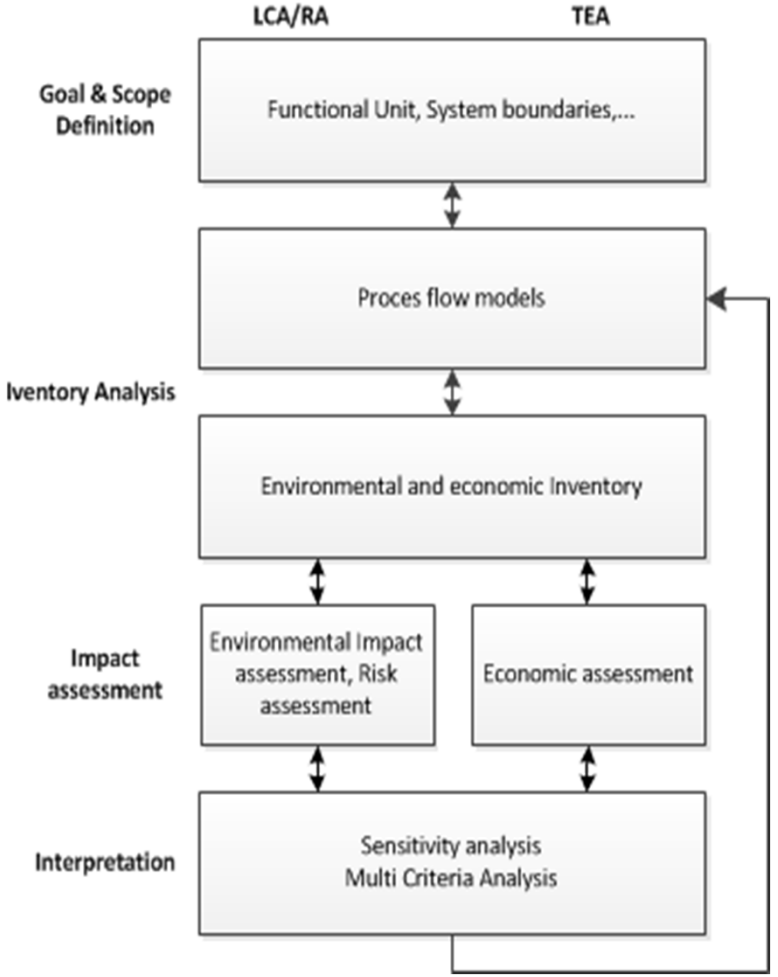
CHROMIC – value chain assessment

Circular economy context, integrated LCA-RA-TEA study

Iterative process

Aim: provide feedback to technology development





CHROMIC – community interaction

CHROMIC is an inclusive project

Community involvement in three waves:

- Focus groups: lay people -> be aware of key concerns for LCA-RA-TEA
  - Ongoing (Italy, Belgium completed)
- Stakeholders -> technical/legal concerns
- 3rd wave -> to be defined based on output first two waves

4 locations: Belgium, France, Germany, Italy

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