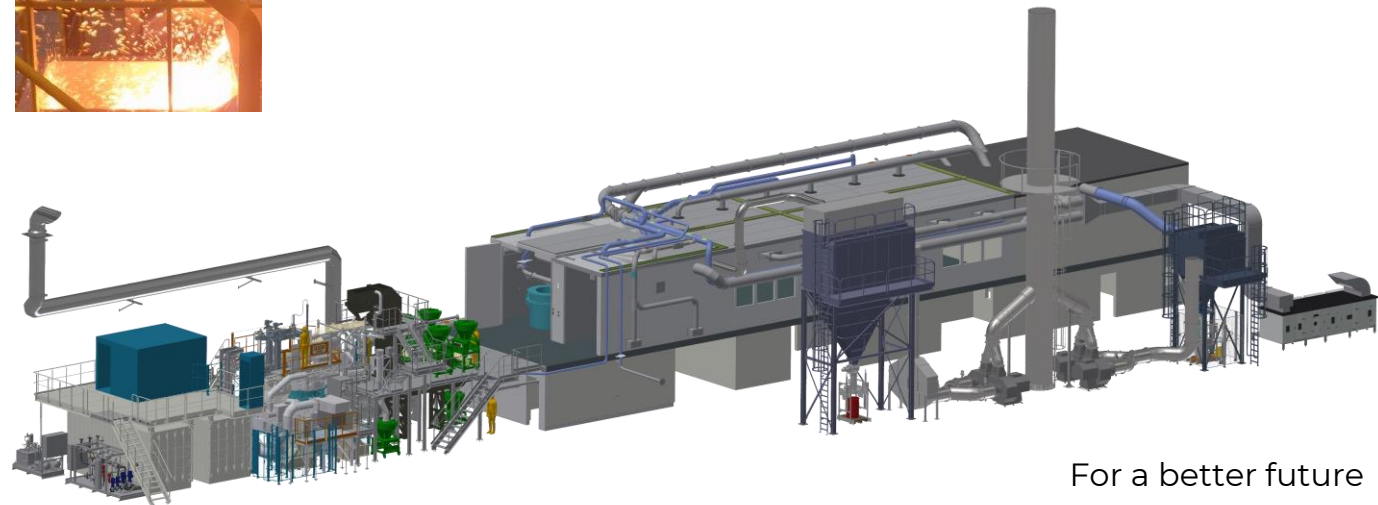


New pilot scale plasma furnace at the service of circular economy and energy transition

Bernard Vanderheyden, CRM Group



PROMETIA's 10th Scientific Seminar – Metnet session
Lisboa - November 30, 2023



For a better future

For a better future

CRM Group in a nutshell

- Independent RTO founded in 1948
- 290+ researchers
- Developing industrial solutions for process, product or applications involving metals in many sectors



- > 20 000 m² labs and pilot-scale facilities in Liège & Gent
- Global presence with activities & customers all over the world



- 45+ industrial members,
> 350 clients/year

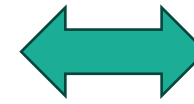


Metal recycling platform @ CRM Group

Real take-off in 2014... thanks to **Wallonia/EU** leveraging



Advanced Metal Recycling Processes and Technologies



2014 : U Liège and CRM among EIT RM founding members

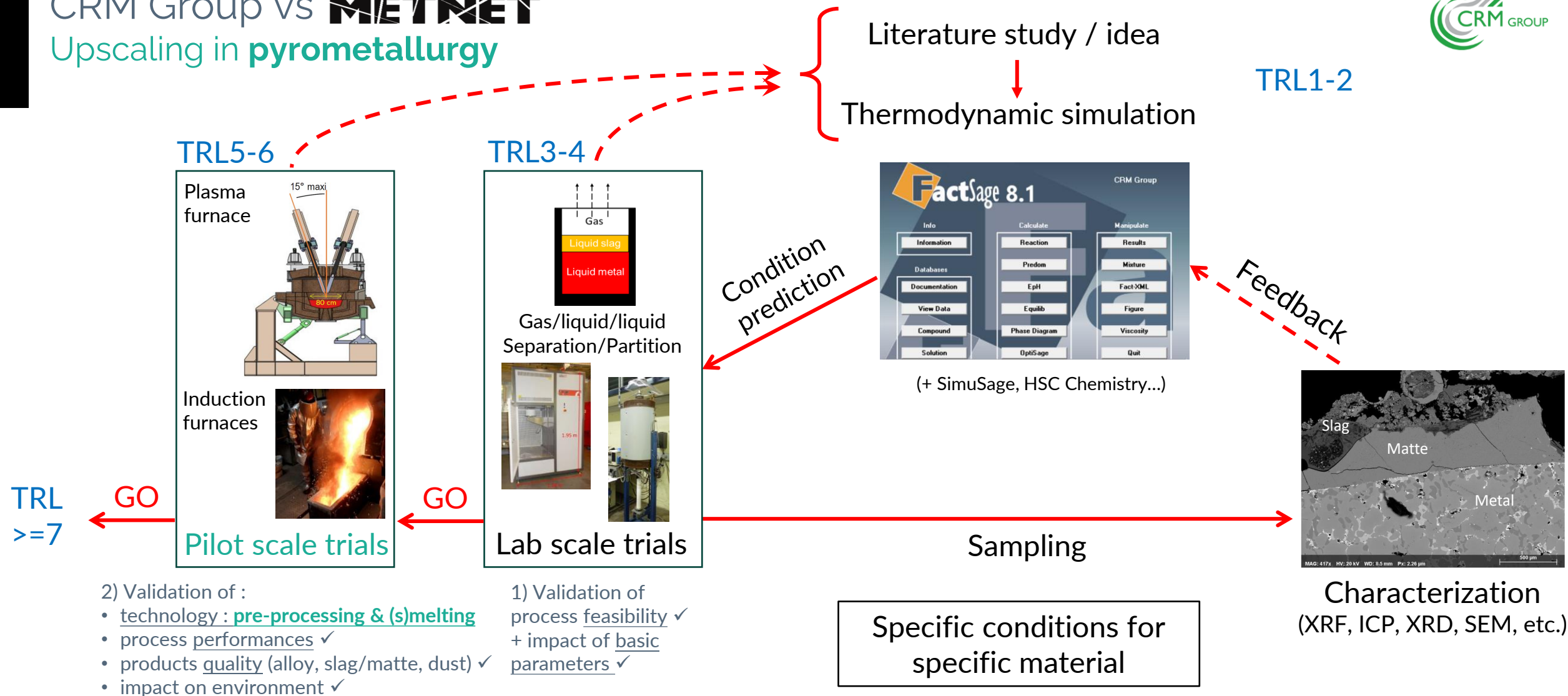
2016 : start of first EIT RM projects

- ✓ Upscaling
- ✓ Education
- ✓ Networks of Infrastructure among which PilotMet → **METNET** (initiated within Prometia)

PROMETIA's 10th Scientific Seminar – Metnet session – Lisboa, 30th of November 2023
New CRM Group's pilot scale plasma furnace at the service of circular economy and energy transition

For a better future

CRM Group vs **MIETNET** Upscaling in **pyrometallurgy**



Conditioning for recycling

Pre-processing of byproducts, manufacturing residues & end-of-life products for efficient recycling into (pyro)metallurgical processes (direction reduction, (s)melting, fuming...)



Mixing / granulation /



Compaction



Pelletising



extrusion



Briquetting



Industrial partnerships

operam



Aurubis



eramet



HYDROMETAL



ArcelorMittal

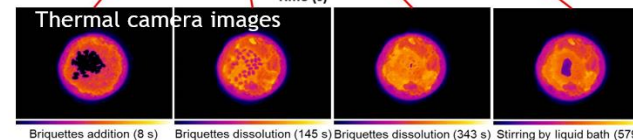
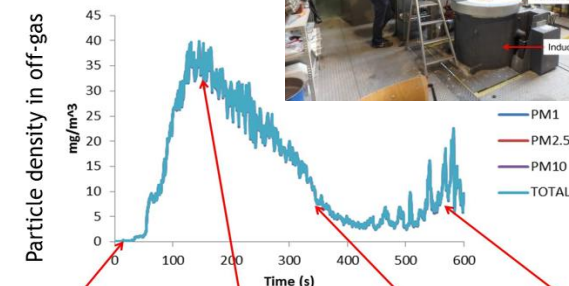
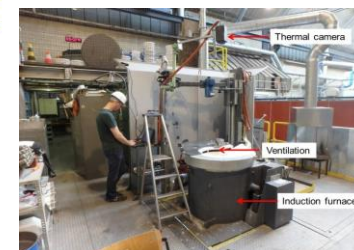
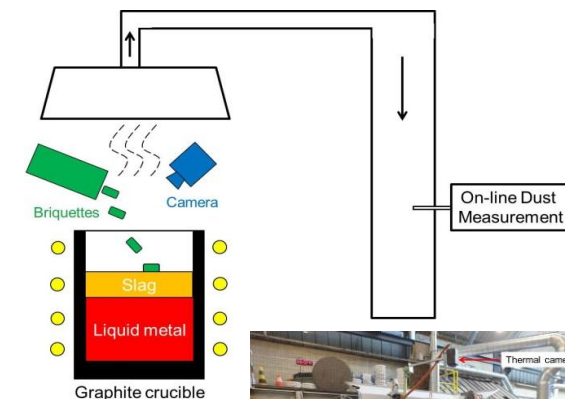
TATA STEEL

REVATECH

FIVEN

MARICHAL KETIN

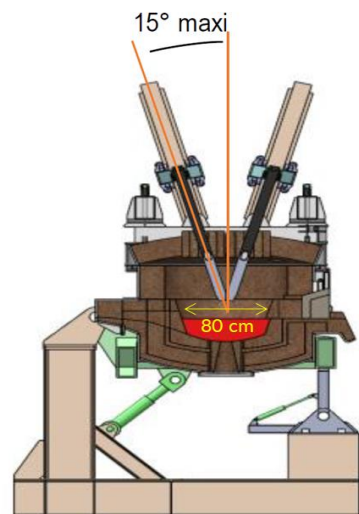
SAFRAN



Plasma furnace



Furnace area



125 L, 700 kW



& ancillary
equipment



Clean rooms for materials
preparation & crucible maintenance

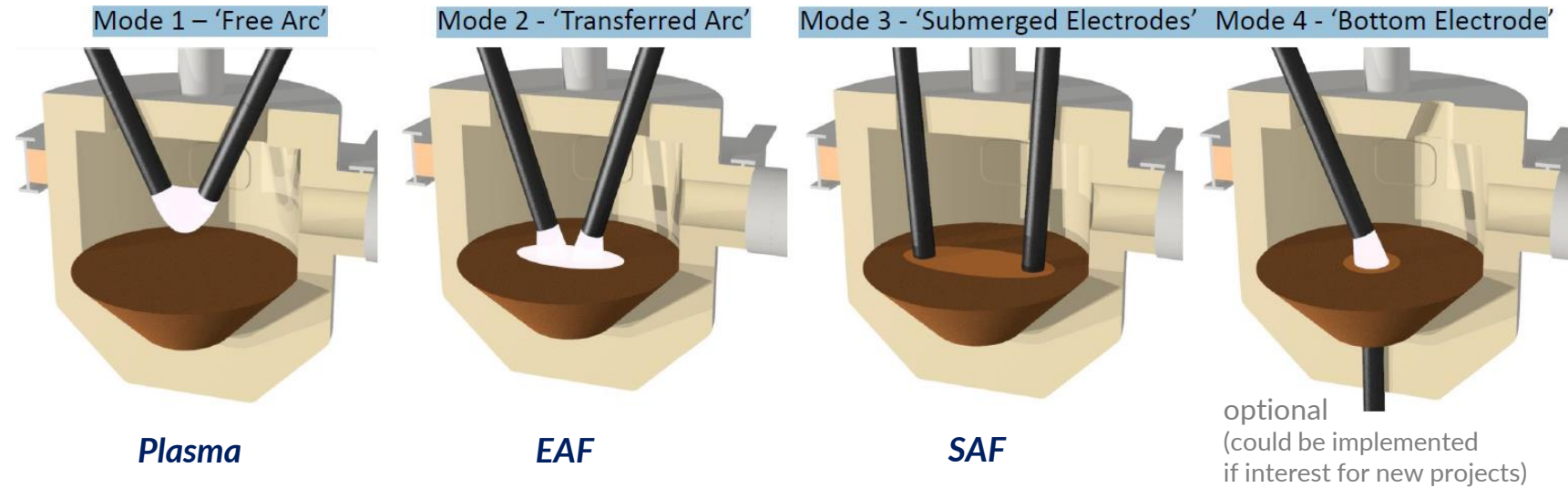


Furnace feeding:
Dosing hoppers & conveying system



Post combustion chamber

Plasma furnace – operation modes



With :

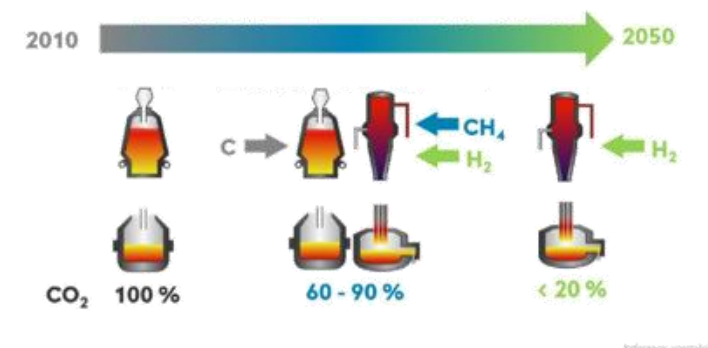
- bottom-blown stirring (Ar, N₂, ...)
- various sensing techniques
- injection lances
- ...

Main (first) plasma furnace applications

- ✓ **Recovery of CRM's** from industrial byproducts, WEEEs, e.o.l. batteries, magnets & catalysts...



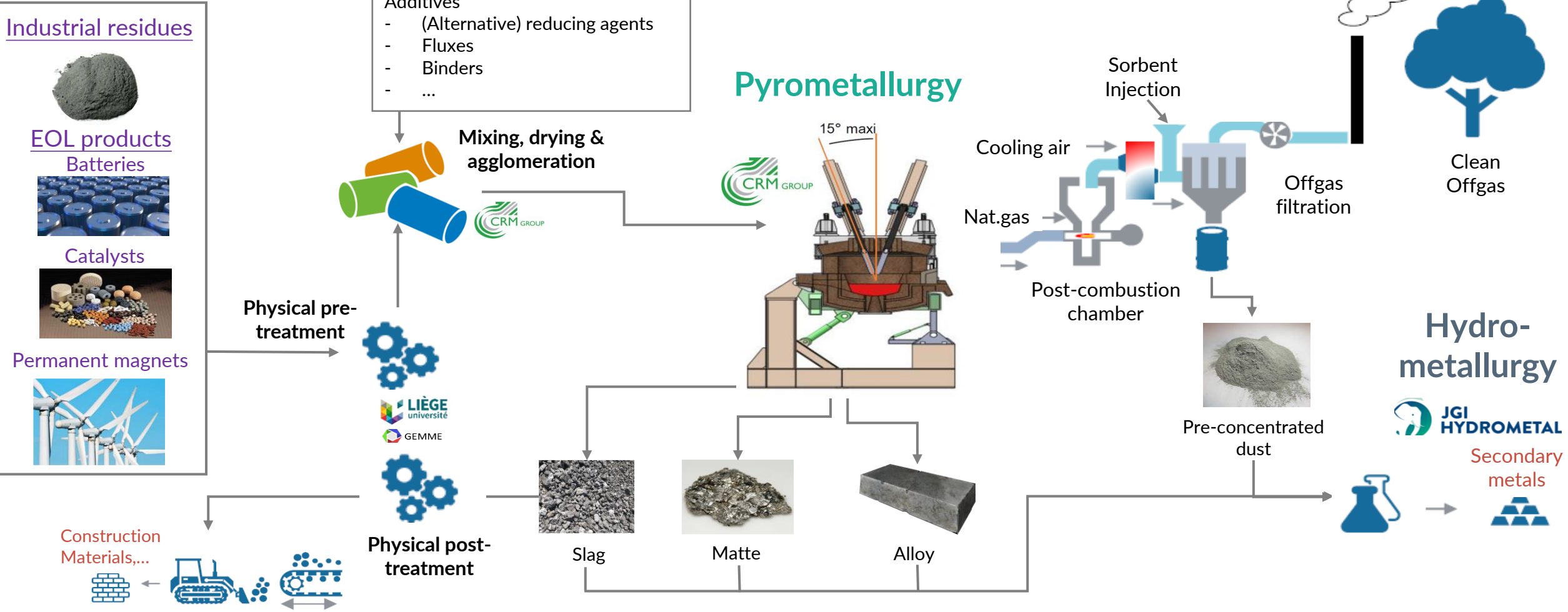
- ✓ **Decarbonisation of steel industry** : assessment (de-risking) of various new steelmaking scenarios and technological options



- ✓ **Circular economy** : valorisation of slags in **industrial symbiosis** with wastes from other sectors



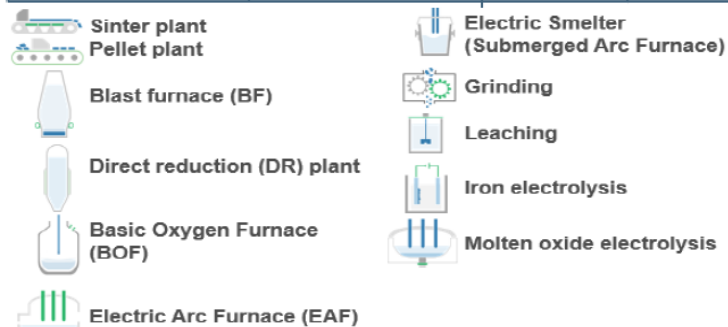
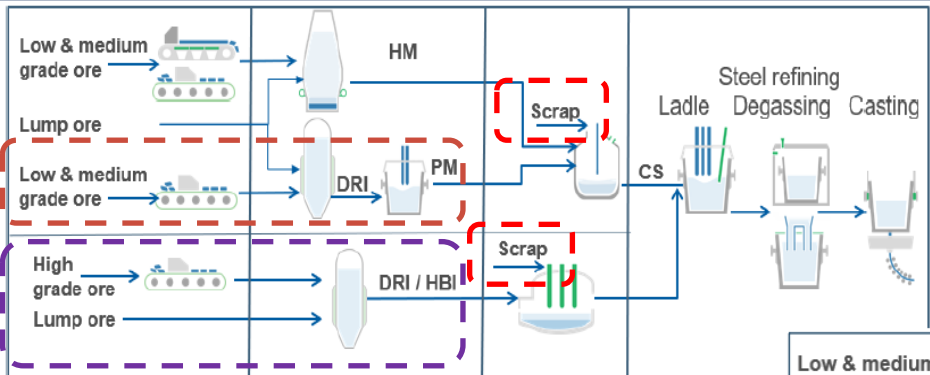
Metal recovery from complex waste materials through combined Pyro- & Hydrometallurgical processes (simplified)



Near term (2030)

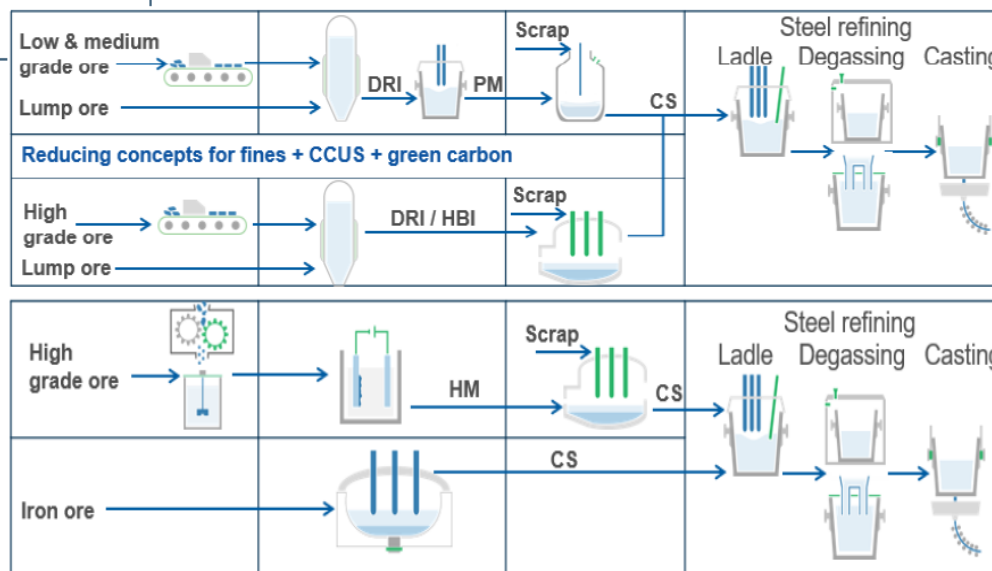
Mid term (2040)

Long term (2050)



HM Hot Metal
DRI Direct Reduced Iron
PM Pre Melt
CS Crude Steel
HBI Hot Briquetted Iron
CCUS Carbon, Capture, Utilization and Storage

New technologies like **direct reduction of iron and iron electrolysis** will gradually replace existing technologies in parts of the production process

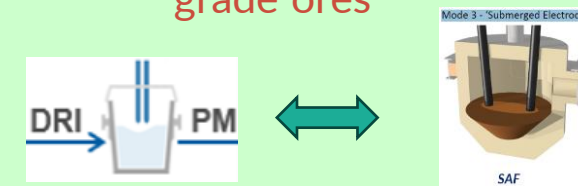


Melting technologies to be adapted vs new needs :

- ✓ Lower quality scrap
- ✓ New DRI types
 - ✓ NG/H₂-based reduction from high grade ores



- ✓ From low-medium-grade ores



Source : <https://www.estep.eu/assets/Uploads/SRIA-Update-Draft-V2-20230915.pdf>

Industrial symbiosis for added value valorisation of slags

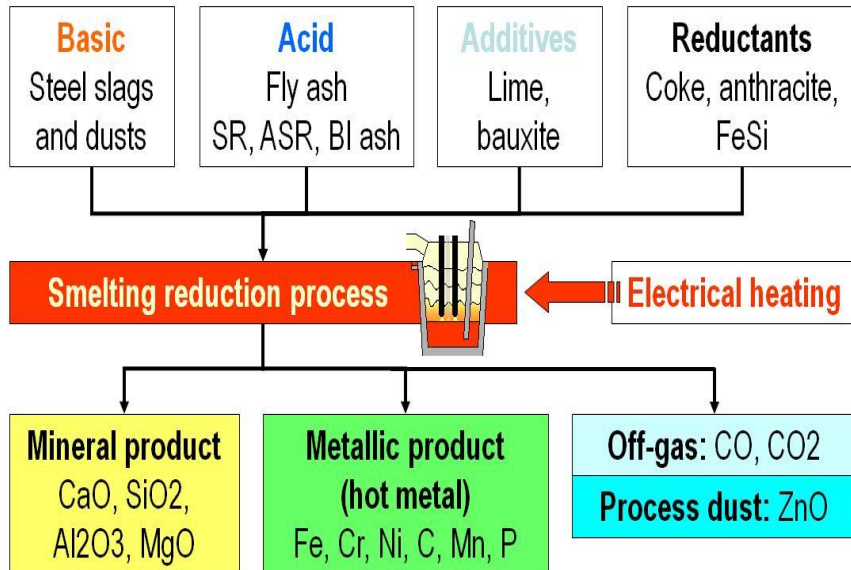


ZeWa (ZEro WAsTe) project (FP5, 2001-2003)

New smelting reduction technology to valorise steel-making slags in synergy with residues from other sectors



Funded by the
European Union



✓ Successfully tested at demo scale

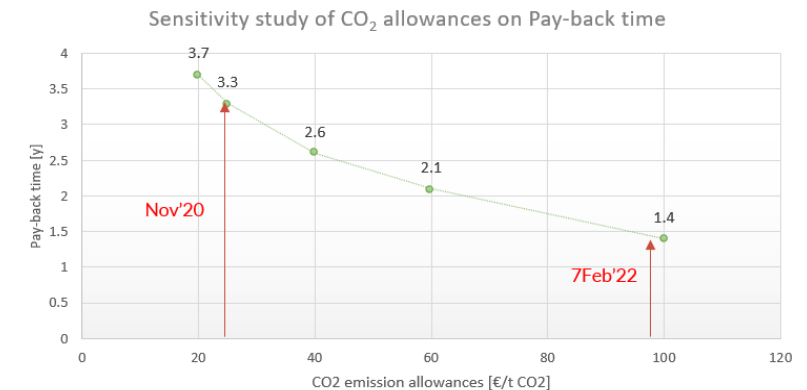


20 t ladle furnace



Slag granulation

Updates 2022 : → profitability vs CO₂



→ other possible input materials

BOF Slag
8.3 Mt/y

Red mud
7 Mt/y

Cu Slag
5.7 Mt/y

Glass waste
4.8 Mt/y

EAFC Slag
4.1 Mt/y

→ new green products : geopolymers,...

Partners		Country
FEhS (coord.)	R&D	Germany
CRM		Belgium
Rina-CSM		Italy
K1-Met		Austria
BFI		Germany
SSSA		Italy
ArcelorMittal	Steel industry	France
Voestalpine		Austria
O.R.I. Martin		Germany
Sidenor		Spain
Saarstahl		Germany
Tenova	Technology suppliers	Italy
Primetals		Austria

Objectives :

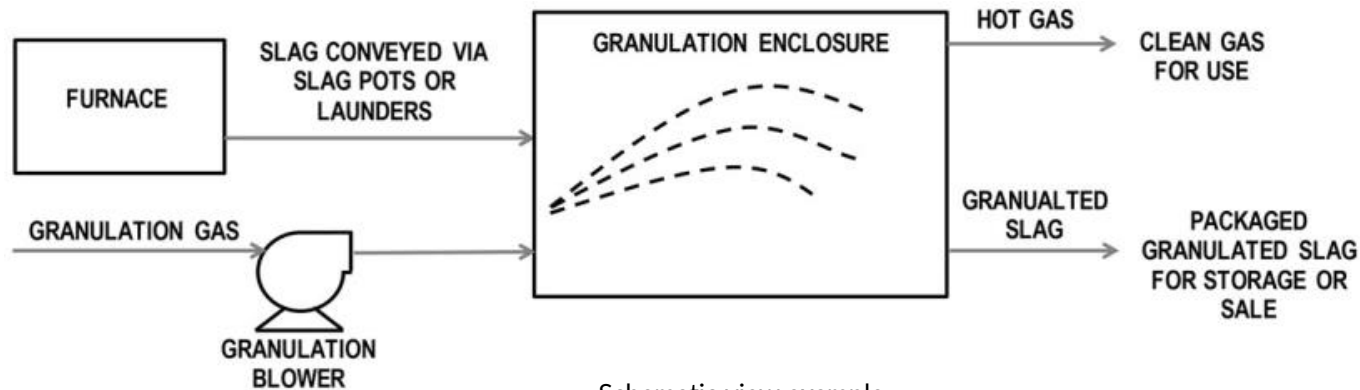
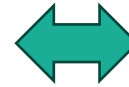
- understand the potential impact of next generation steelmaking on the resulting **new slags**
- provide guidelines for their **valorisation**

CRM contributions :

- Future slag features estimation (EAF model + lab tests)
- <> DRIs → EAF and SAF slag production (pilot **plasma furnace**)
- Slag characterisation (high temperature **viscosimeter**)
- Slag granulation**
- Industrial symbiosis : mixing with other by-products to increase value

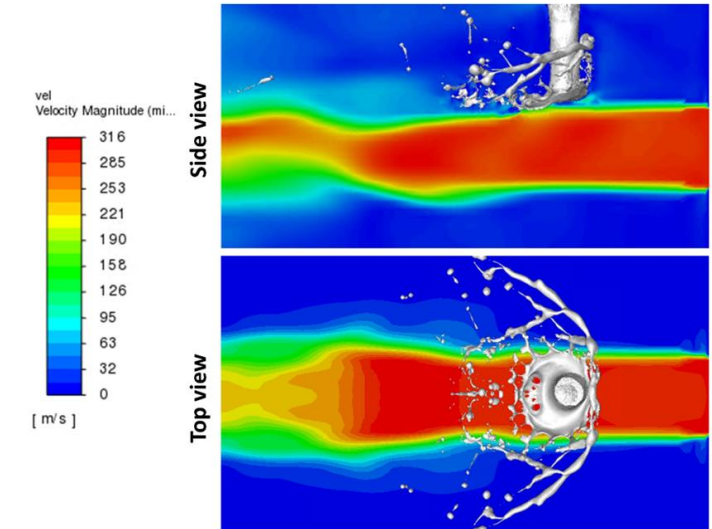
NEW : slag Granulation at CRM (pilot scale)

- Synthetic slags OR remelting of industrial slag
- Selected technology = dry granulation
 - reduced water consumption
 - possible heat recovery



Schematic view example

[source : Lindvall et al. (2019), Stabilization of stainless steel slag via air granulation. Journal of Sustainable Metallurgy]



CFD simulation of slag/air interaction

- Home-made design – under construction

Metal recycling platform @ CRM Group

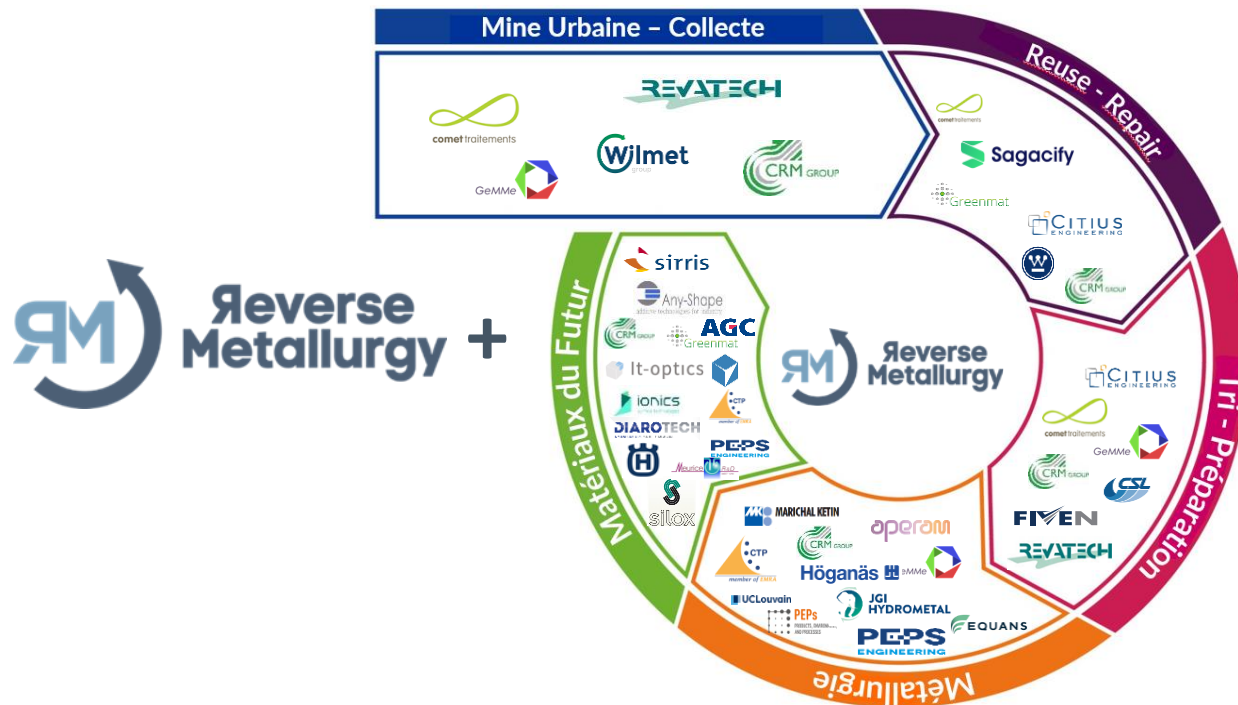
Latest evolutions of regional context



Funded by
the European Union
NextGenerationEU



2022 – 2026 : platforms for industrial, technological and scientific excellence
in METALS AND MINERALS



1. Materials for renovation or sustainable construction
2. High-performance concrete for construction and offshore sectors
3. Hydraulic binder-free hardened materials for road technology
4. Construction materials intended for road technology

PROMETIA's 10th Scientific Seminar – Metnet session – Lisboa, 30th of November 2023
New CRM Group's pilot scale plasma furnace at the service of circular economy and energy transition

For a better future

Metal recycling platform @ CRM Group

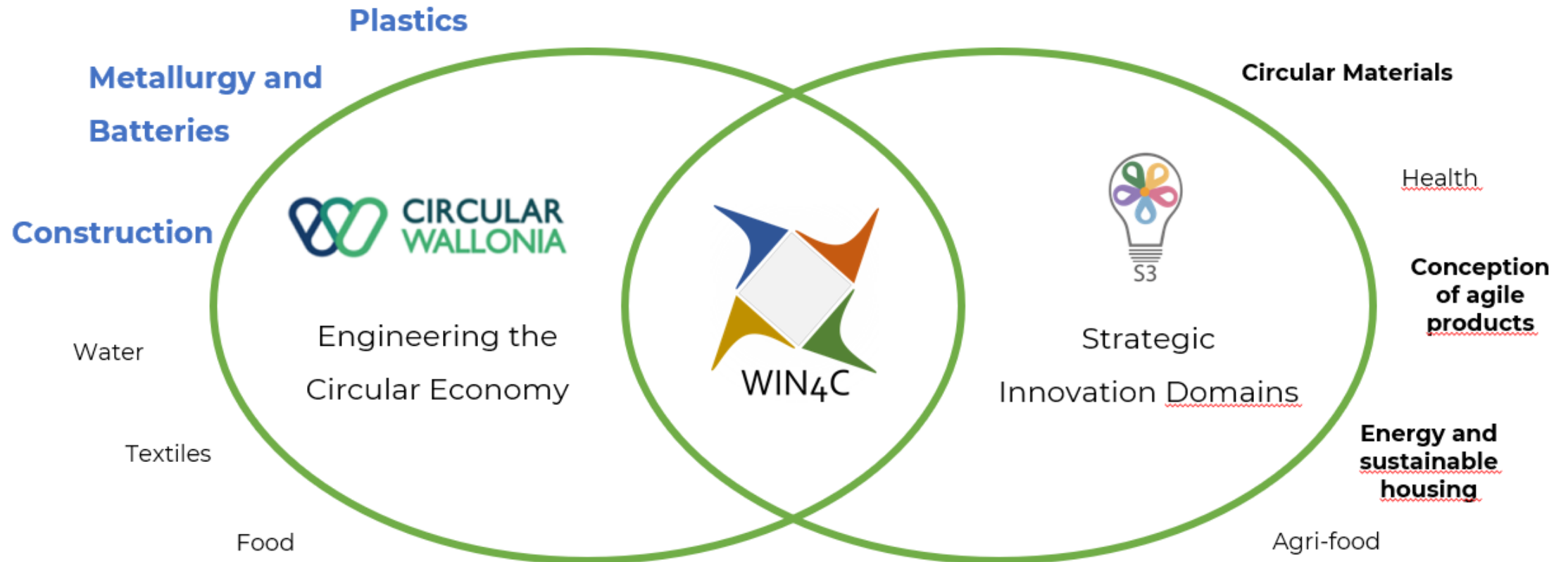
Latest evolutions of regional context



2022



Adoption of WIN4C, a key Strategic Innovation Initiative about Circular Materials (Metals, Minerals and Polymers) deployed as part of the Walloon S3 - Smart Specialization Strategy



NETWORK

INNOVATION

SUPPORT COMPANIES TO SHINE INTERNATIONALLY

TRAIN

Networking all players in the circular economy of **technological materials**. Pool **remarkable platforms** for the characterization, development, processing and recycling of materials. Supporting companies in setting up **innovation projects** and promoting them **internationally**. Support Walloon actors in **training and implementing the circular economy**.

Want to know more:

LinkedIn



win4c@crmgroup.be

What next

- ✓ Plenty of collaboration opportunities between Prometia/METNET and Win4C
 - ✓ a.o. new Upscaling capabilities vs new needs
- Let's discuss about it...



New pilot scale plasma furnace at the service of circular economy and energy transition



PROMETIA's 10th Scientific Seminar – Metnet session
Lisboa - November 30, 2023



Bernard Vanderheyden
Unit Manager, Metal Production and Recycling
Centre for Research in Metallurgy (CRM Group)
bernard.vanderheyden@crmgroup.be