



METGROW+ Approach to Flexible Raw Material Production

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 690088.



METGROW+ PROJECT AND CONCEPT

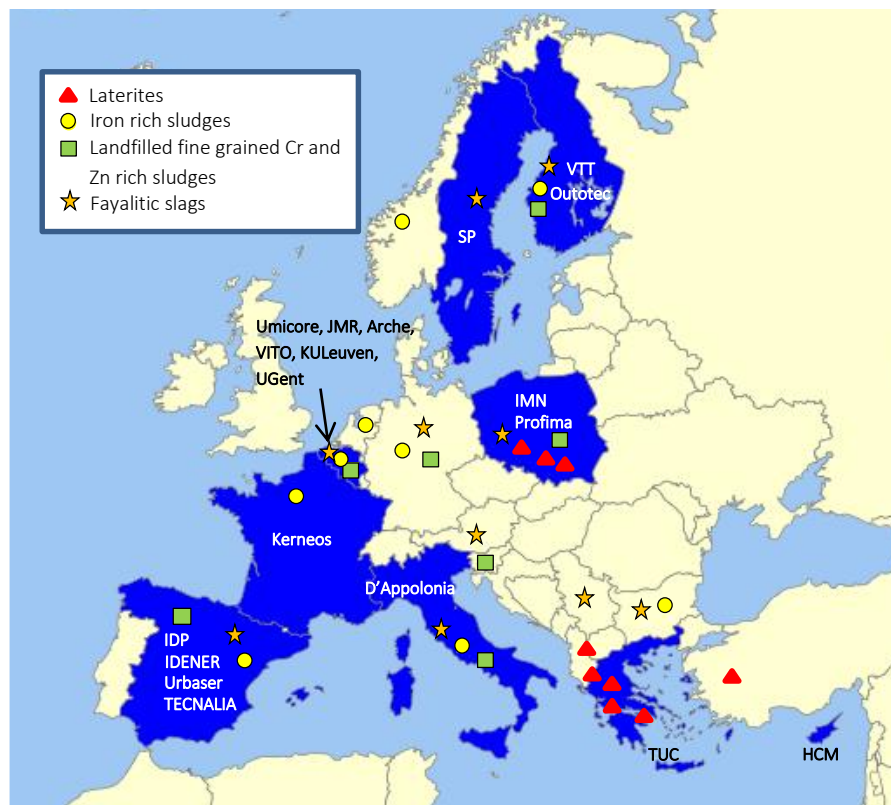


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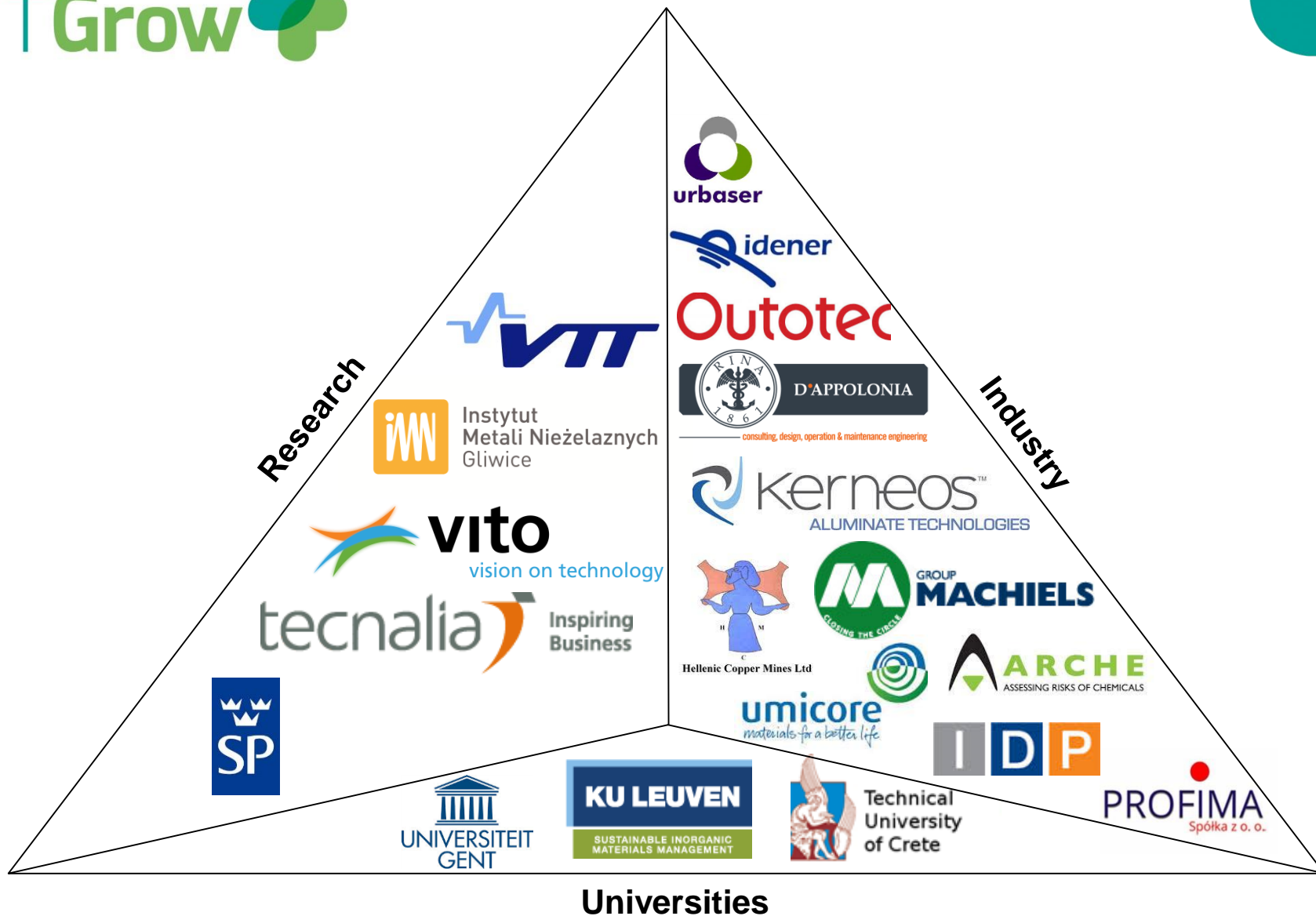
METGROW+ Project

- Metal Recovery from Low Grade Ores and Wastes Plus
- 4 years
- 1.2.2016 – 31.1.2020
- Topic: New metallurgical systems
- 7.9 M€, 19 partners from 9 member states
 - 5 SMEs
 - 6 large companies
 - 5 research institutes
 - 3 universities



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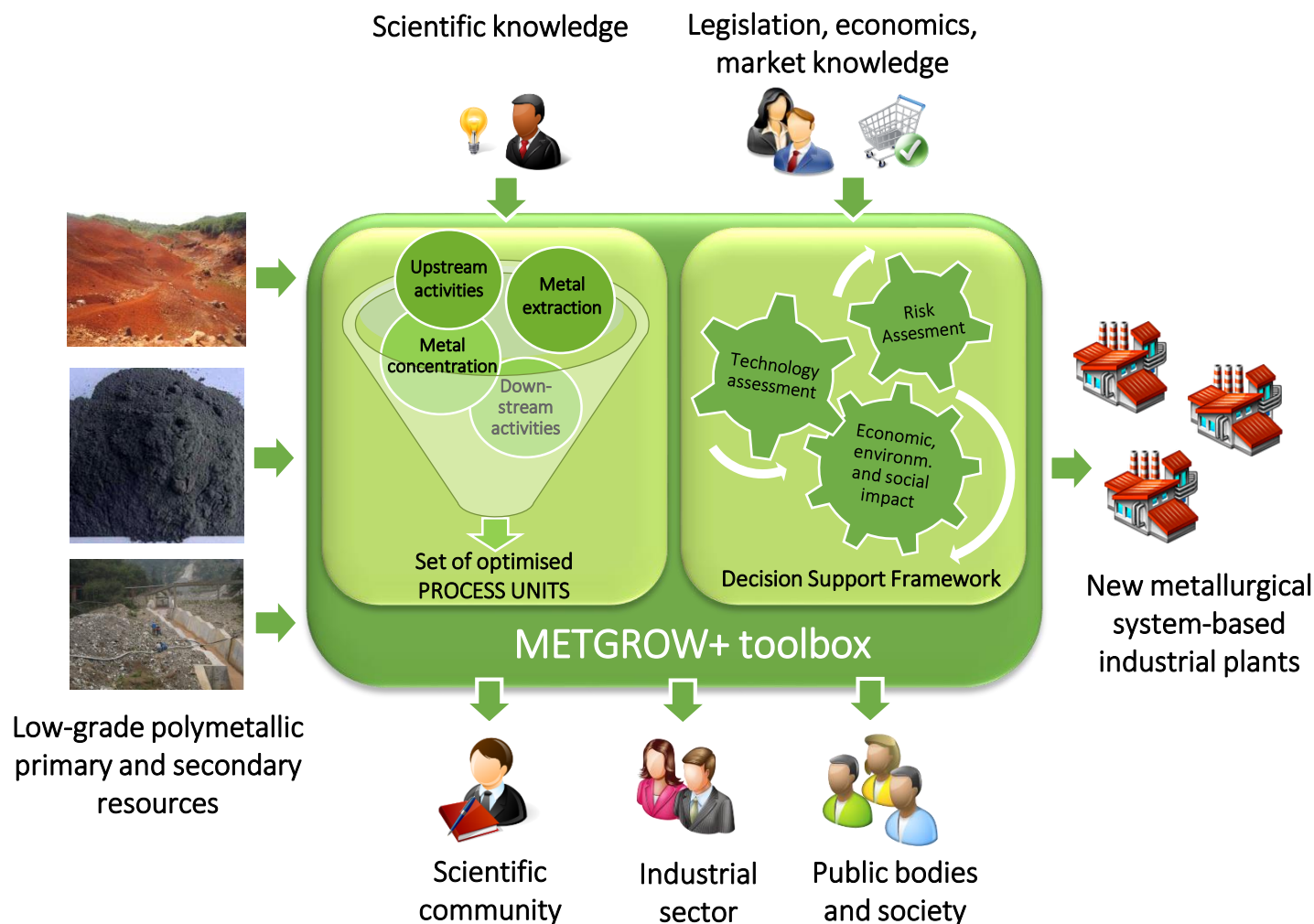
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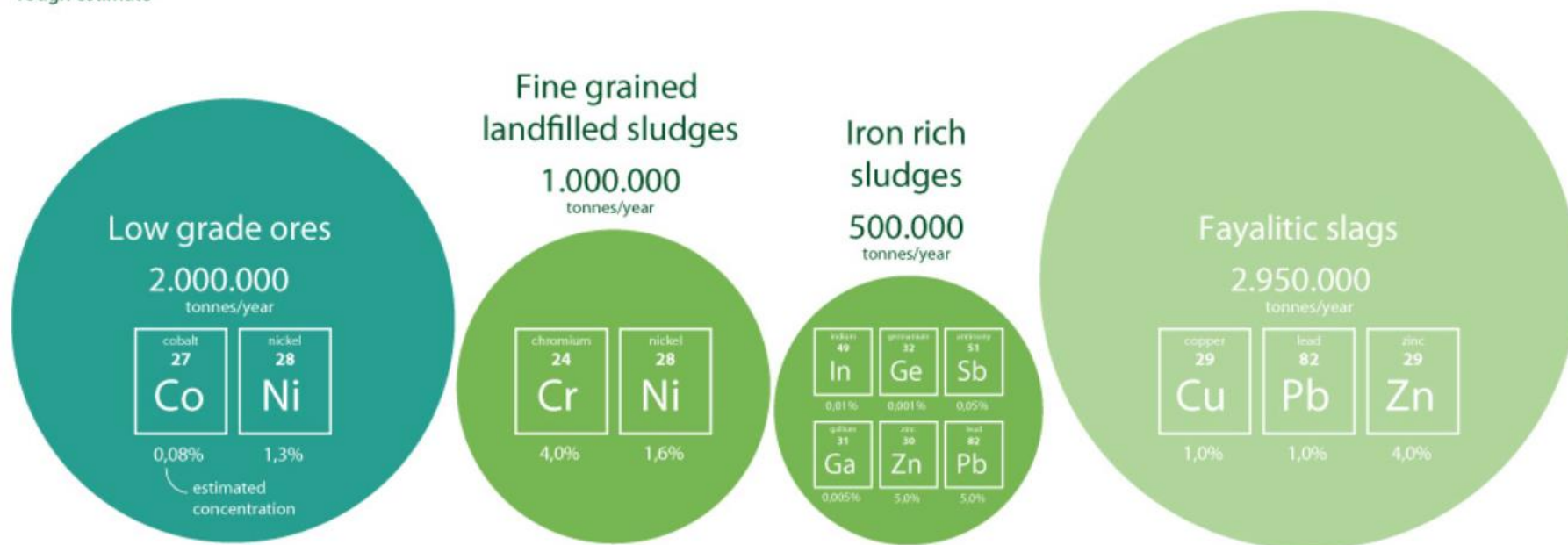
Concept



Four Selected Low-Grade Resource Families

Material streams in METGROW+ project: yearly production rates in the EU *

* rough estimate



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Specific selected materials

<u>LOW GRADE ORES</u>	<u>REFINING PROCESS FRACTIONS</u>	<u>WASTE TREATMENT FRACTIONS</u>
<ul style="list-style-type: none"> • Polish saprolitic laterite • Greek saprolitic laterite • Greek limonitic laterite 	<ul style="list-style-type: none"> • Jarosite • Goethite • Fayalitic slag • Fe-Ni slag 	<ul style="list-style-type: none"> • Landfilled Zn-rich sludge • Landfilled Cr-rich sludge • Steel sludge • Shredder sludge • Automotive shredder residues • Old heap from copper leaching



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LATERITE



LATERITE



FERRONICKEL SLAG



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ZN-RICH SLUDGE



ZN-RICH SLUDGE

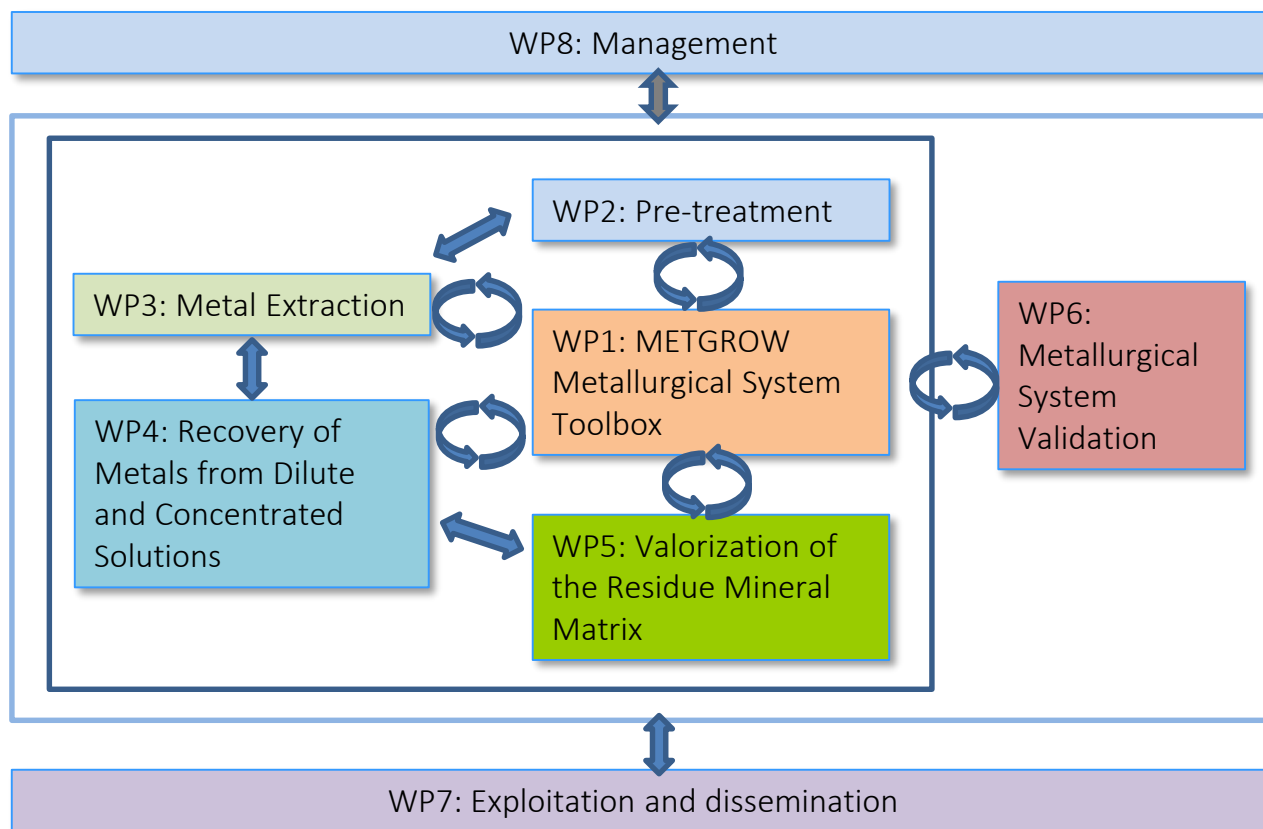
FAYALITE



JAROSITE



Value chain in METGROW+



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TECHNOLOGY DEVELOPMENT



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Pre-treatment

- Detailed characterization of low grade primary and secondary materials
 - Content of economically important and critical metals
 - Some materials very fine or with high organics content
- Selection and optimisation of the most flexible technologies for pre-treatment
- Production of enriched materials
 - High efficiency, low operating costs and limited environmental impact



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Main pre-treatment results

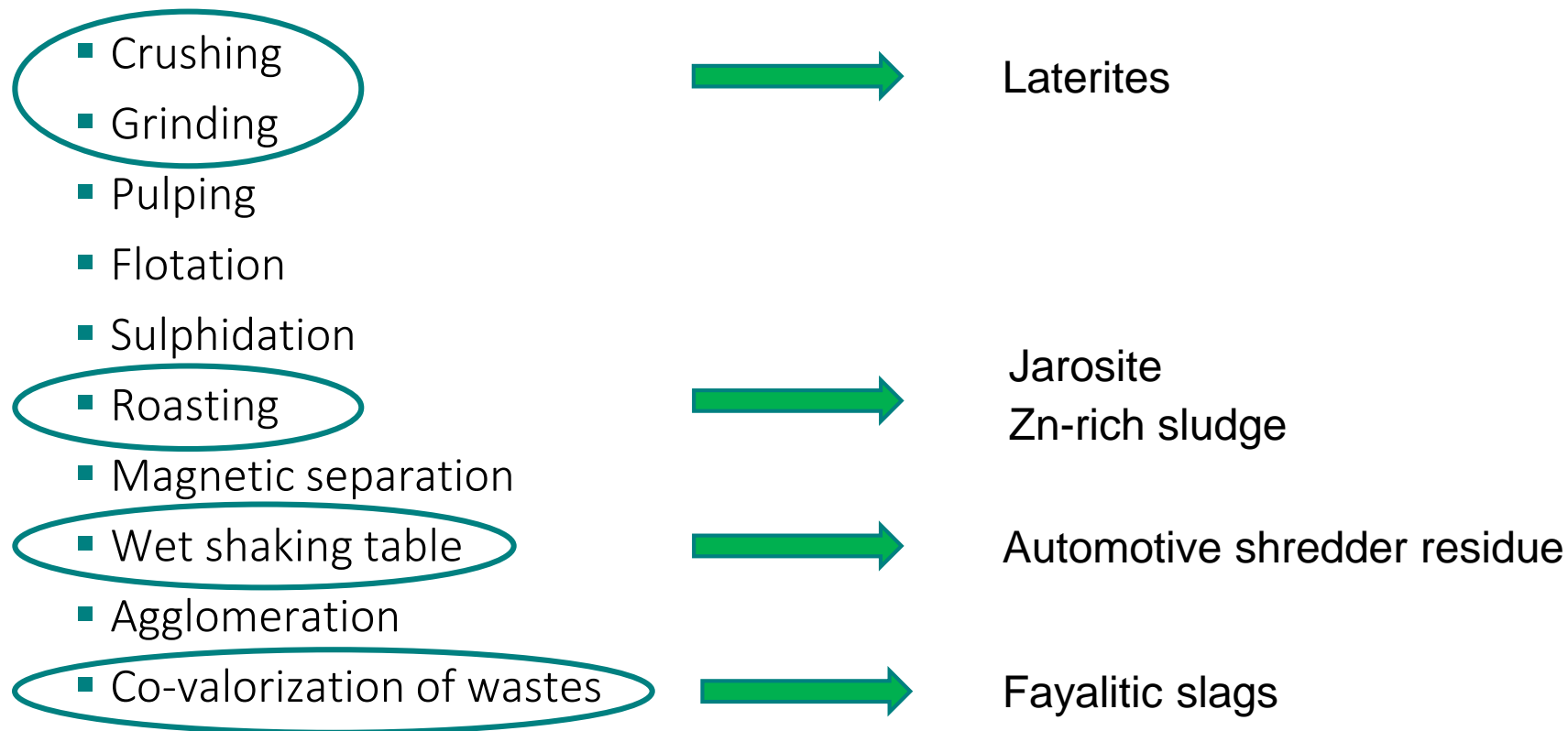
- Crushing
- Grinding
- Pulping
- Flotation
- Sulphidation
- Roasting
- Magnetic separation
- Wet shaking table
- Agglomeration
- Co-valorization of wastes



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Main pre-treatment results



Metal extraction

1.

Secure high yield for main target metal

“Secure industrial viability”

Is S/L separation successful?

Metal extraction process development

2.

Process optimization

- Secure yields for secondary target metals
- Increase selectivity
- Increase kinetics
- Increase reject quality
- Decrease costs



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Extraction methods for laterites

POLISH LATERITE – Main target Ni

Atmospheric acid leaching	Heap leaching	Heterotrophic bioleaching	Solvometallurgical leaching
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GREEK LATERITES (3 ores) – Main target Ni

Atmospheric acid leaching	Heap leaching	Autotrophic bioleaching	Ionometallurgical extraction
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Extraction methods for refining process fractions

JAROSITE – Main target Zn and Pb					
ROASTING PRE-STEP	NATIVE JAROSITE				
Heap leaching	Heap leaching	Autotrophic bioleaching	Solvometallurgical leaching	Ionometallurgical extraction	Two step plasma-pyro

FAYALITIC SLAG - Main target Zn			
Autotrophic bioleaching	Heterotrophic bioleaching	Ionometallurgical extraction	Plasma-pyro

FE-NI SLAG – Main target Ni	
Atmospheric acid leaching	Heap leaching



Extraction methods for sludges

LANDFILLED ZN-RICH SLUDGE – Main target Zn		
NATIVE SLUDGE	THERMAL PRE-TREATMENT (Removal of oil/grease)	
Heap leaching	Autotrophic bioleaching	Ionometallurgical extraction

L.F. CR-RICH SLUDGE Main target Cr and Ni	
Heap leaching	Solvometallurgical leaching

STEEL SLUDGE – Main target Zn		
MAGNETIC SEPARATION	NATIVE SLUDGE	
Heap leaching	Solvometallurgical leaching	Ionometallurgical extraction





Extraction methods for sludges

SHREDDER SLUDGE Main target Zn and Cu
MAGNETIC SEPARATION
Heap leaching

AUTOMOTIVE SHREDDER RESIDUE Main target Zn and Cu
Heterotrophic bioleaching



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Main metal extraction results

- New methods for challenging materials
 - Laterites, new hydrometallurgical research
 - Multiple new treatment methods for jarosite, fayalite and sludges



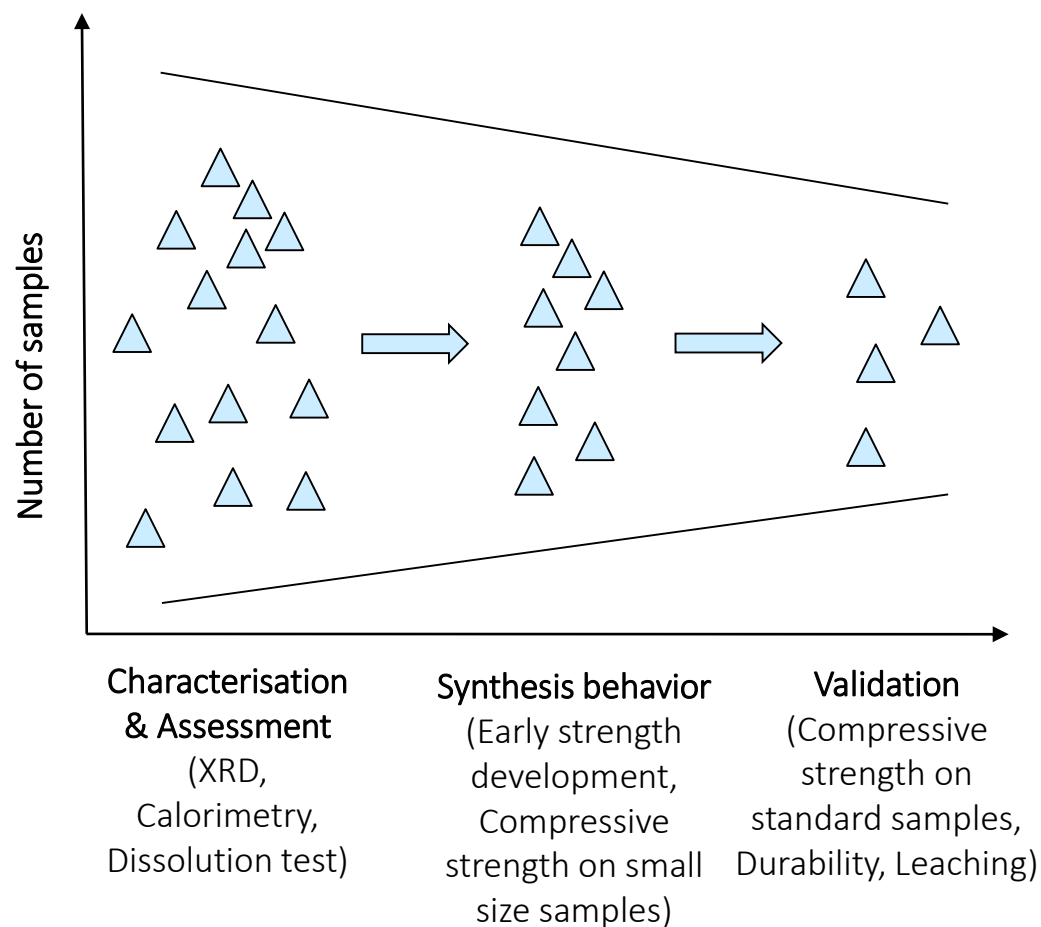


Metal recovery from leachates

Physico-chemical recovery		
Solvent extraction, precipitation and ion exchange	Supported liquid membranes	Supported ionic liquid phases
Biological recovery		
Biosorption	Bioprecipitation	Assessment of cost effective energy sources
Electrowinning recovery		
Metal electrodeposition from Deep Eutectic Solvents		Recovery of copper from dilute solutions



Screening tool for characterization and assessment of residues



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TARGET IN FLEXIBLE PROCESSING

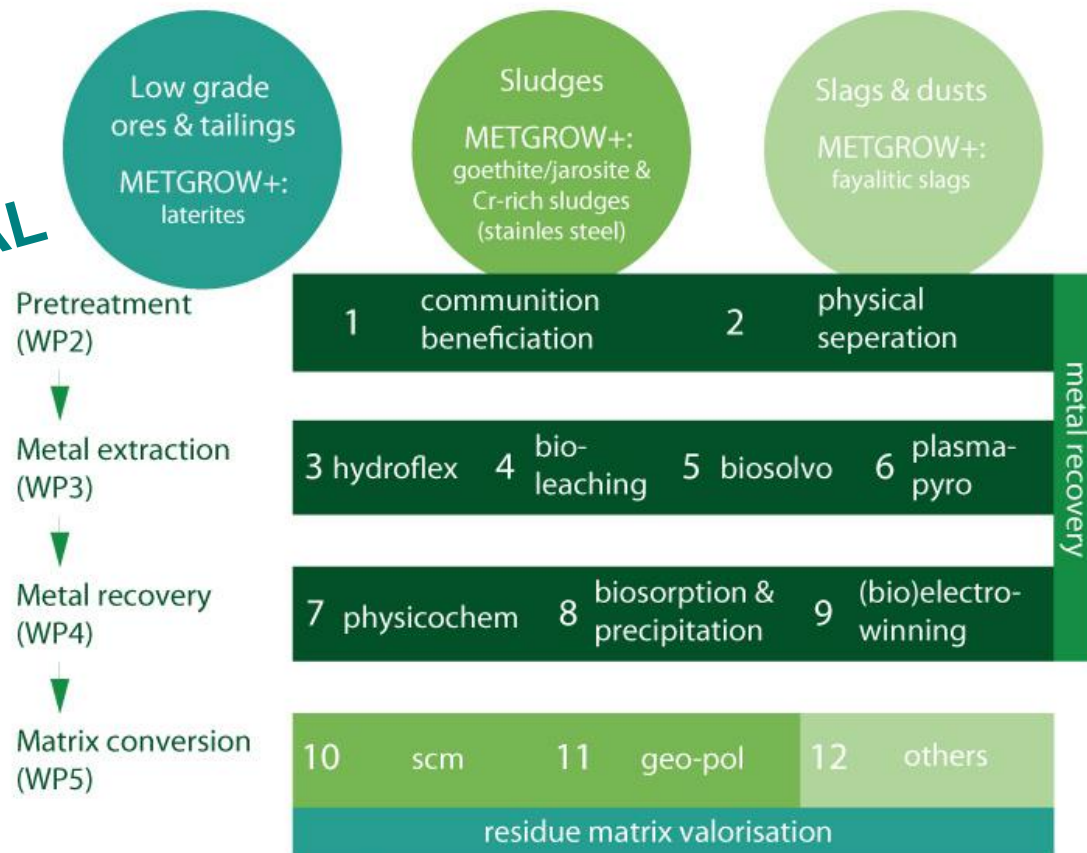


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Primary and secondary resources containing base and critical metals

METGROW+ METALLURGICAL SYSTEMS TOOLBOX



"Apart from the metal recovery, METGROW+ will create additional value by the valorisation of the matrix material"



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Progress in the state-of-the-art

- Several unit processes developed
- Progress beyond the state-of-the-art is also a combination of pre-treatment, leaching, recovery and residue valorization
- Validations for best process flow sheets start in the beginning of 2018



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- Previously untapped primary and secondary resources are unlocked
- Direct impact in metal exploitation and production rates
- Decrease of import dependency
- Toolbox including technological, environmental, economic and social assessments helps in decision making process



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Thank you for listening.