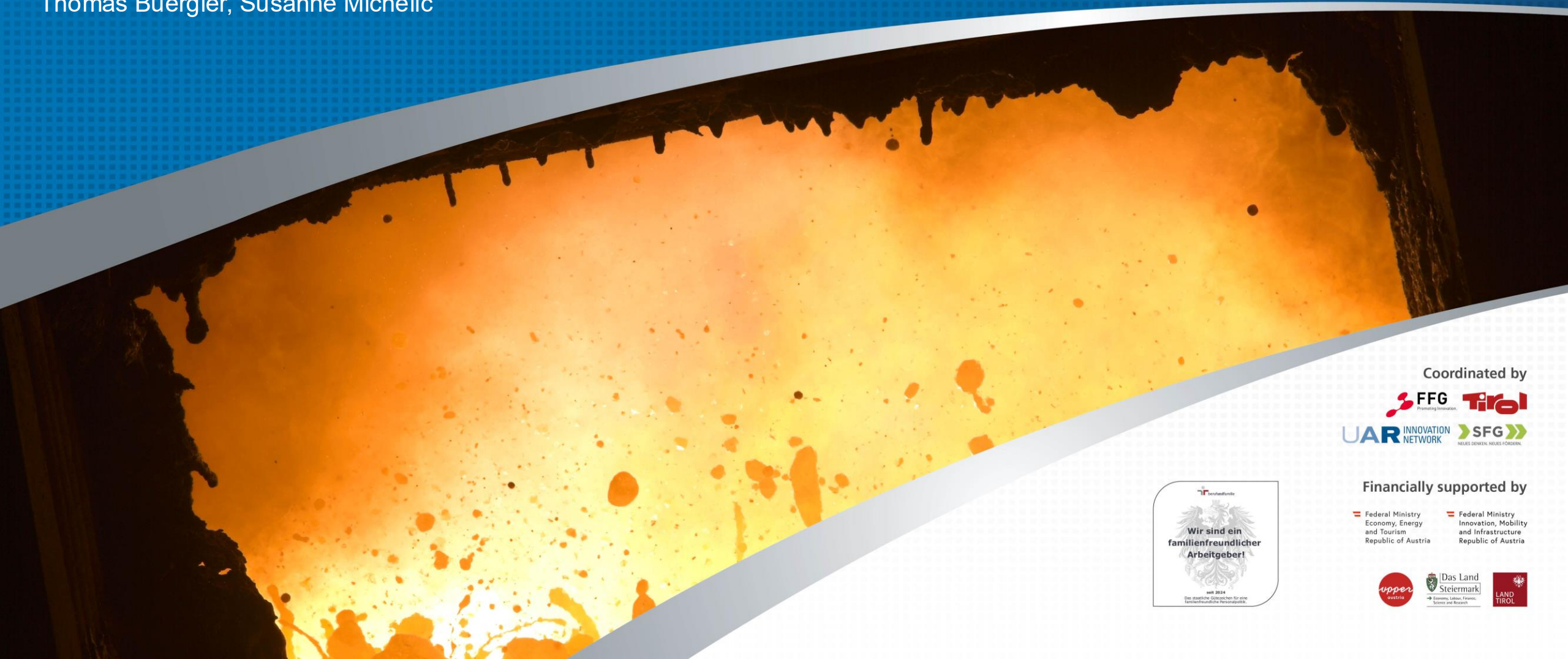
K1-MET Overview

SusMet4Planet (2023 – 2027)

Linz, 1 July 2023

Thomas Buergler, Susanne Michelic



K1 MET
metallurgical competence center

Coordinated by

FFG Promoting Innovation. Tirol

UAR INNOVATION NETWORK SFG NEUES DENKEN. NEUES FÖRDERN.

Financially supported by

Federal Ministry Economy, Energy and Tourism Republic of Austria

Federal Ministry Innovation, Mobility and Infrastructure Republic of Austria

upper austria

Das Land Steiermark
Economy, Labour, Finance, Science and Research

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berufundfamilie
Wir sind ein familienfreundlicher Arbeitgeber!
seit 2024
Das staatliche Gütezeichen für eine familienfreundliche Personalpolitik.

K1-MET at a glance

international metallurgical research competence center

- focus on ferrous and nonferrous metallurgy
- founded in July 2015 as a limited liability company
- 84 employees (as of 1 July 2023)
- partially funded by an Austrian competence center programme
- annual revenue of 10 million €
- 100 projects and associated partners from industry and science
- 28 Company Partners
- 13 Scientific Partners

Current research programme 2023 – 2027

K1-MET

and some partner locations

metallurgical competence center

LEOBEN
Technical University of Leoben (Branch office)

WELS
University of Applied Sciences Upper Austria

GRAZ
Graz University of Technology

LINZ
K1-MET GmbH (Headquarter)

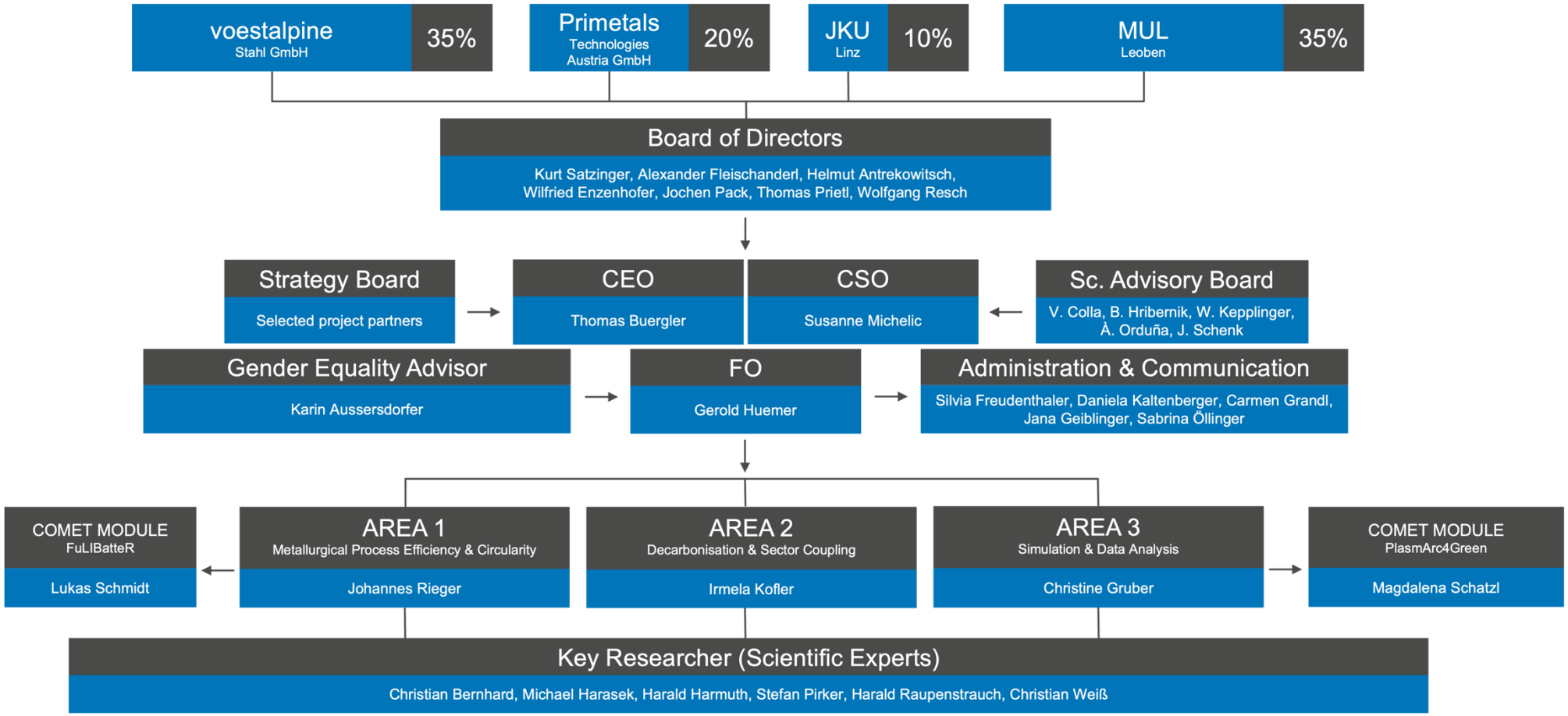
LINZ
Primetals Technologies Austria GmbH

LINZ
voestalpine Stahl GmbH

VIENNA
Vienna University of Technology

LINZ
Johannes Kepler University Linz

Organizational structure
of K1-MET GmbH



Sustainable Development Goals (SDGs)

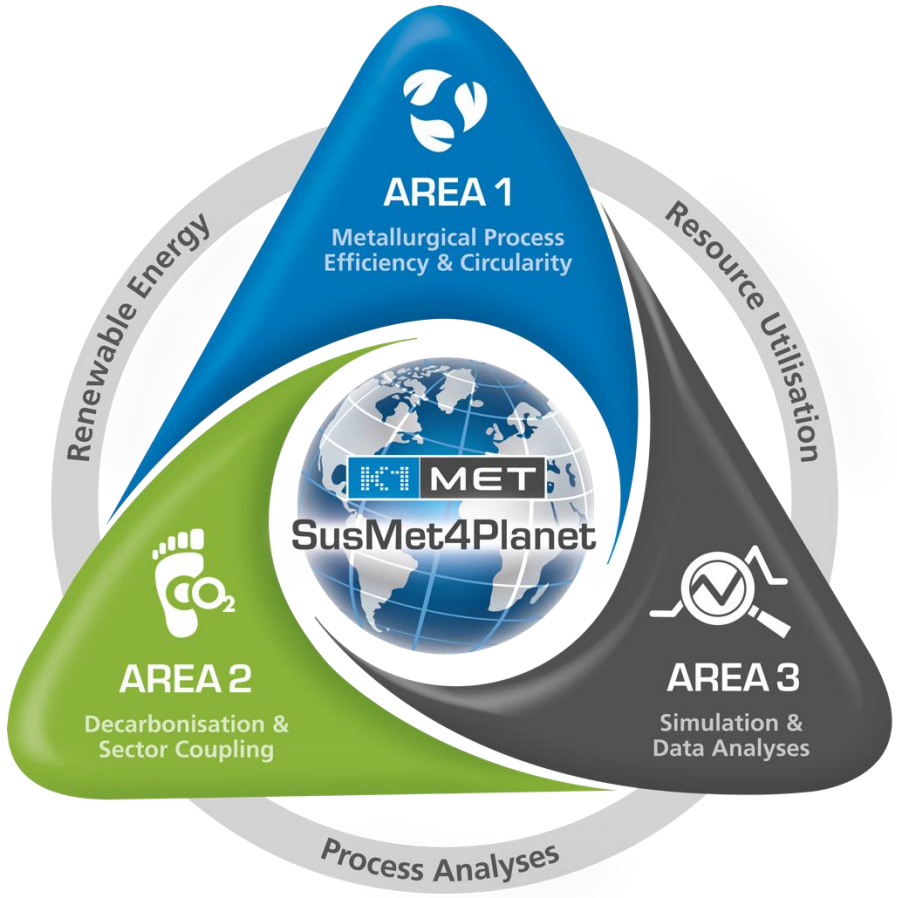
Contribution of K1-MET towards a sustainable economy & society

- K1-MET is in accordance with the SDGs
- SDGs related to environmental (climate) impact
  - Energy efficiency and clean energy technologies – SDG 7
  - Increase resource efficiency in metallurgical processes – SDGs 8 & 9
  - Enhance utilization and recycling of metallurgical residues – SDG 12
  - Reduce CO_2 emissions – SDG 13
- SDGs related to human resources
  - Gender equality – SDG 5
  - Female employees in all organizational levels and uniform salary scheme
  - Current female share of K1-MET staff: 40 %
- Decent work and economic growth – SDG 8
  - 80 full time equivalents (full configuration)
  - 18 PhD Researchers planned (20 in total)
  - 10 Master students planned (40 in total)

Source: https://sdgs.un.org/goals

Future research programme

SusMet4Planet (2023 – 2027)



“Sustainable digitalized Metallurgy for a climate neutral and resource efficient Planet”

K1-MET addresses the challenges of the metallurgical industry in staying competitive and reaching climate neutrality

Area 1: Metallurgical Process Efficiency & Circularity

Enhancement of process efficiency and product quality through analytics and treatment of raw and secondary materials

Area 2: Decarbonisation & Sector Coupling

Solutions for climate neutral metallurgy and CO_2 as a source for the carbon cycle

Area 3: Simulation & Data Analyses

Application of modelling approaches to new and existing metallurgical processes and data analysis for an increase of process efficiency

SusMet4Planet

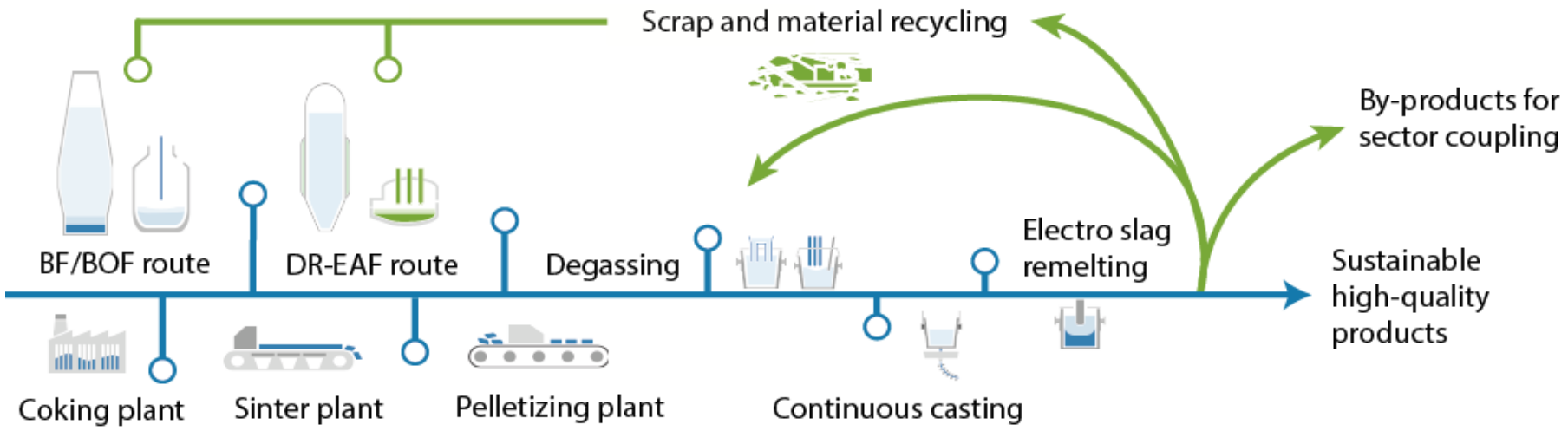
2023 – 2027

- cross-sectorial consortium of 42 excellent national and international company and scientific partners from all over the world
- contribution to sustainability, efficient processes and climate neutrality for all energy intensive industry sectors, supported with increasing digitalization and superior product qualities
- Objectives:
  - Strategic goal 1: Increase process efficiency and strengthen circularity in metallurgy
  - Strategic goal 2: Push forward the decarbonisation of the metallurgical industry and sector coupling
  - Strategic goal 3: Generate and use of metallurgical process knowledge through digital technologies

Area 1

Metallurgical Process Efficiency & Circularity

- Enhancement of resource and process efficiency for ferrous and nonferrous metal production/refining

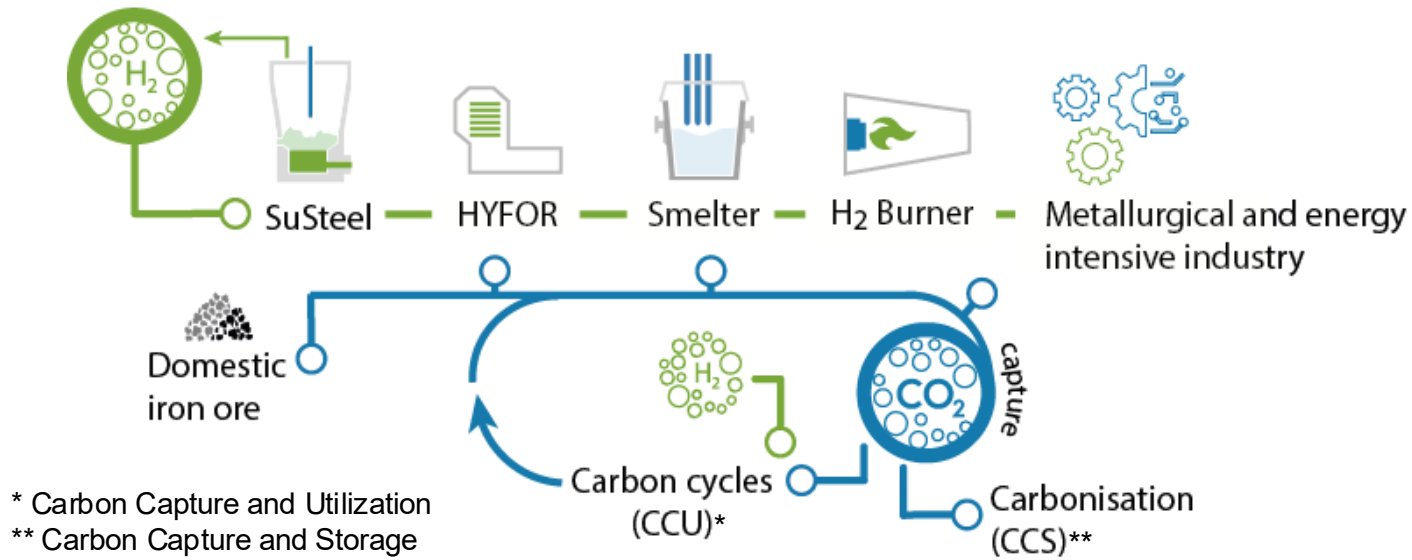


- Advanced analytics of raw and recycled materials
- Sustainable sinter and low-emission BF-process
- Resource efficient copper refining process
- Sustainable continuous casting process
- Inclusion removal and steel cleanness
- Sustainable processing of solid residue streams
- Valorisation of steelmaking slags
- Insights into metallurgical processes (experiments and thermodynamics)

Area 2

Decarbonisation & Sector Coupling

- Carbon direct avoidance (CDA) and carbon capture and utilisation/storage (CCU/S) processes for climate neutrality in 2050



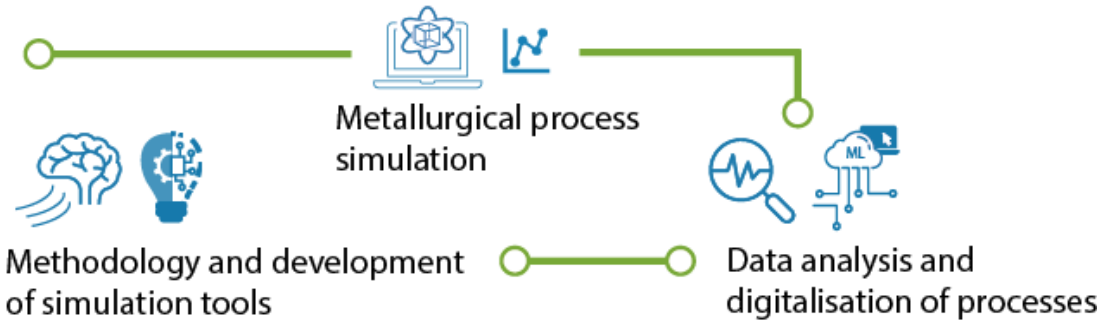
* Carbon Capture and Utilization
** Carbon Capture and Storage

- Continuous H_2 Plasma Smelting Reduction (HPSR) process development
- Domestic ore for green steel
- Carbonisation
- Energy efficient CCU process
- Green smart furnaces
- Smelter development for net zero-carbon steelmaking
- Flowsheet modelling for CO_2 reduction
- Alternative iron and carbon sources

Area 3

Simulation & Data Analyses

- Application and implementation of insights for process optimization in metallurgical processes:
  - Development of simulations and simulation methodology and application to steelmaking
  - Extended process data analyses (big data and machine learning)
  - Connection to domain knowledge for industrial process optimization

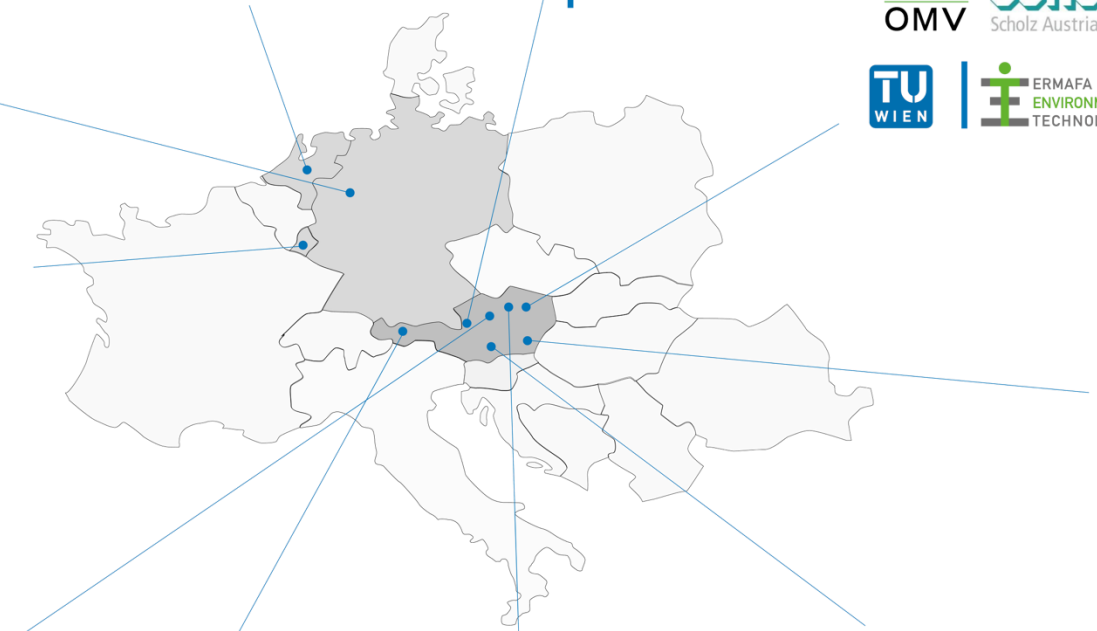


- Multiphase fluid modelling and simulation
- Multi-scale and reactive granular flows
- Advancement of simulation acceleration for process applications
- Hybrid modelling

Partners and locations of the COMET programme

Austria and Central Europe

metallurgical competence center



Germany

RWTH AACHEN UNIVERSITY
LTB LASERTECHNIK BERLIN
WACKER
BAM
TU BERGAKADEMIE FREIBERG
calderys

The Netherlands

TATA STEEL

Salzburg

Leube

Vienna

OMV
SCHOLZ Scholz Austria GmbH
TU WIEN
ERMAFA ENVIRONMENTAL TECHNOLOGIES

New partners in COMET

Total partners
28 company partners
13 scientific partners

Luxembourg

PAUL WURTH SMS group

Styria

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Technical University of Leoben
CGI
TU Graz
BÖHLER
voestalpine ONE STEP AHEAD.
RHI MAGNESITA
prozess optimal ingenieurbüro | verfahrenstechnik
ceram austria
HyCentA HYDROGEN CENTER AUSTRIA
ANDRITZ
JOANNEUM RESEARCH
vaerzberg

Upper Austria

PRIMETALS TECHNOLOGIES
K1 MET metallurgical competence center
LCM LINZ CENTER OF MECHATRONICS
JKU JOHANNES KEPLER UNIVERSITÄT LINZ
FH OBERÖSTERREICH
voestalpine ONE STEP AHEAD.
CEMTEC Cement & Mining Technology
EBNER®
NGE MATERIAL MORPHING TECHNOLOGY
Linde
BOREALIS

Carinthia

Alpacem by Wietersdorfer

Tyrol

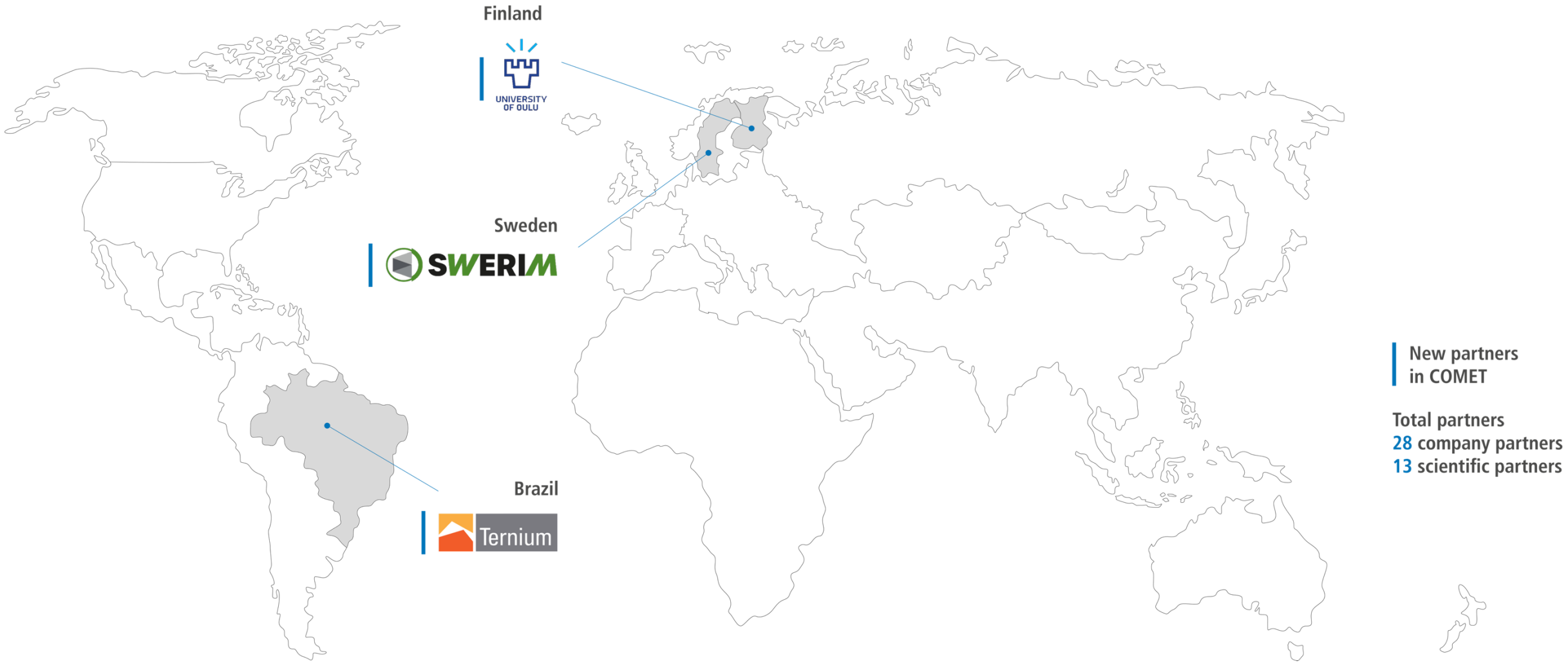
MONTANWERKE BRIXLEGG

Lower Austria

LINE technology

Partners and locations of the COMET programme

Northern Europe and South America



Partners of K1-MET and locations

Cooperations around the World

metallurgical competence center

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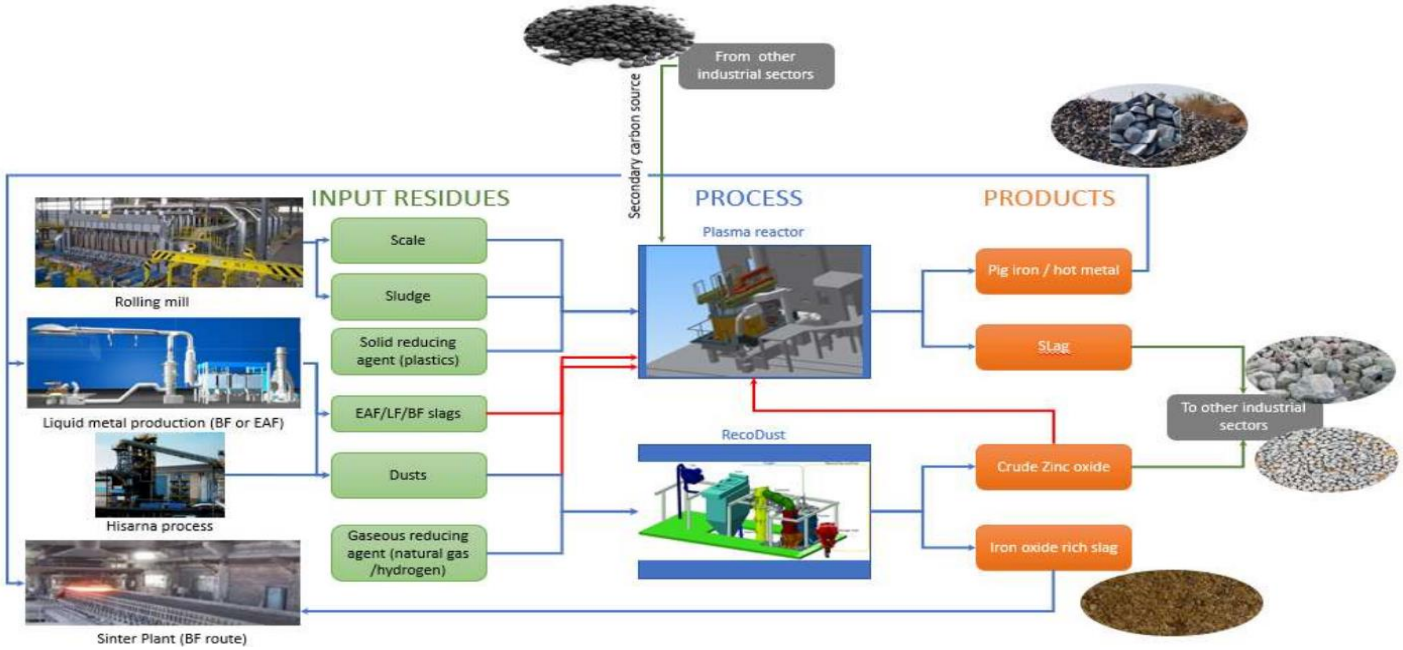
PARTNERS

EU funded project ReMFra

Horizon Europe/Clean Steel Partnership (HEU/CSP)

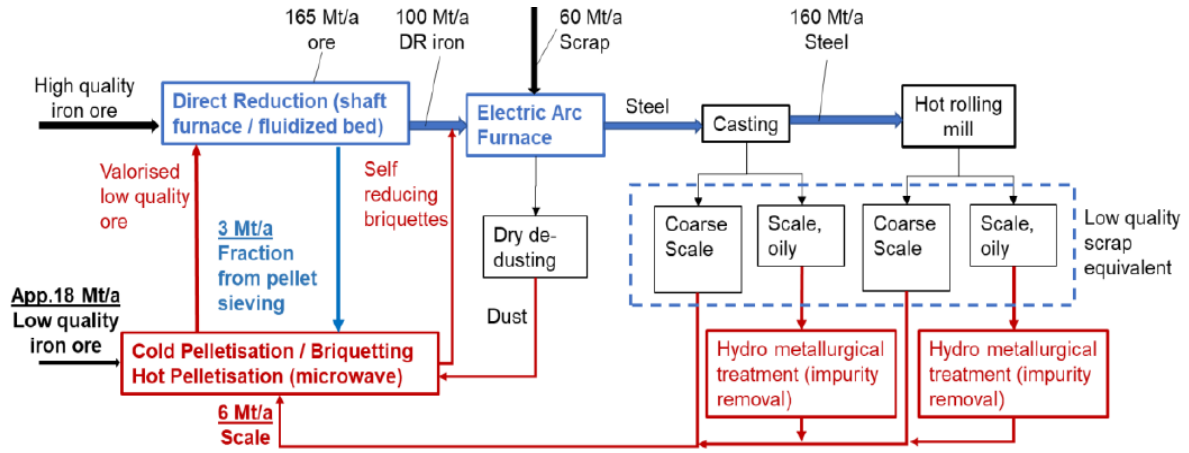
- “Recovering metals and mineral fraction from steelmaking residues”
- Demonstrate and qualify a complete system for the recovery and the valorization of the metal and mineral fractions contained in steel making processing residues
- Project consortium: Tenaris, Tenova, RINA-CSM, ESTEP, FEhS, thyssenkrupp Steel Europe, Tata Steel, Celsa, voestalpine Stahl, K1-MET



EU funded project TransZeroWaste

HEU/CSP

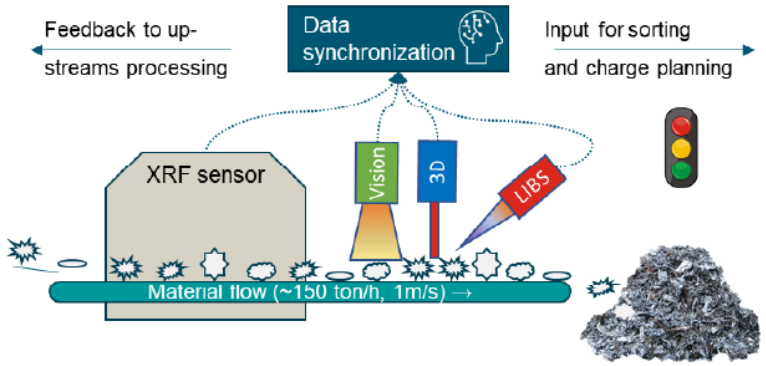
- „Upgrading of low-quality iron ores and mill scale with low carbon technologies”
- Concepts for the use of low-quality iron ore and mill scale
- New/alternative treatment technologies and material use decision support tool based on Life Cycle Assessment for low-grade ores and residues (see Figure below, parts being in the focus of the project marked in red)
- Project consortium: Luxemburg Institute of Technology, BFI, Celsa, University of Valencia, Inceinnmat, Dillinger Huettenwerke, Instituto de Soldadura e Qualidade (ISQ), ESTEP, Advanced Management Solutions, Lukasiewicz Research Institute, CSIC, K1-MET



EU funded project PURESCRAP

HEU/CSP

- „Purity improvement from scrap metal”
- Increase the purity of shredded old scrap through a coupled optical and spectroscopic analyses at the scrap yard and use of artificial intelligence for optimized data synchronization
- Demonstrate the suitability regarding the use of the sorted old scrap to produce standard quality steel grades
- Project consortium: SWERIM, SSAB, Redwave, SSSA, Danieli, Lulea University, Spectral Industries, TU Dortmund, voestalpine Stahl Donawitz, Stena Recycling, ESTEP, K1-MET



RFCS Project InSGeP

Investigations of Slags from Next Generation Steel Making Processes

The InSGeP project aims to understand the potential impact of next generation steel production on the resulting slag. Thus, their chemical, mineral, ecological and physical properties are analyzed and evaluated.

Partner

The consortium consists of 5 steel plants, 6 RTOs and 2 plant manufactures from Austria, Belgium, France, Germany, Italy and Spain.

Project Duration

The project has a duration of 48 months starting from 01 July 2023.

Project Activities

InSGeP involves 6 work packages, 23 tasks, 20 deliverables & 6 milestones.

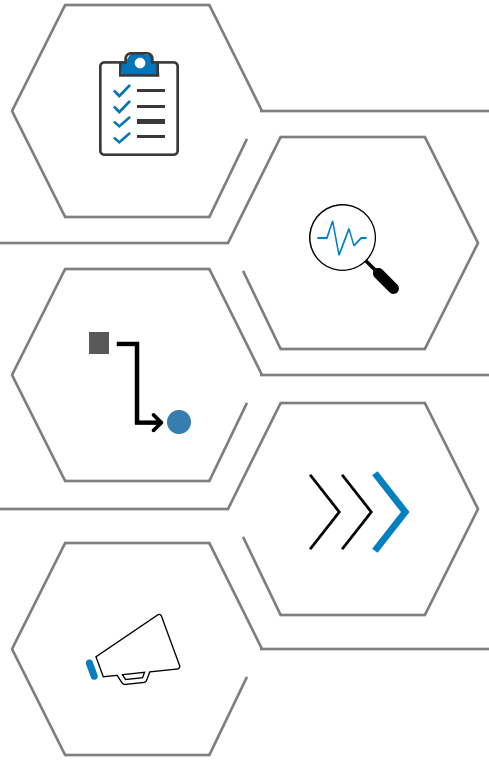
Funding

The project receives funding of the European Commission from the Research Fund for Coal and Steel.

RFCS Project InSGeP

Investigations of Slags from Next Generation Steel Making Processes

metallurgical competence center



Slag next generation steel making

Collection of information about next generation steel making and slag production (incl. regulatory situation and modelling)

Samples & laboratory analysis

Collection and creation of slag samples in laboratory, pilot and industrial scale (incl. analysis)

Slag treatment solutions

Simulation of cooling and (wet and dry) granulation

Possible applications

Testing of possible applications for slag, economic evaluation, environmental evaluation

Dissemination, exploitation & communication

Slag market analysis and exploitation activities, IPR management, website (insgep.eu)

INTERREG Projekt PHOSP4PLANT

Vom Abfall zur Ressource - Recycling von Klärschlamm-Asche zu phosphatreichem Pflanzendünger

Hauptziele

- Phosphor durch biologische Laugung aus Klärschlammaschen herauslösen
- Ammoniumphosphatdünger herstellen
- Düngerwirkung an Modellpflanzen testen

K1-MET: Koordination, Laugungsexperimente und Herstellung des Phosphatdüngers

BOKU, Institut für Abfall- und Kreislaufwirtschaft, Wien: Biolaugungsversuche, Bewertung des Prozesses

Masaryk Universität, Brünn: Metallanalytik, Pflanzenversuche im Gewächshaus, Bodenuntersuchungen

Technische Universität Brünn

Herstellung verschiedener Klärschlammaschen im Technikum

Partner

Das Konsortium besteht aus 4 wissenschaftlichen Partnern aus Österreich und Tschechien

Projektlaufzeit

36 Monate, laufend seit 01.05.2024

Förderung

Das Projekt wird aus Mitteln des EFRE gefördert (80% Förderquote)

Phosphorrückgewinnung

Bioelektrochemischer Ansatz

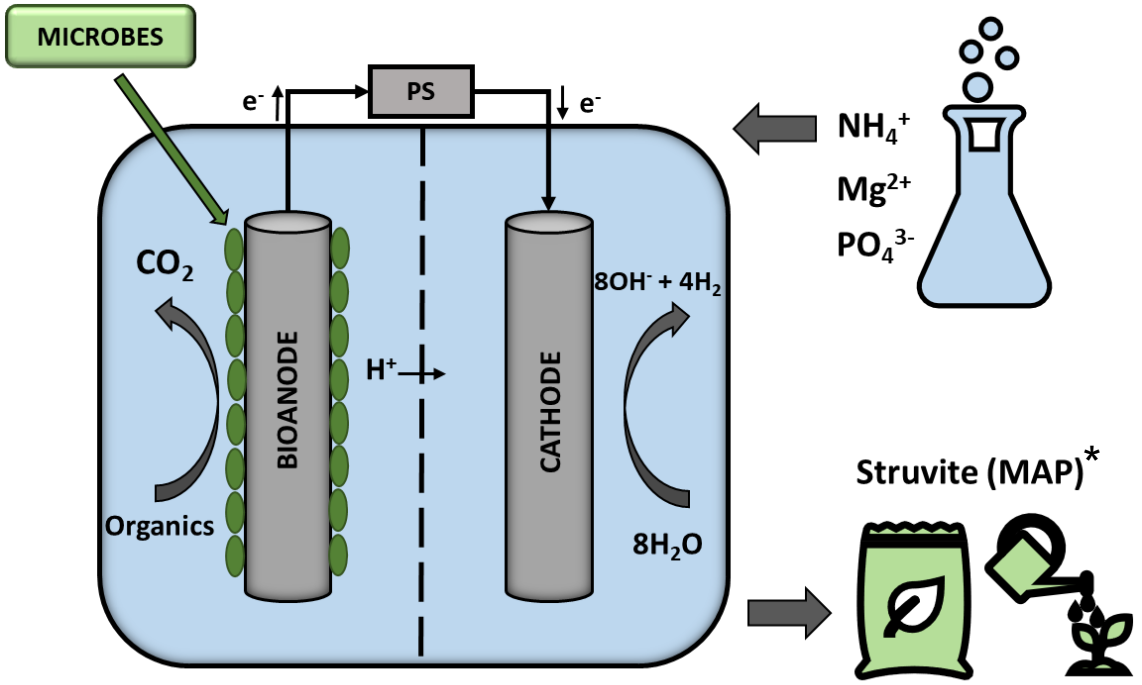
Bioanode

- Besiedelt von elektroaktiven Mikroorganismen
- Oxidieren organische Substanzen (z.B. Abwasser)
- Elektronen werden von Mikroorganismen an Anode abgegeben

$C_6H_{12}O_6 + 6\ H_2O \rightarrow 6\ CO_2 + 24\ H^+ + 24\ e^-$

Kathode

- Reduktion von Wasser, pH Anstieg
- Phosphorrückgewinnung als Struvit (Mg-Ammonium-Phosphat) durch Fällung mit Mg und N bei pH 8-10



* Magnesium-Ammonium-Phosphat

COMET Module FuLIBatteR

Future Lithium Ion Battery Recycling for Recovery of Critical Raw Materials

Module within the **COMET** – Competence Centers for Excellent Technologies Program focusing on:

- Waste management and waste technological approaches for lithium-ion-battery (LIB) recycling
- Pyrometallurgical processing of LIBs and black matter
- Bio-hydrometallurgical treatment of LIB residues

Project Period: 01/07/2022 – 30/06/2026

Company partners:

Scientific partners:

Financially supported by:

Federal Ministry Economy, Energy and Tourism Republic of Austria

Federal Ministry Innovation, Mobility and Infrastructure Republic of Austria

Coordinated by:

COMET Modul FuLIBatteR

Future Lithium-Ion Battery Recycling for Recovery of Critical Raw Materials

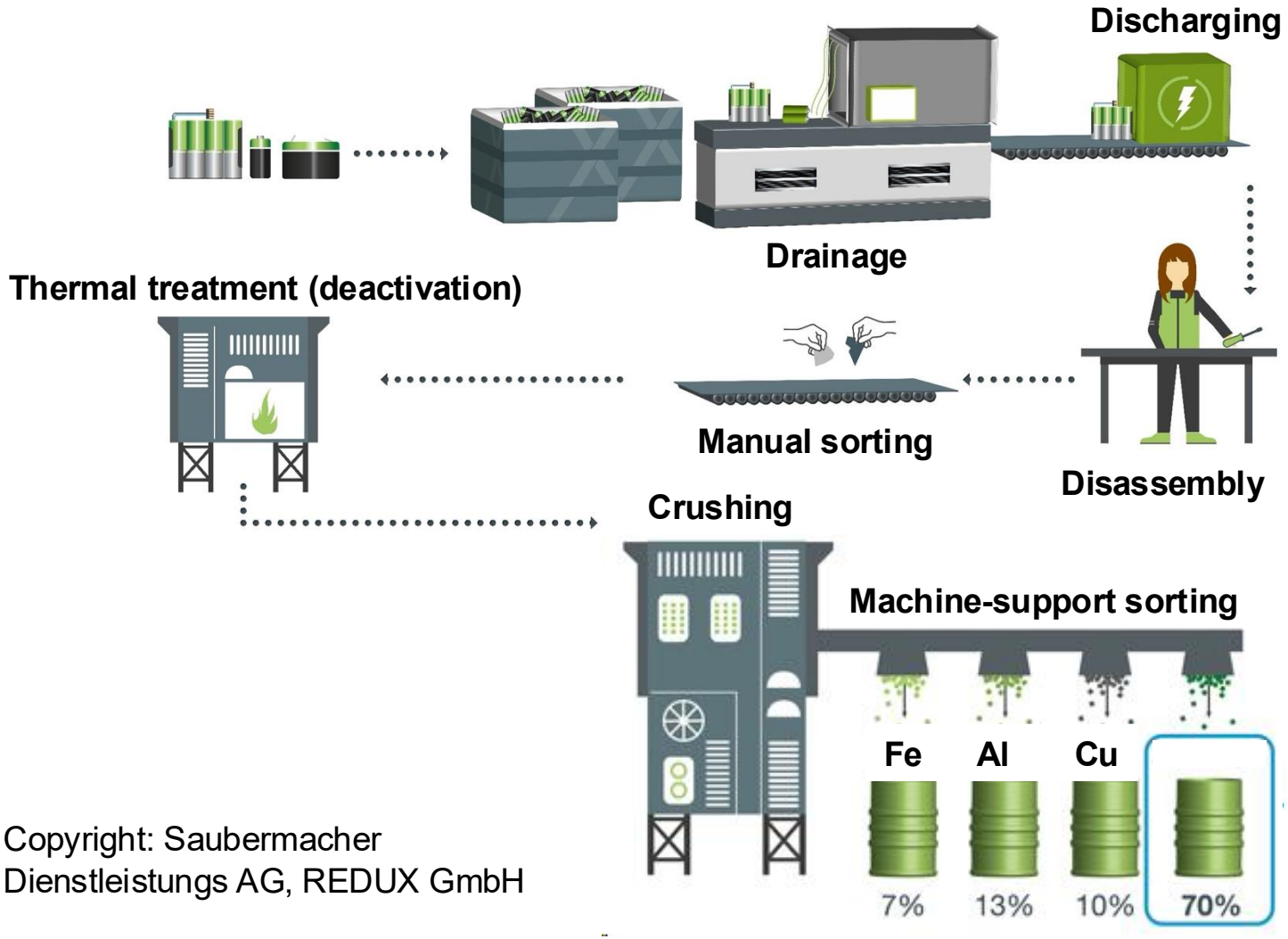
Module Consortium

Funding

Batteries as a source for secondary alloys

Austrian funded project „FuLIBatteR“

Future Lithium Ion Battery recycling to recover critical raw materials



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Federal Ministry Economy, Energy and Tourism Republic of Austria

Federal Ministry Innovation, Mobility and Infrastructure Republic of Austria

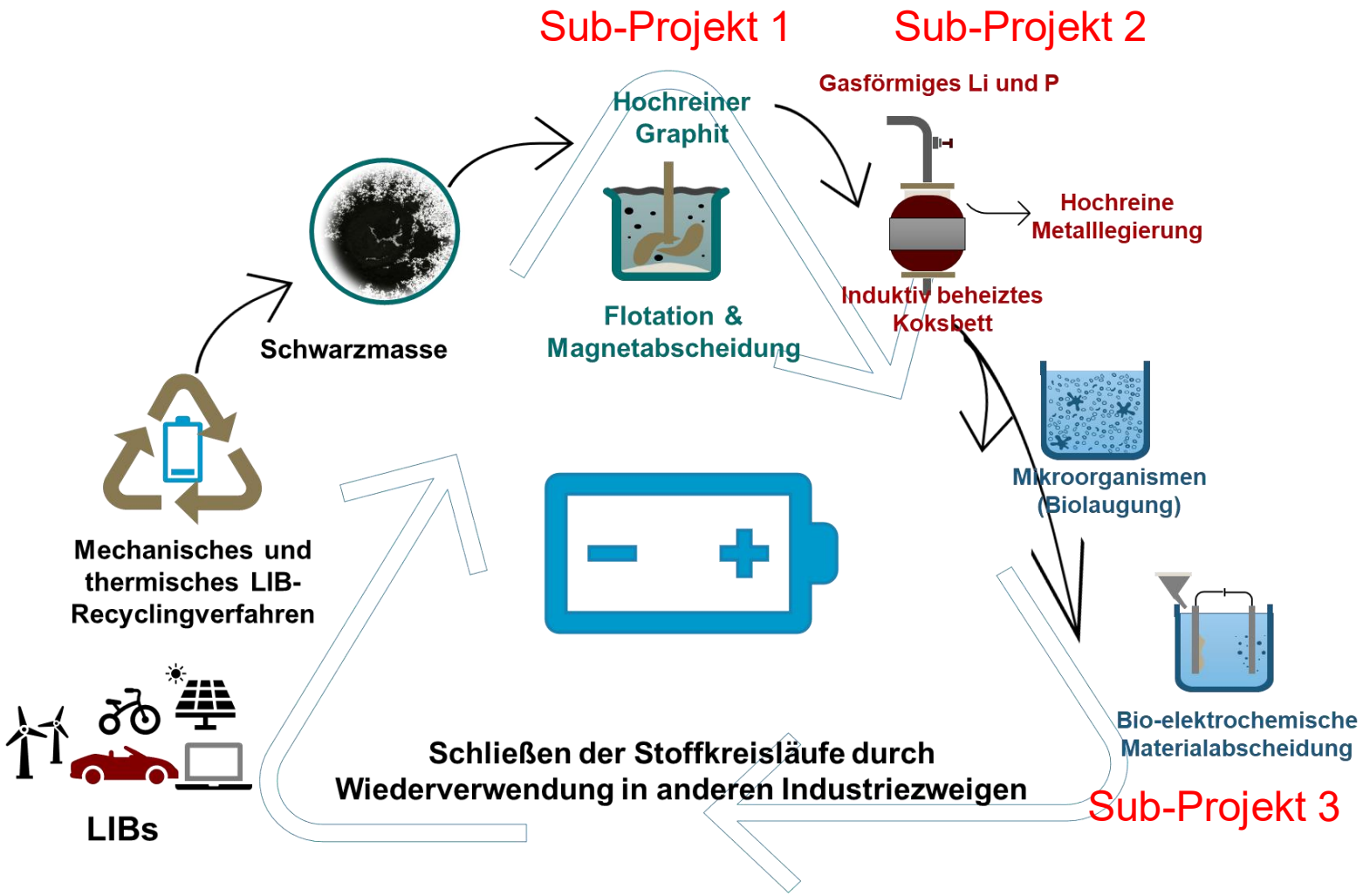
FFG Promoting Innovation.

- Austrian funded project (3.8 M€, 2022-2026)
- Fundamental project to selectively recover (critical) raw materials Li, Cu, Ni, Co, P, C from the active material
- Different approaches
  - Physical separation (flotation)
  - Pyrometallurgical treatment
  - Bioleaching and electrochemical metal separation

FuLIBatteR

Inhalte des COMET-Moduls

- Feinkörniges Aktivmaterial (Schwarzmasse) nach dem thermisch-mechanischen Batterierecyclingprozess als Startpunkt
  - Macht rund 70% des Batteriegewichts aus und enthält bis zu 40 Gew.-% Graphit sowie Li, Co, Mn und P
  - Derzeit noch keine Verfahren zur (möglichst) selektiven Rückgewinnung von Wertstoffen



Zero emissions through sector coupling

Industrial symbiosis

Type:	Flagship project
Costs:	16.7 M€
Funding:	7.6 M€
Funding Agency:	Climate and Energy fonds
Duration:	10/2023 - 09/2027 (4 years)

(Co)

Project Goals

- Cost-optimized green hydrogen production to balance the electricity grid
- Demonstration of CO_2-capture and utilization (CCU) process chains at TRL=7 to close the CO_2-cycle
- Accelerate technology transfer into practice
- Identify synergies between energy intensive industries
- Techno-economic analysis

COMET Module – PlasmArc4Green

PlasmArc4Green

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SIMULATION, MODELLING AND MONITORING OF PLASMA AND ARC BASED PROCESSES FOR GREEN METAL PRODUCTION

Project Budget:	3 750 000 €
Funding:	3 000 000 €
Module Duration:	01 July 2024 – 30 June 2028
Funded by:	BMK, BMAW as well as federal provinces of Upper Austria, Styria and Tyrol

FFG Promoting Innovation.

Federal Ministry Economy, Energy and Tourism Republic of Austria

Federal Ministry Innovation, Mobility and Infrastructure Republic of Austria

upper austria

Das Land Steiermark
Wirtschaft, Tourismus, Wissenschaft und Forschung

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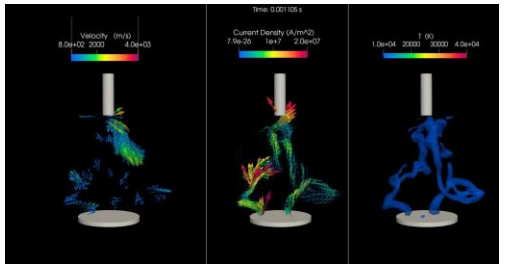
COMET Module – PlasmArc4Green

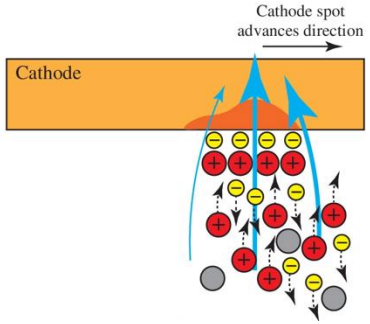
Plasma modelling and experimental validation

- **Project 1 – Bulk Plasma Properties and Dynamics**

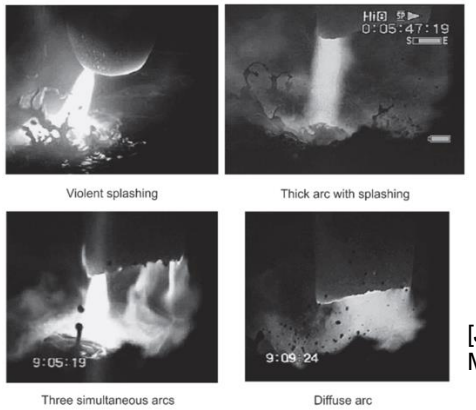


[Reference: A. Kharicha]

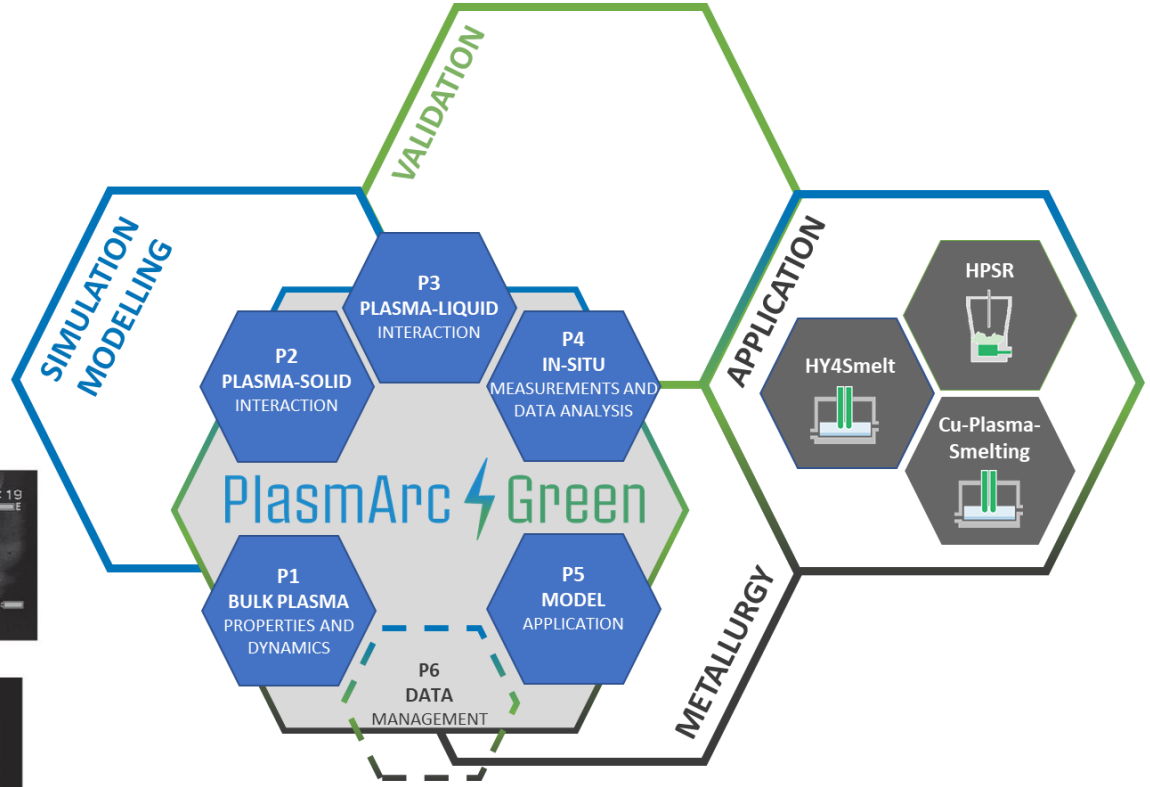
- **Project 2 – Plasma-solid interaction**



[Z. Ren et al, 2022]



- **Project 3 – Plasma-liquid interaction**

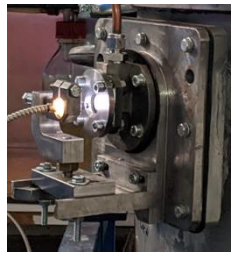


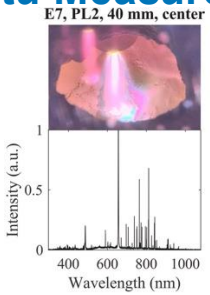
[Jones et al.,
Minerals Engineering, 2002]

COMET Module – PlasmArc4Green

Plasma modelling and experimental validation

- **Project 4 – In-Situ Measurements and Data Analysis**





[Pauna et al., 2022]

- **Project 5 – Model Application**

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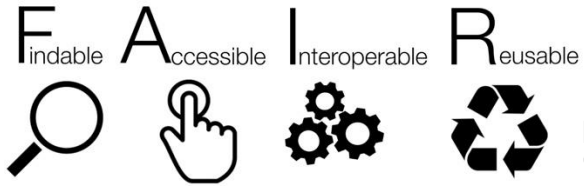
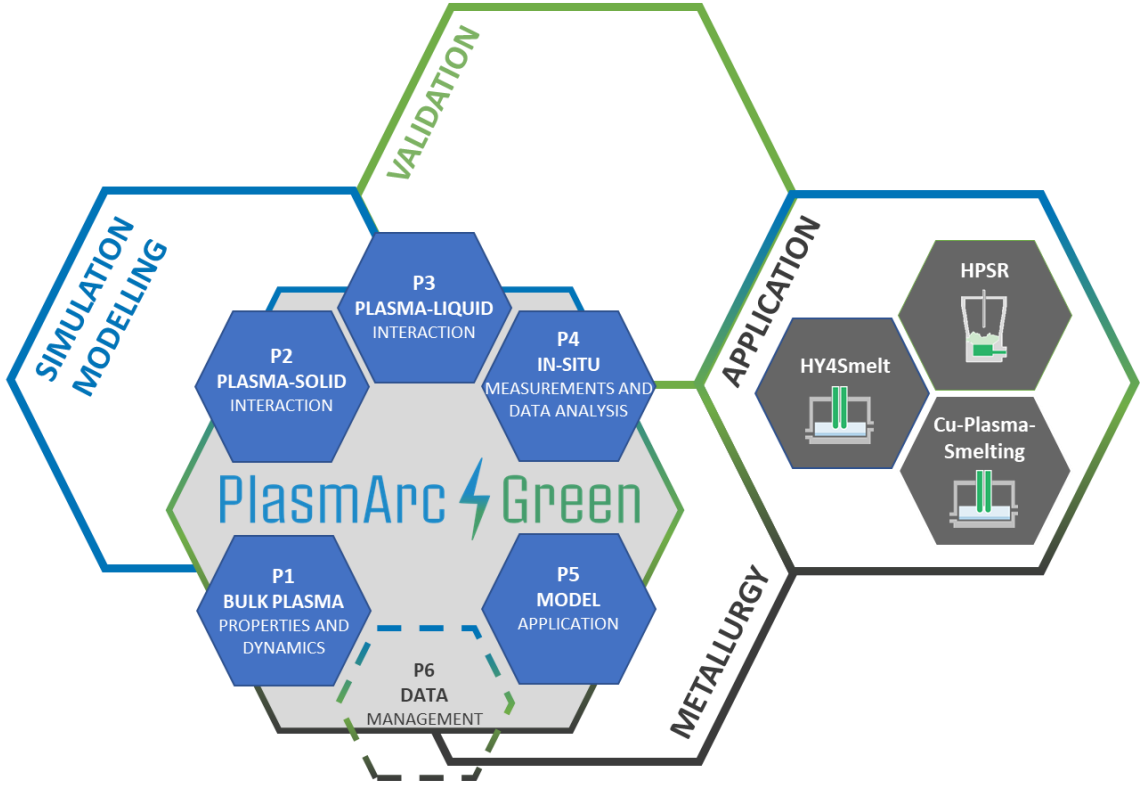
Reference: voestalpine

- **Project 6 – Data Management**



[Sangya Pundir / CC BY-SA (https://creativecommons.org/licenses/by-sa/4.0)]



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Linz, 1 July 2023

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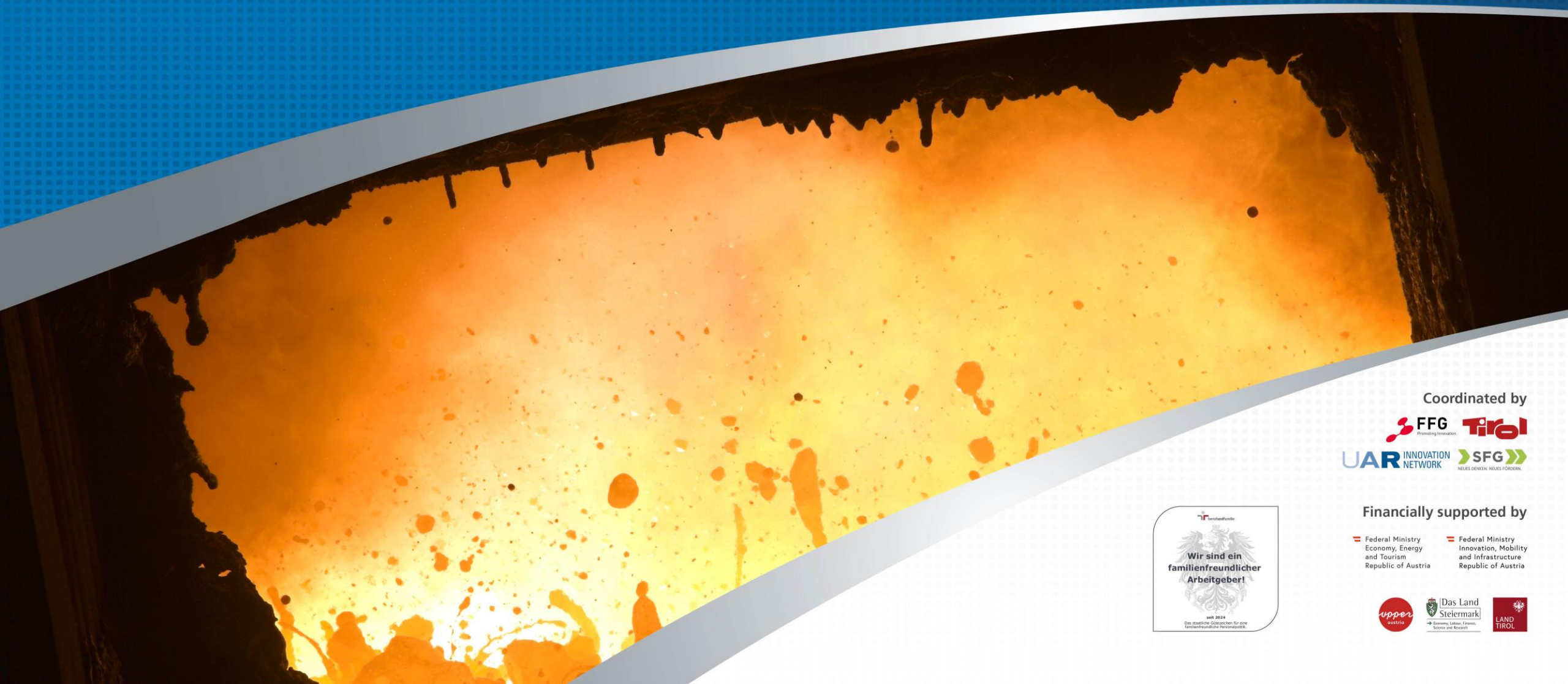

metallurgical competence center

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upper austria

Das Land Steiermark

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Wir sind ein familienfreundlicher Arbeitgeber!