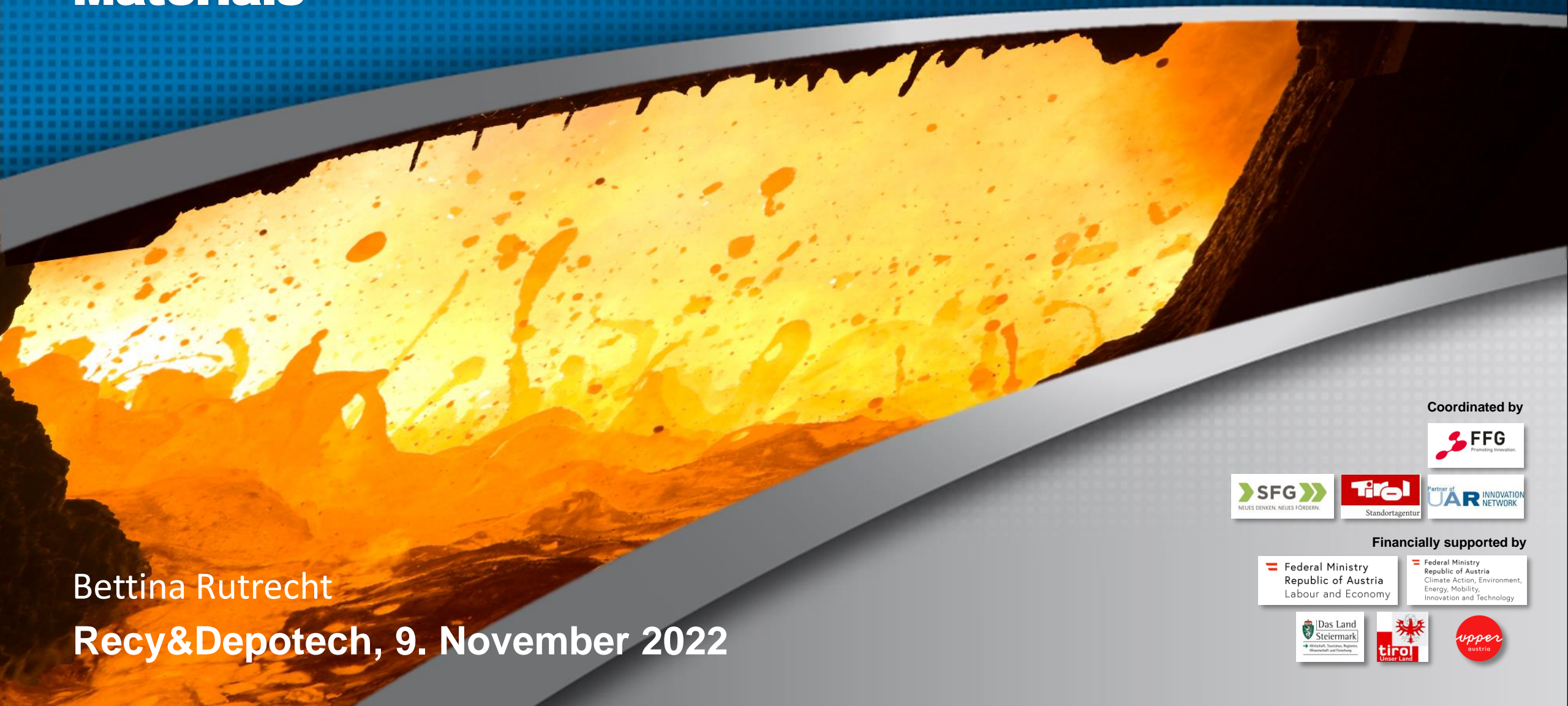


FuLIBatteR – Future Lithium-Ion Battery Recycling for Recovery of Critical Raw Materials



Bettina Rutrecht
Recy&Depotech, 9. November 2022

Coordinated by



Financially supported by





K1-MET GmbH



Initial Situation

E-mobility and CRM
Green Technology and CRM
Demand for CRM
Supply Risk of CRM



Project FuLiBatter

Overview
Structure
Work Packages



Summary

K1-MET GmbH

Since 2015

Competence Center for
Excellent Technologies in
Advanced **Metallurgical**
and **Environmental**
Process Development

Budget: 22.7 M€

Main locations

- Linz
- Leoben

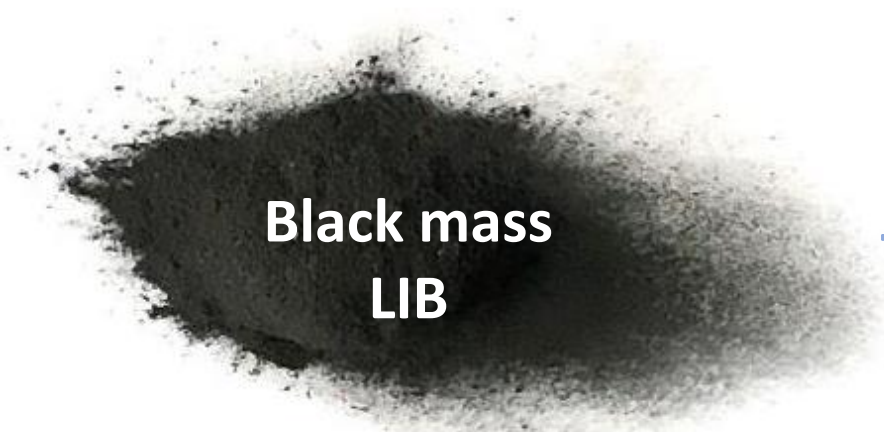
75 employees





Four symbiotic areas:

- **Area 1: Raw Materials and Recycling**
 - Endeavours the best possible utilisation of all resources.
- **Area 2: Metallurgical Processes**
 - Unites the core topics of metallurgical process developments.
- **Area 3: Low Carbon Energy Systems**
 - Is dedicated to the developments of carbon-lean steel production.
- **Area 4: Simulation and Analyses**
 - Represents the enveloping area for numerical developments and data analyses.



Black mass
LIB



Four symbiotic areas:

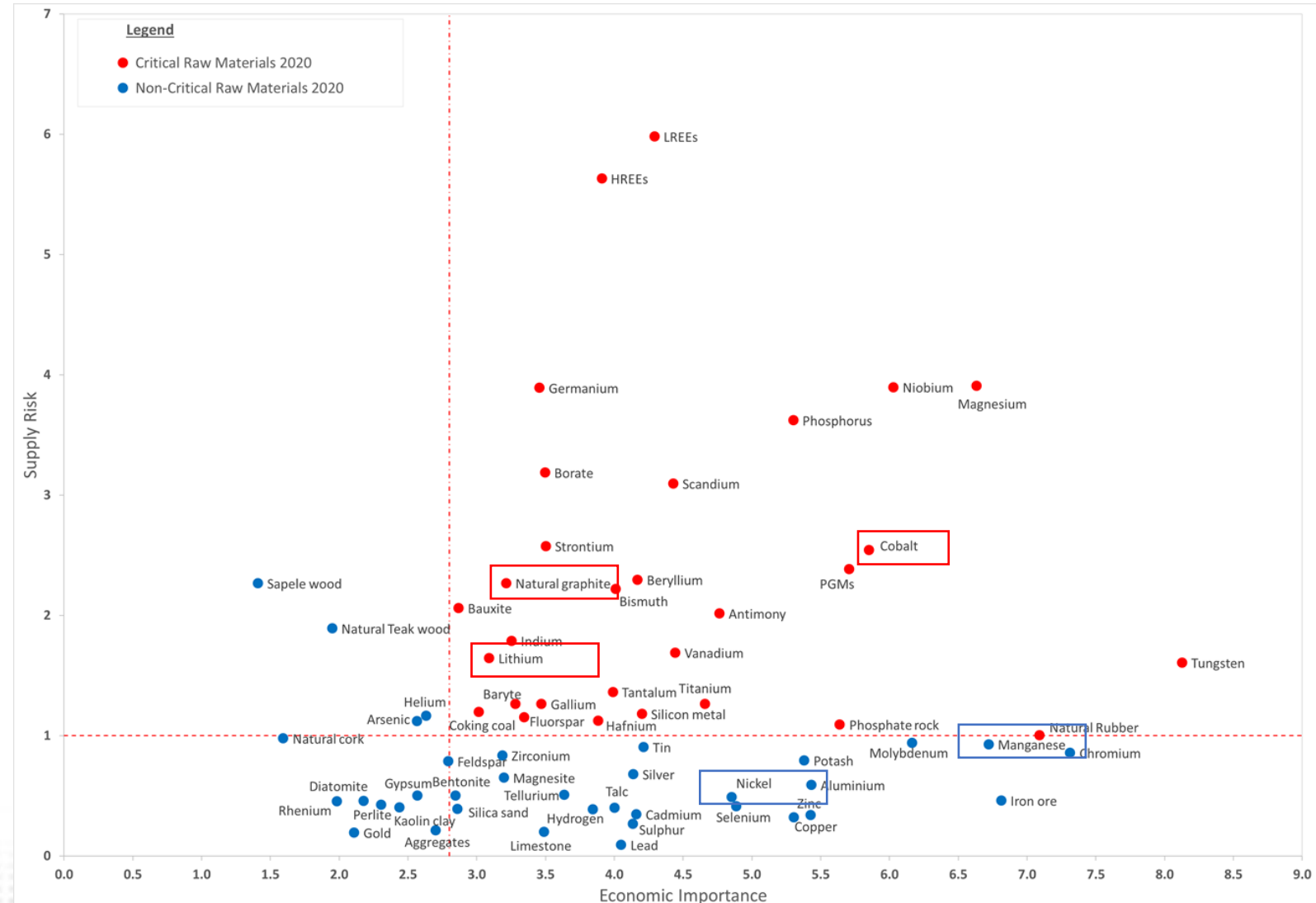
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Initial Situation

E-mobility and Critical Raw Materials

- **Energy Storage System (type NMC532)¹**

- 8 kg **Li**
- 35 kg **Ni**
- 20 kg **Mn**
- 14 kg **Co**
- **Graphite**

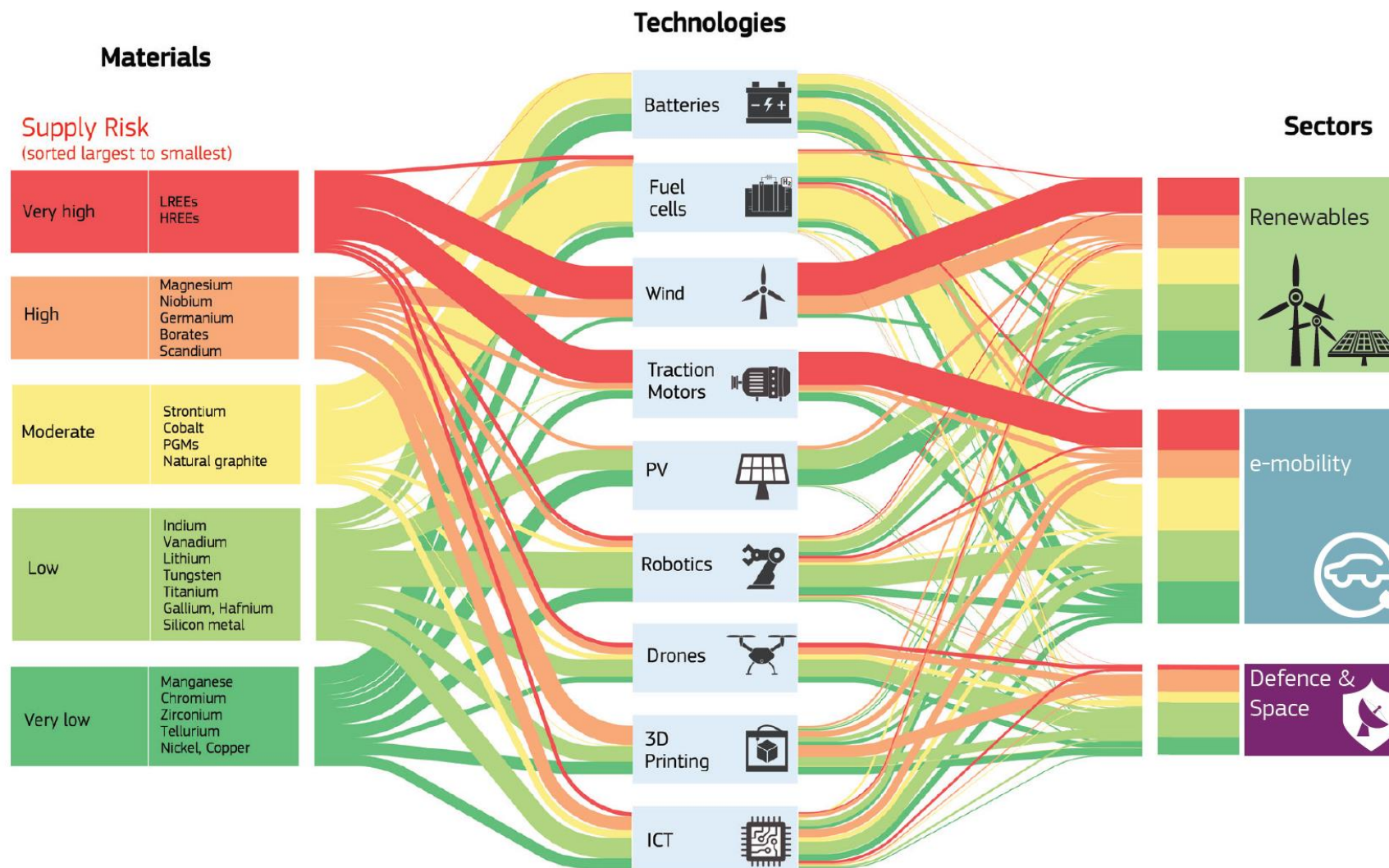


¹ Source: Argonne National Laboratory 2020

Figures: ESS BMWi3 Bmwblog 2017; RMIS - CRM list 2020

Initial Situation

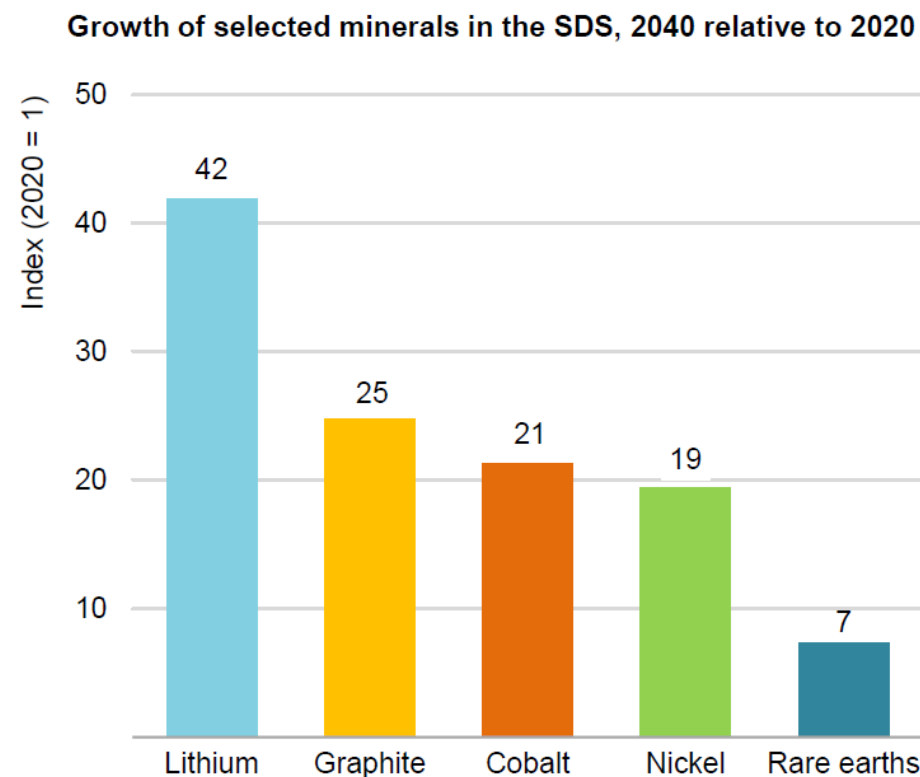
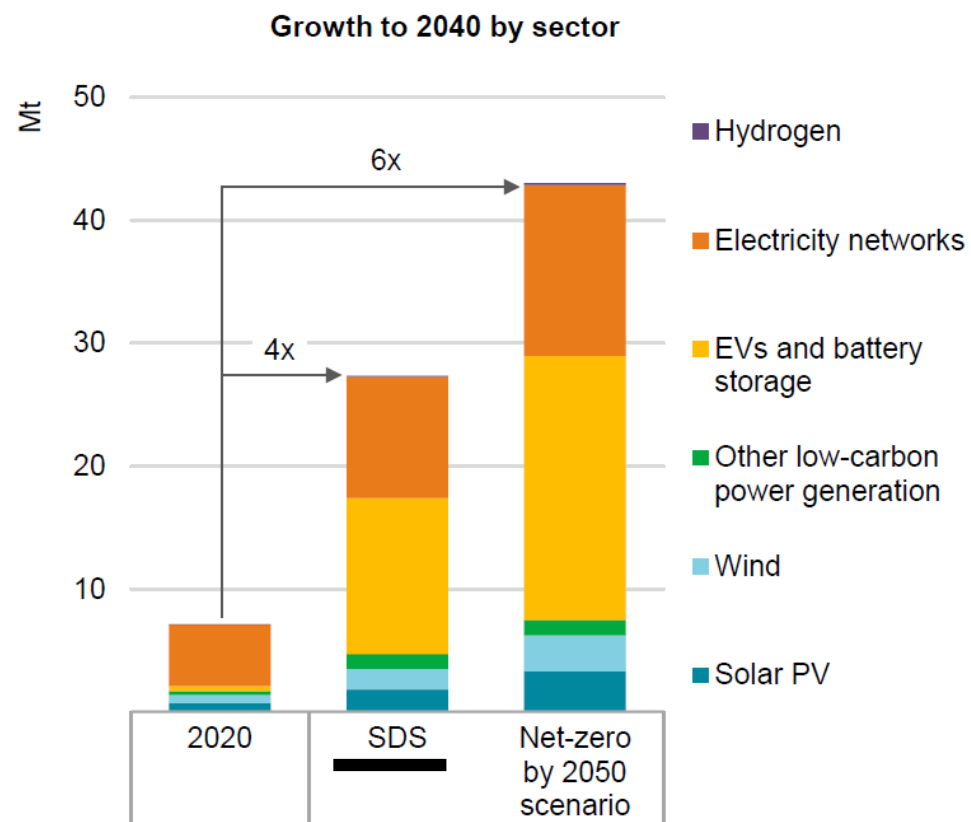
Green Technologies and Critical Raw Materials



CRM are of significant economic importance for the EU

Initial Situation

Demand of Critical Raw Materials



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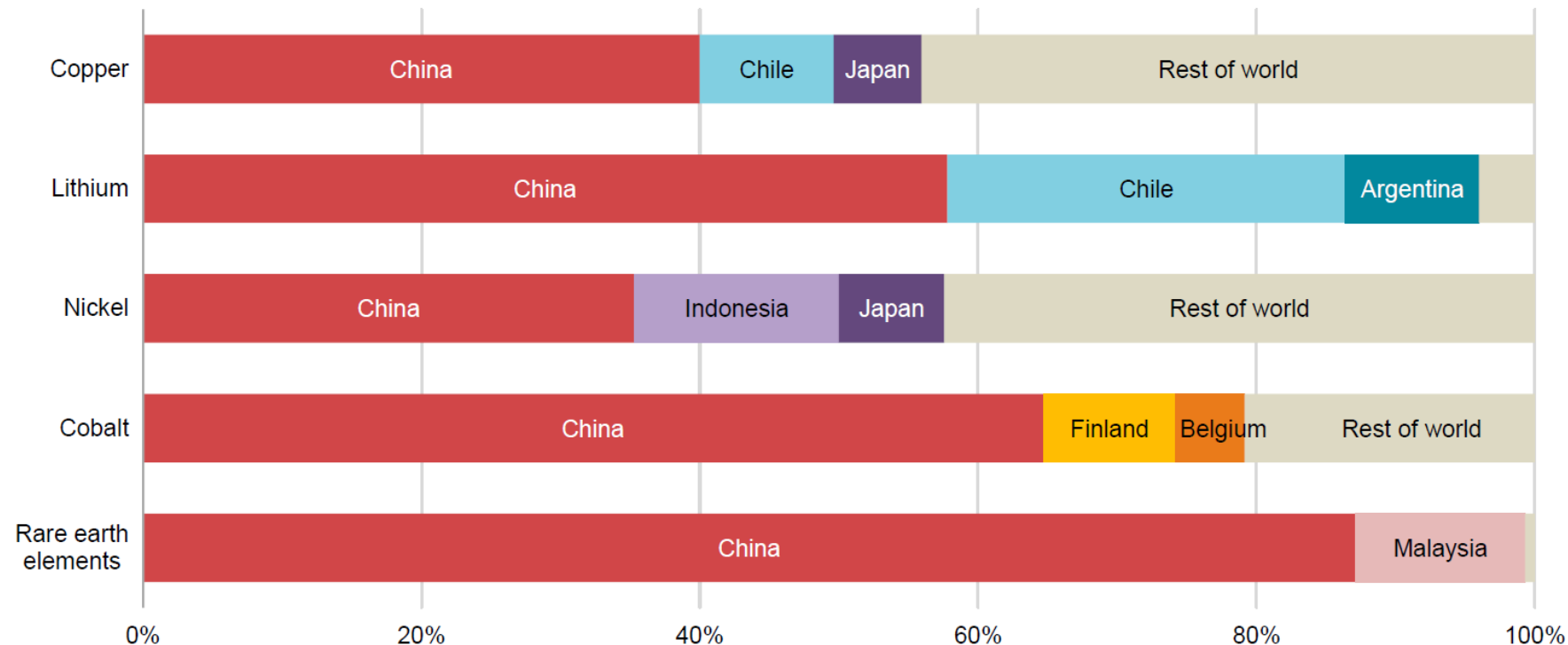
SDS

Sustainable Development Scenario. Supply required to meet Paris Agreement Goals ($\Delta T = +2,0^{\circ}\text{C}$)

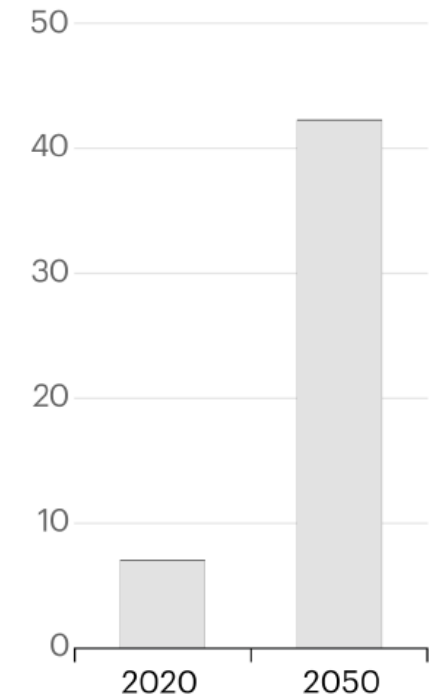
Initial Situation

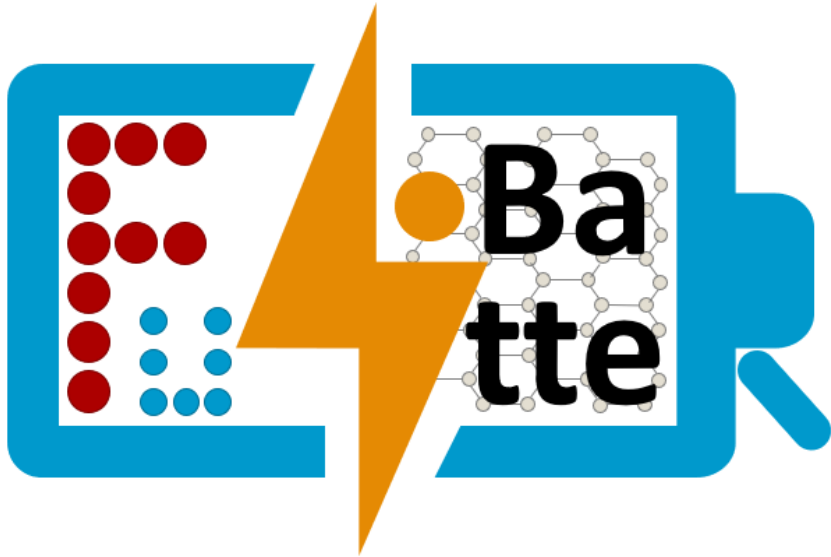
Supply Risk of Critical Raw Materials

Share of processing volume by country for selected minerals, 2019



Critical minerals demand (Mt)





Project FuLiBatter



Project FuLiBatter

Future Lithium-Ion-Battery Recycling for Recovery of CRMs



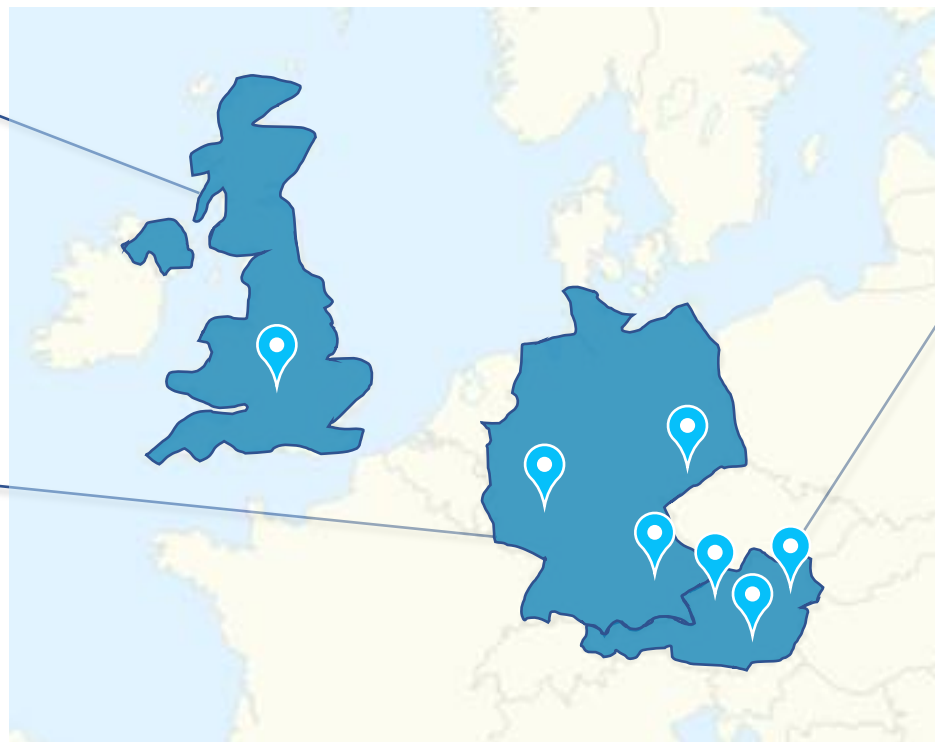
United Kingdom



Germany



B·R·A·I·N



Duration
Budget

07/2022 - 06/2026
3.75 Mio €

Austria

EBNER®



RHI MAGNESITA



christof
industries



voestalpine

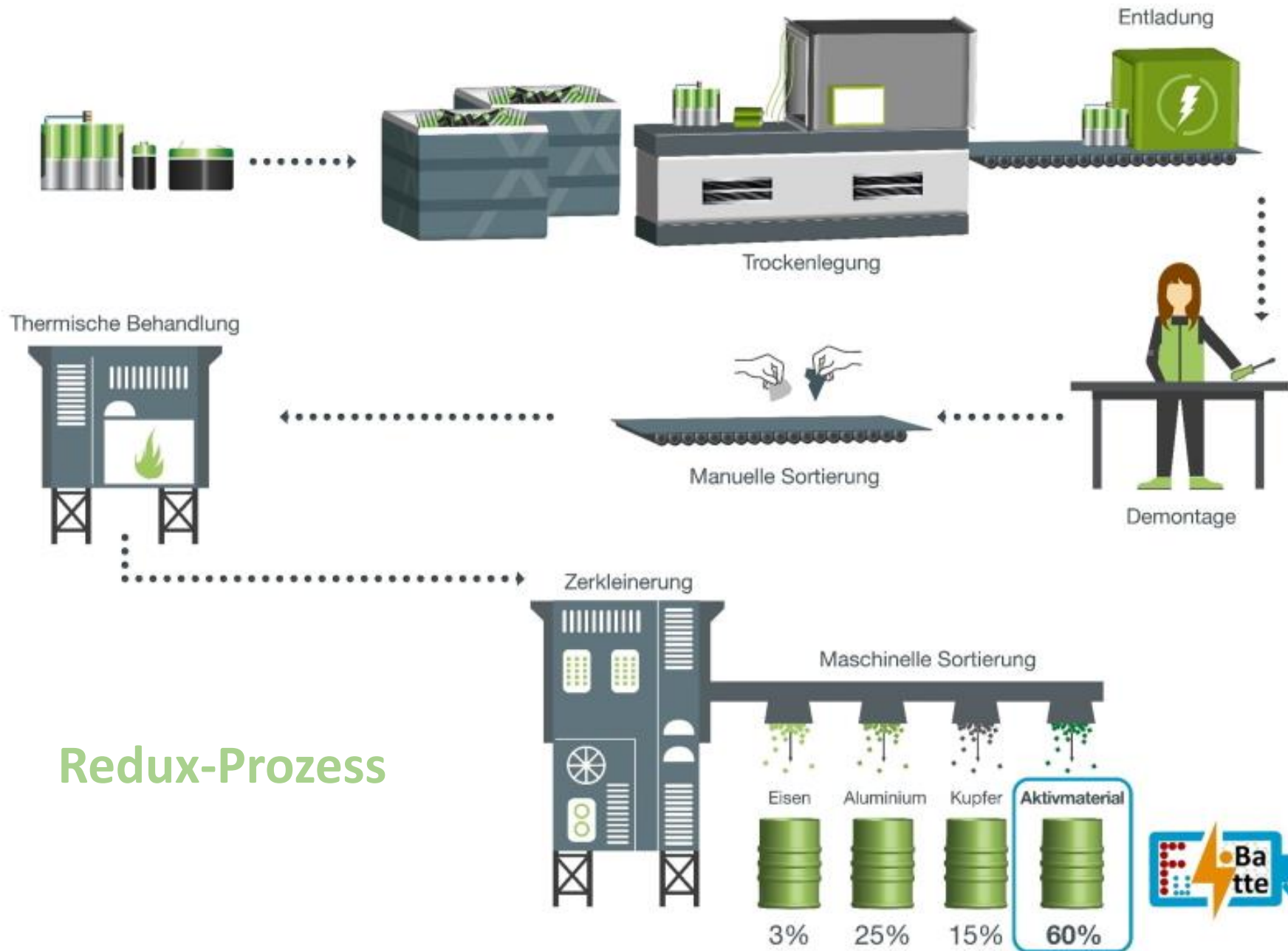
ONE STEP AHEAD.

MONTAN
UNIVERSITÄT



Landesgesellschaft
Österreich

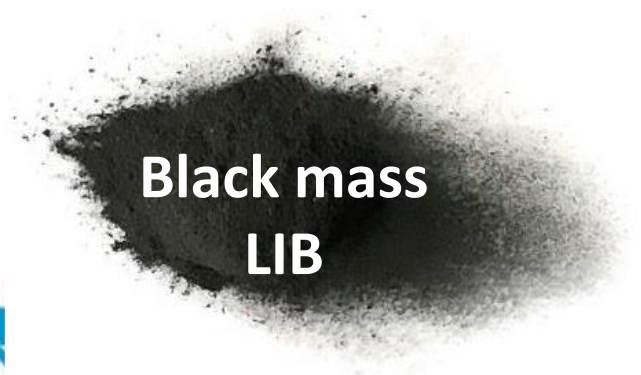
Saubermacher



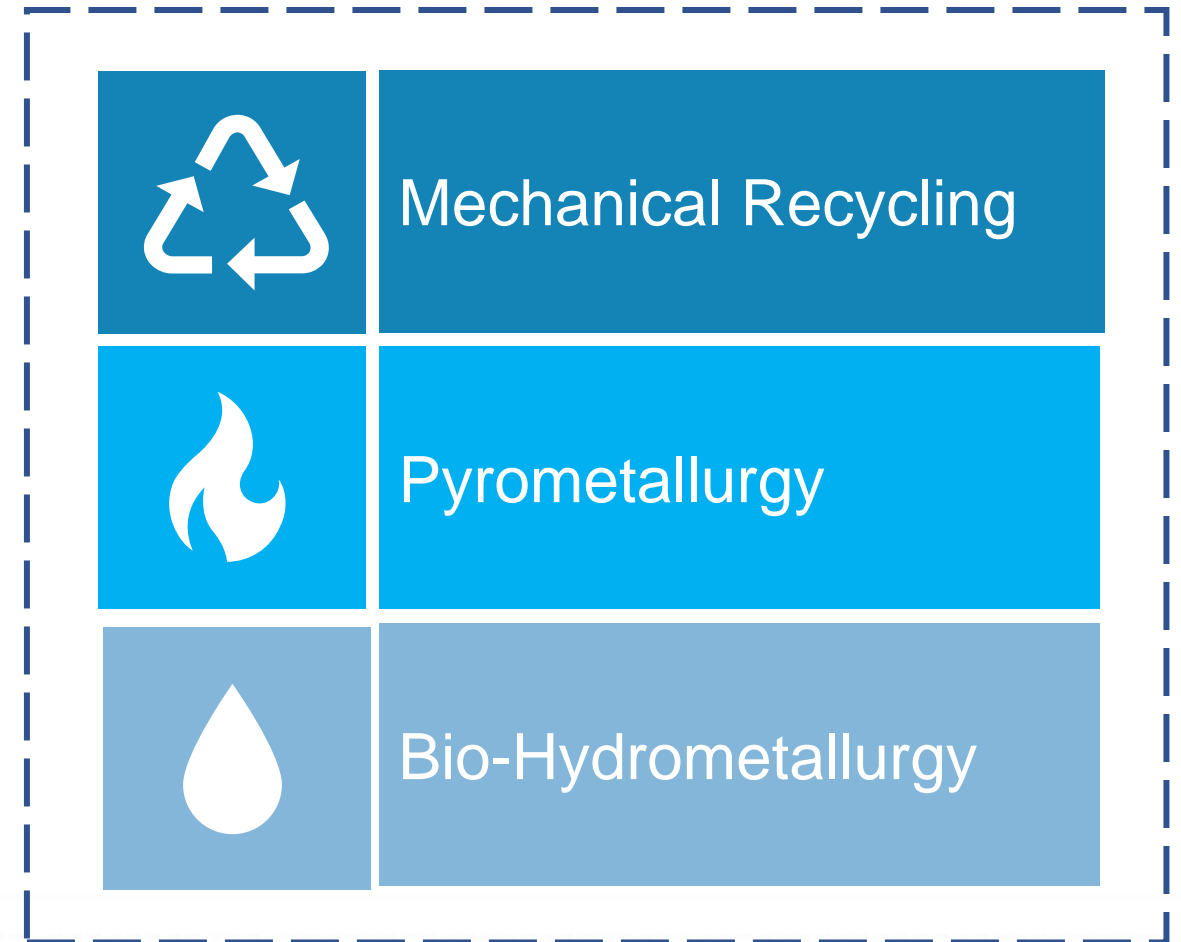
Redux-Prozess

LIB-ESS (type NMC532) ¹

- 8 kg Li
- 35 kg Ni
- 20 kg Mn
- 14 kg Co



LCA and Zero Waste Concept





FuLIBatteR

2026



Waste Management and Waste Technological Approaches for LIB Recycling



Pyrometallurgical Process of LIBs and Black Matter



Bio-Hydrometallurgical Treatment of LIB Residues

1 - Waste Management and Waste Technological Approaches for LIB Recycling



WP1.1: Physical separation of CRM fractions, quantitative evaluation, and quality verification

WP1.2: Processing of flotation liquid fraction

WP1.3: Materials characterisation and marketability evaluation of process outputs

WP1.4: Market analysis and identification of opportunities and challenges for LIB recycling

2 - Pyrometallurgical Process of LIBs and Black Matter



WP2.1: Simulation and development of optimized thermal deactivation step in REDUX process

WP2.2: Material specific investigations and process simulation based on thermodynamics

WP2.3: High-temperature experiments in inductively heated packed bed reactor

WP2.4: Post-treatment of pyrometallurgical recycling output

3 - Bio-Hydrometallurgical Treatment of LIB Residues



WP3.1: Selection and cultivation of microorganisms

WP3.2: Biobleaching batch tests and process scale-up advances

WP3.3: Catalysis of leaching reaction by biosurfactants and metal ions

WP3.4: Metal recovery from leaching solutions

FuLiBatteR

2026



Waste Management and Waste Technological Approaches for LIB Recycling



Pyrometallurgical Process of LIBs and Black Matter

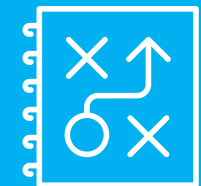


Bio-Hydrometallurgical Treatment of LIB Residues

MFA & LCA



Best option?



How to?

- **FuLIBatteR is committed to contribute its share to enable circularity**
- **Enable strategic resilience**
 - with regards to CRMs and other valuable raw materials on EU level (Li, Co, Ni, Mn, Cu, Al, P, C, Si)
- **Provide a solid basis for discussion of ecologically reasonable LIB recycling**
 - Life-cycle assessment of LIB recycling steps, Zero Waste concepts
- **Offer secondary raw materials for steelmaking and other resource intensive industries**
- **Transfer of science and technology**



Please, feel free to visit our homepage or follow us on social media for updates!

- <https://www.k1-met.com/>
- <https://www.researchgate.net/project/FuLiBatteR-Future-Lithium-Ion-Battery-Recycling-for-Recovery-of-Critical-Raw-Materials>
- <https://www.linkedin.com/company/k1-met/>



Thank you for your attention!



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Area Raw Materials and Recycling

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