

# COMET Module FuLiBatter



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

Workshop: Critical Raw Materials for Electric Vehicles

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Virtual, 15/12/2022

Coordinated by



Financially supported by



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# **1 Welcome**

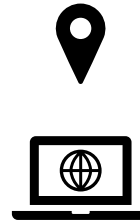
# Welcome

## Get-to-know



Elizaveta Cheremisina  
(Post-Doc)

- K1-MET – Competence Center for Excellent Technologies in Advanced Metallurgical and Environmental Process Development
- Currently 78 employees
- Thereof 65 researchers (master and PhD students, post-docs, Senior Experts)
- Locations: Linz and Leoben
- <https://www.k1-met.com>



### Financing:

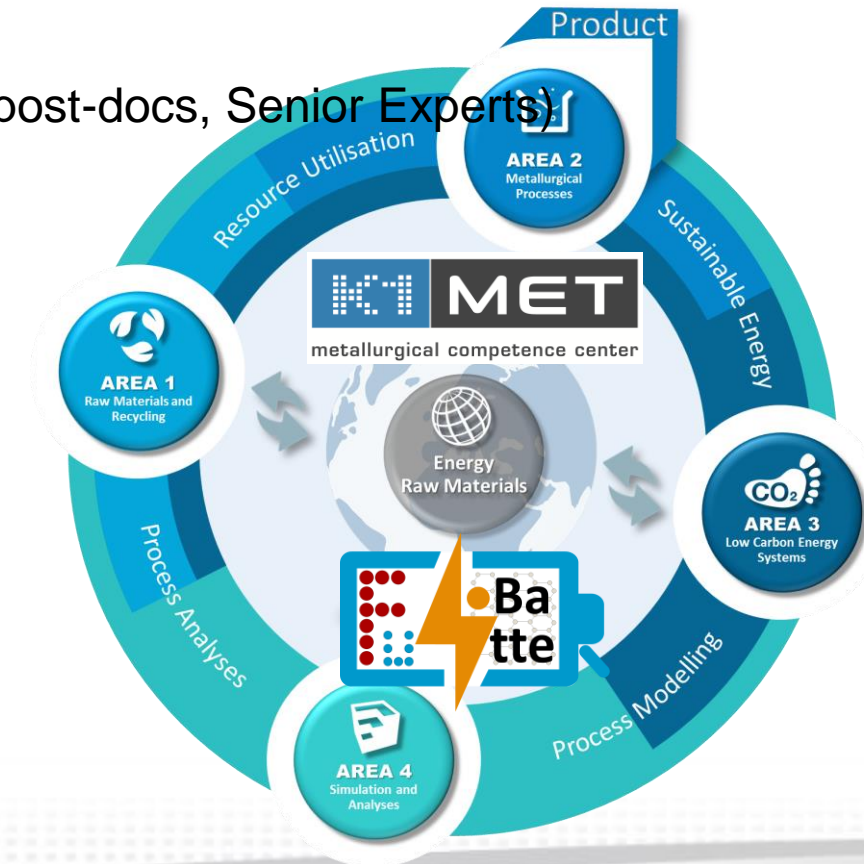
45% funding

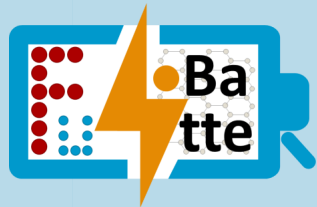
30% Austrian Research Promotion Agency

15% Participating federal states

5% scientific partners

50% Corporate Partners





## 2 Introduction of the Module **FuLIBatter**



- Based on the [European Green Deal](#), the [Circular Economy Action Plan](#) and the [Industrial Strategy](#), there is an ambition to increase the collection rates and recycling of Li from LIBs to 70% and recovery rate of Co, Ni, and Cu up to 95% in 2030
- The aim of the [European Battery Alliance](#) is to build up battery technology and increase the production and recycling of LIBs in the EU, reach climate neutrality with low-emission mobility by 2050, secure access to raw materials by closing material cycles
- Focus on Circular Economy with special emphasis on the recovery of valuable metals and critical raw materials (CRM) from Lithium-Ion Batteries (LIB) and closing the gap in material cycles

**Climate neutrality  
with low-emission mobility**



**Circular economy**

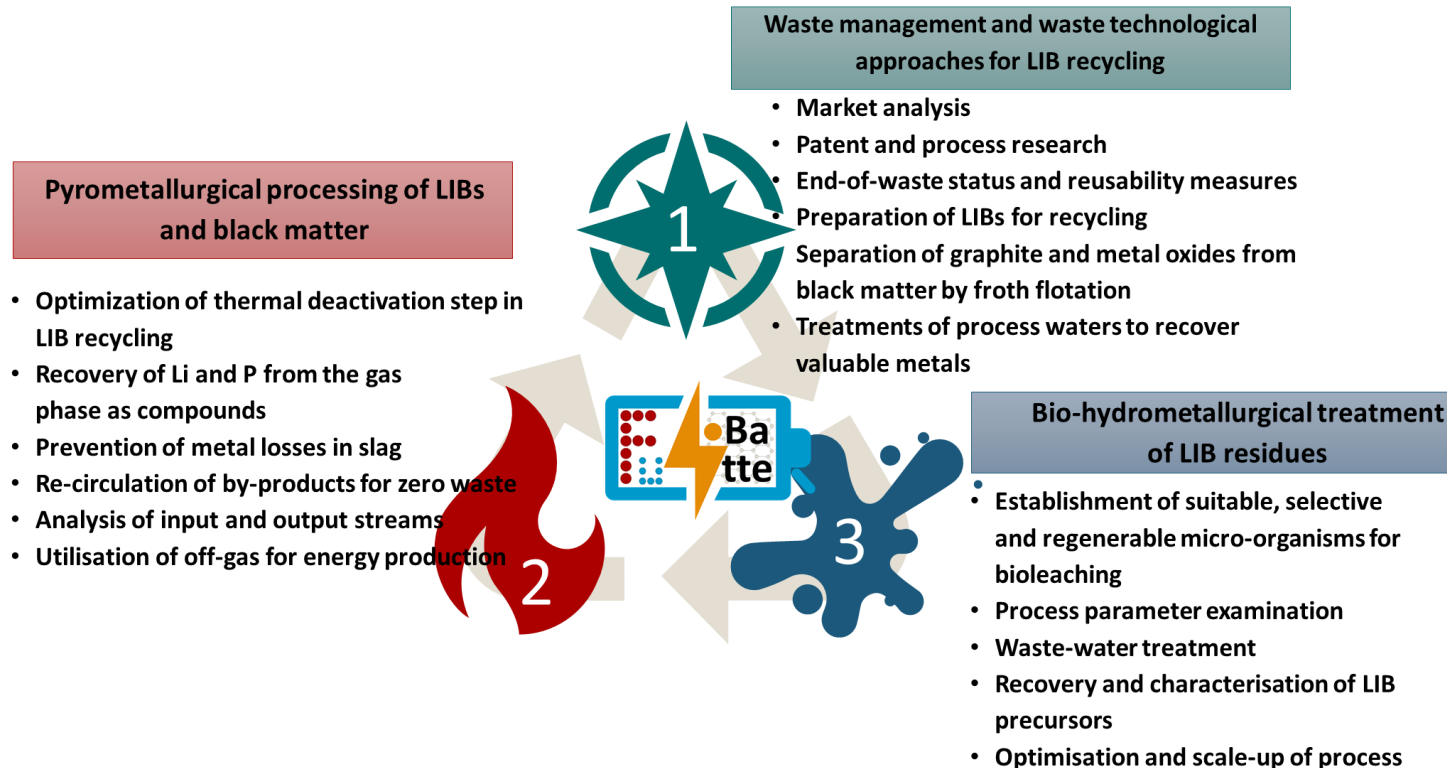


**Zero waste policy**



### Modul FuLIBatteR: Future Lithium-Ion Battery Recycling for Recovery of Critical Raw Materials

**Development of a robust, sustainable, closed-loop LIB-recycling process for the recovery of valuable metals and critical raw materials**



#### Duration

01.07.2022 - 30.06.2026

#### Funding

Federal funding, state funding from Upper Austria and Styria, participation of scientific and industrial partners

#### Budget

3,75 Mio.€

# FuLiBatter

Consortium of the Module



B·R·A·N

EBNER®



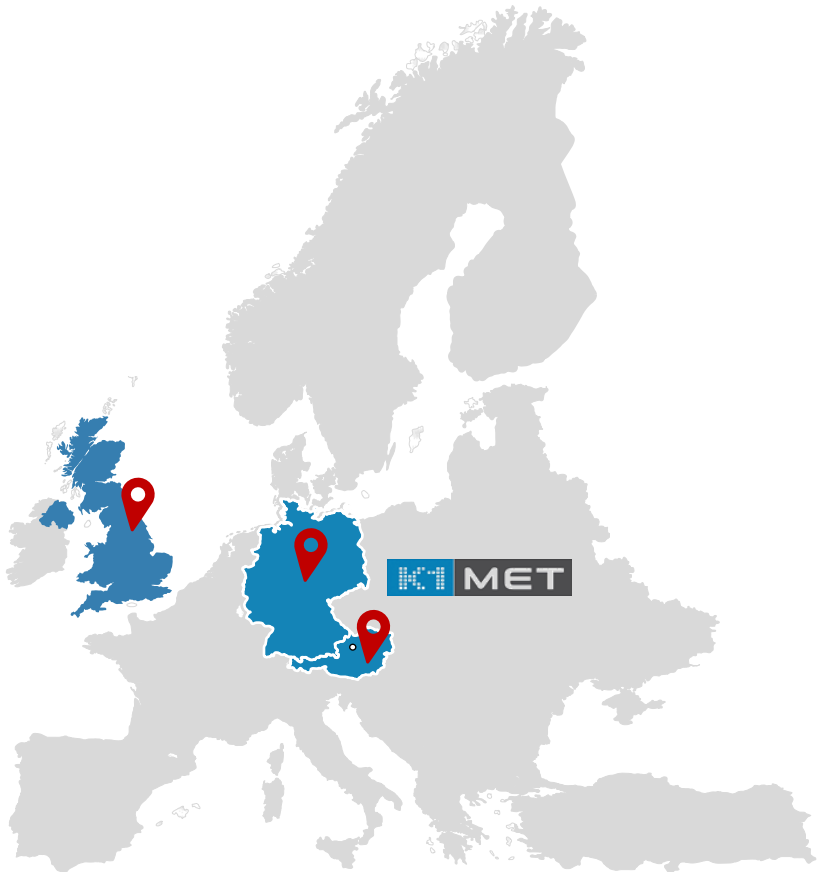
RHI MAGNESITA

Saubermacher



voestalpine

ONE STEP AHEAD.





### COMET Module Programme of FFG only for existing COMET K1 Centres

Financing	EUR p.a.	% of budget
Public fundings by Federal Ministries	500,000	53.33
Public fundings by Upper Austria and Styria	250,000	26.67
Contributions of the Scientific Partners	46,875	5.00
Contributions of the Company Partners	140,625	15.00
<b>Total</b>	<b>937,500</b>	<b>100.00</b>

### Funded by

 Federal Ministry  
Republic of Austria  
Climate Action, Environment,  
Energy, Mobility,  
Innovation and Technology

 Federal Ministry  
Republic of Austria  
Labour and Economy



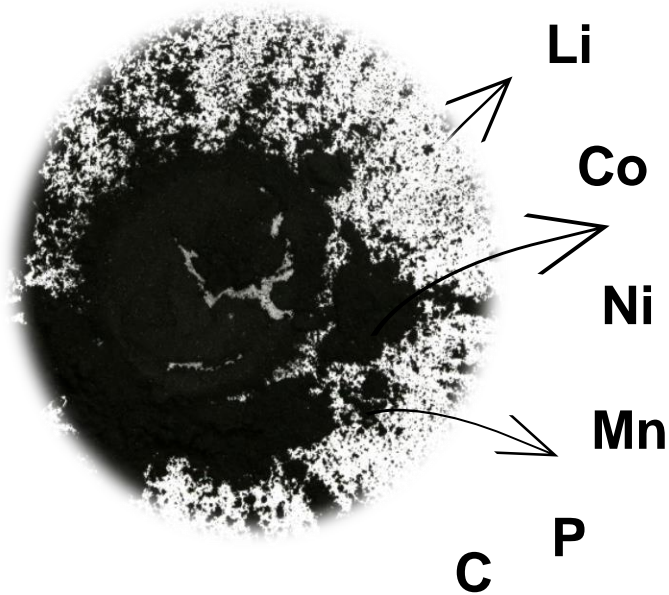
### Supported by



# **3**

## **Technical Problem Description**

- **Fine-grained residue fraction from the mechanical and thermal decomposition of LIB; contains the critical raw materials (Li, P, Co and graphite) and metals (Cu, Ni and Mn)**

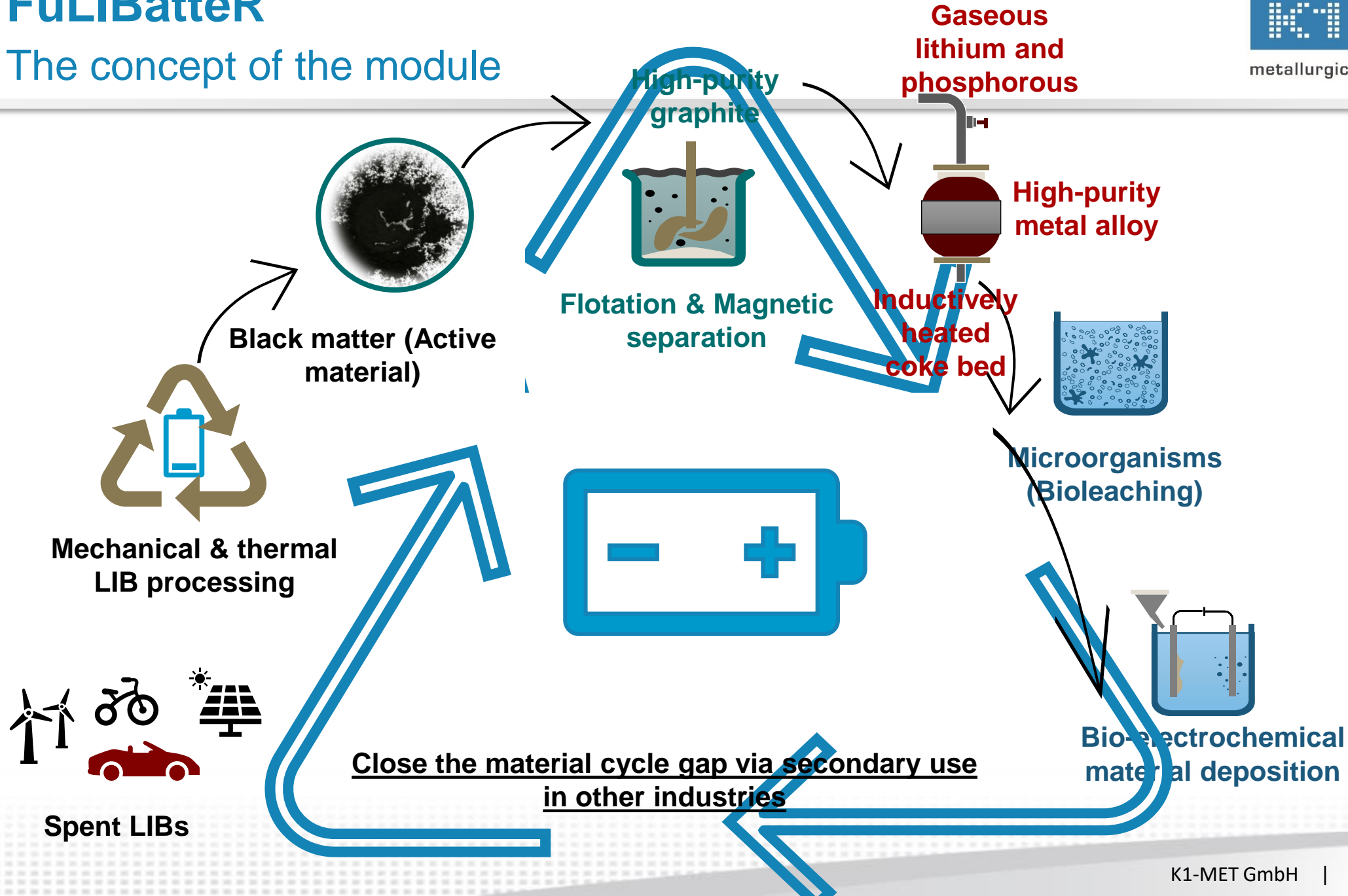


- Ensure a safe, circular and sustainable battery value chain
- Provide sustainably produced secondary raw materials for the battery production
- Secure raw material supply and reduce the dependency on the global raw material markets
- Prevention of landfilled end-of-life wastes
- Increase social acceptance of LIB and application in the automotive industry
- Fundamental research on raw material characterization and recycling of metal containing residues

- **Efficient routes going beyond state-of-the-art to treat residues from the mechanical and thermal LIB decomposition process**
- **Cross-sectorial approach with an intersection of waste management, process technology and metallurgy**

# **4**

## **The Concept**

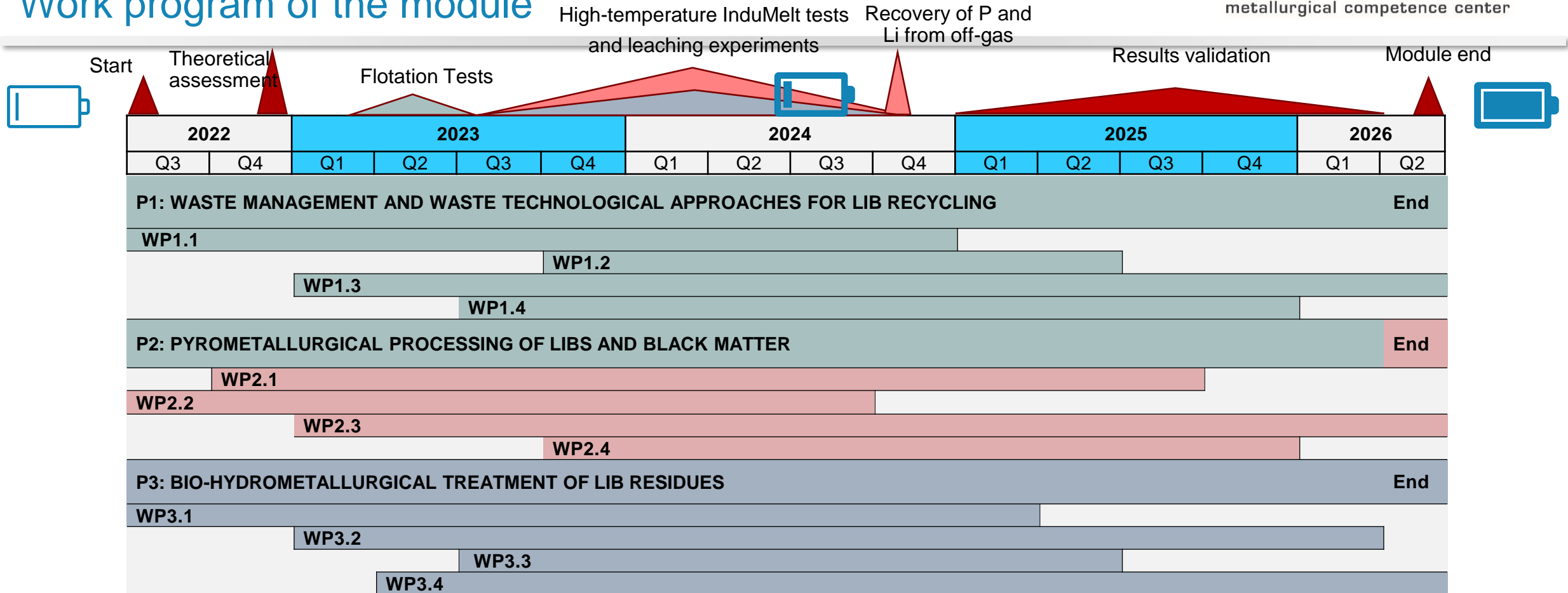




# **5 Status & Progress**

# Status & progress

## Work program of the module



### 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 PROCESSING OF LIBS AND BLACK MATTER

- WP2.1: Simulation and development of optimised 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: Bioleaching 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

# **6**

## **Introduction of the Sub - Projects 1-3**



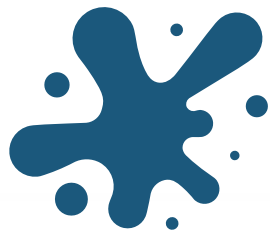
### Project 1:

- Sampling of active material was done (for example LIB types: NMC, LFP, HLF)
- Chemical analyses of LIB types started and element distribution (Si, Cu, Ni, P etc.) in LIB types determined
- Preparation for the flotation tests and selection of suitable flotation agents



### Project 2:

- TGA/DSC measurements for NCA, NMC samples; thermal behaviour of cathode materials at 1400-1515 °C
- First tests for gas analysis from NiMH (H<sub>2</sub>, CO, CO<sub>2</sub>)
- Data collection for battery modelling and implementation of solid transport models and turbulent gas reactions; planning of the first box tests



### Project 3:

- Selection of a common growth medium
- Cultivation and adaptation of bacteria
- Investigation of further adaptation strategies

# 7

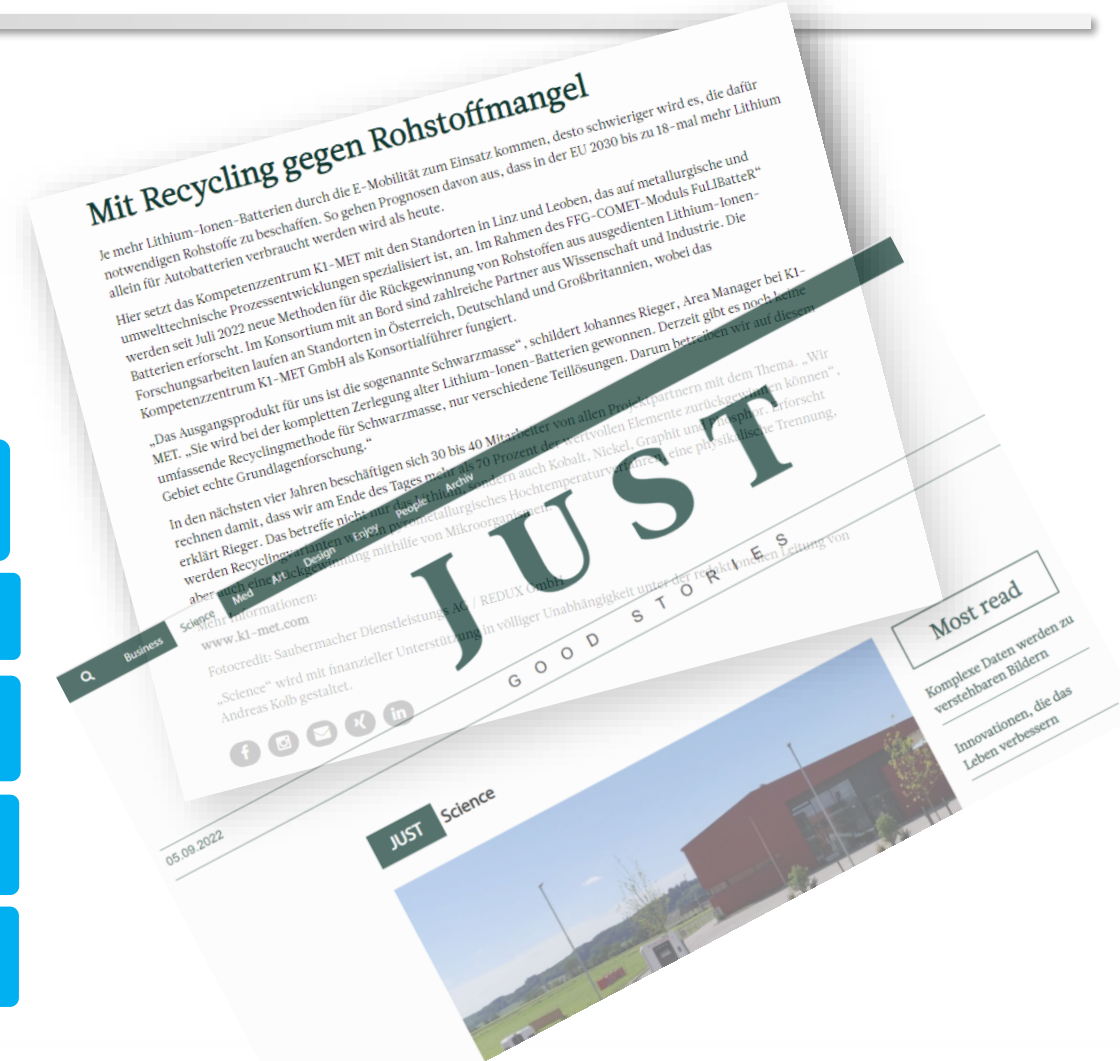
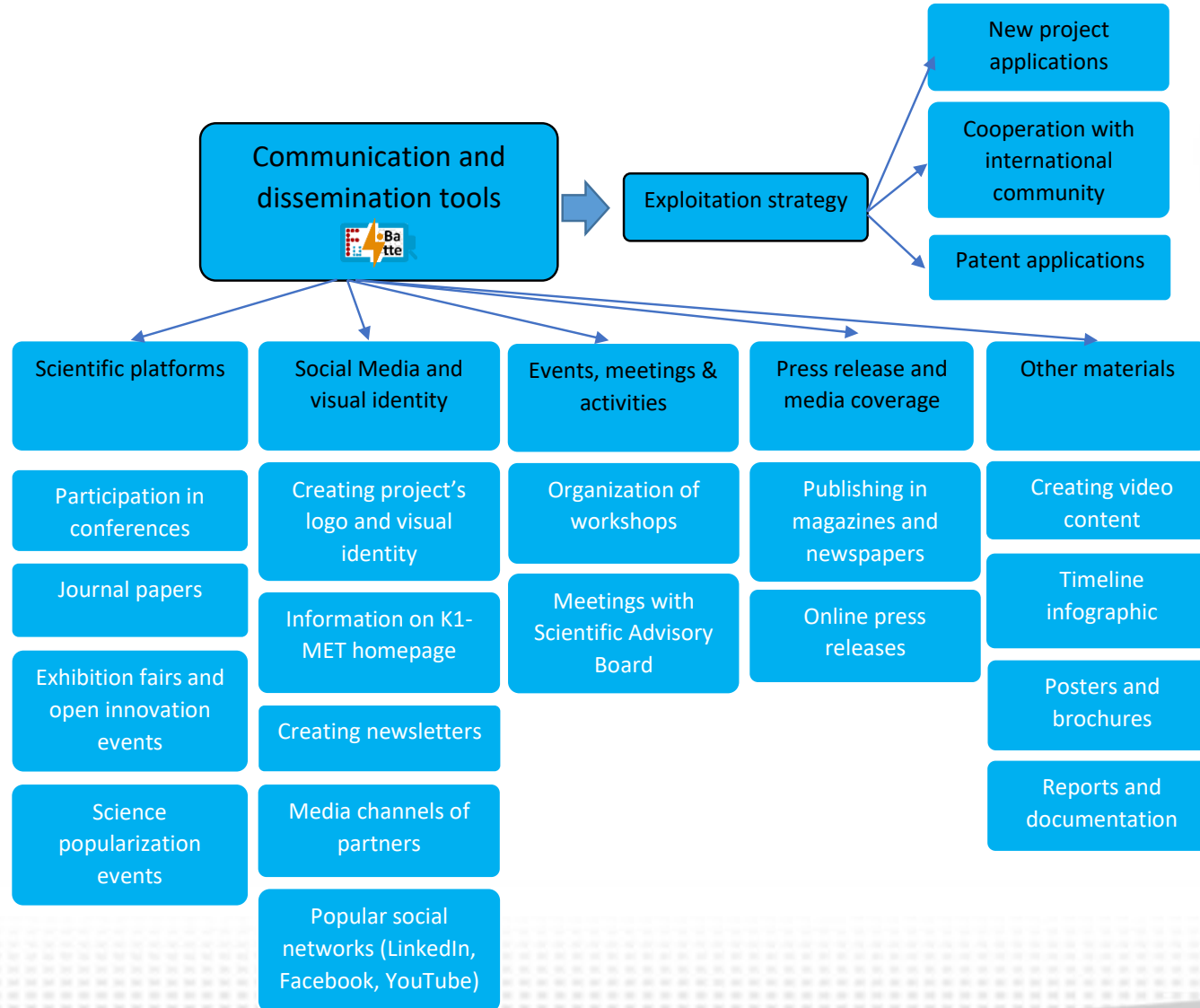
## **Quantitative Indicators / Target Values**



Modules Plan: Target Values of FuLiBatter		
Quantitative indicators / Target Values	Planned 2022-2026	Current Q4 2022
Indicators related to science		
Contributions in scientific papers with peer-review	12	-
Contributions at conferences with peer-review	8	2
Total number of PhDs (thereof at the centre)	5 (4)	5 (4)
Total number of master theses (thereof at the centre)	10 (5)	1 (0)
Outgoing research stays	3	-
Incoming research stays	5	-
Indicators related to industry		
Total number of patents	2	-

# 8

## **Dissemination, Communication and Exploitation Plan**




[www.k1-met.com](http://www.k1-met.com)


Visit us on [LinkedIn](#)

 PROJECT 1

 PROJECT 2

 PROJECT 3

 MODULE PARTNERS

 PUBLICATIONS

 EVENTS

 DOWNLOADS

# FuLiBatter

## Downloads



**Welcome to the download area of the module FuLiBatter**

For direct downloads or links to the corresponding pages of success stories, intermediate reports etc. please click on the requested content.



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