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ERA-MIN 3

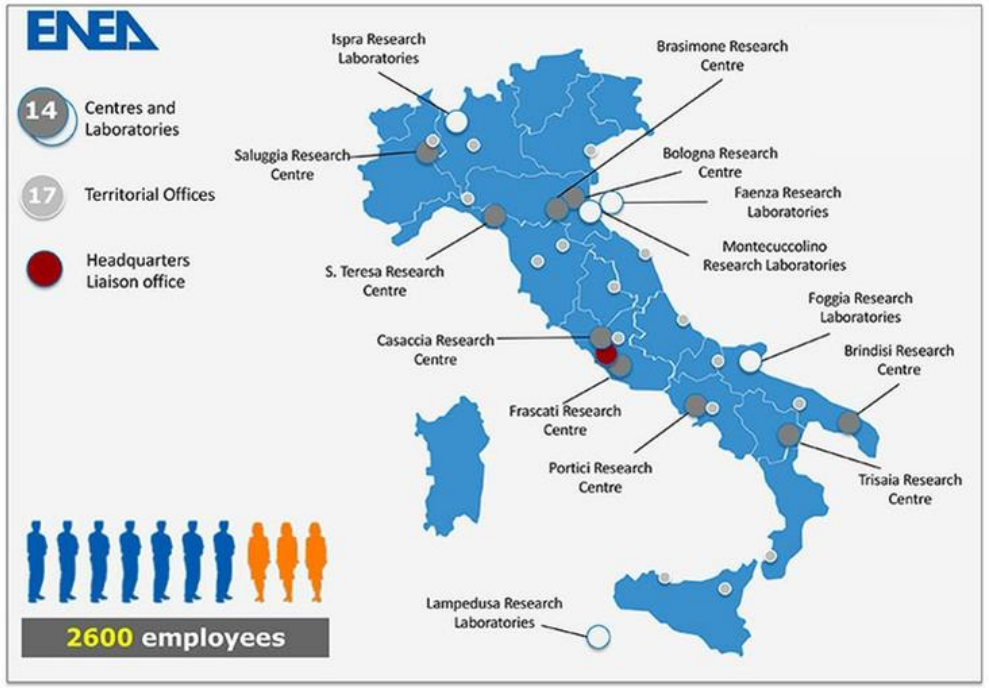
Recycling of lithium iron phosphate batteries: the ACROBAT project

Federica Forte

ENEA, Department for Sustainability

Something about ENEA

Italian National Agency for New Technologies, Energy and Sustainable Economic Development



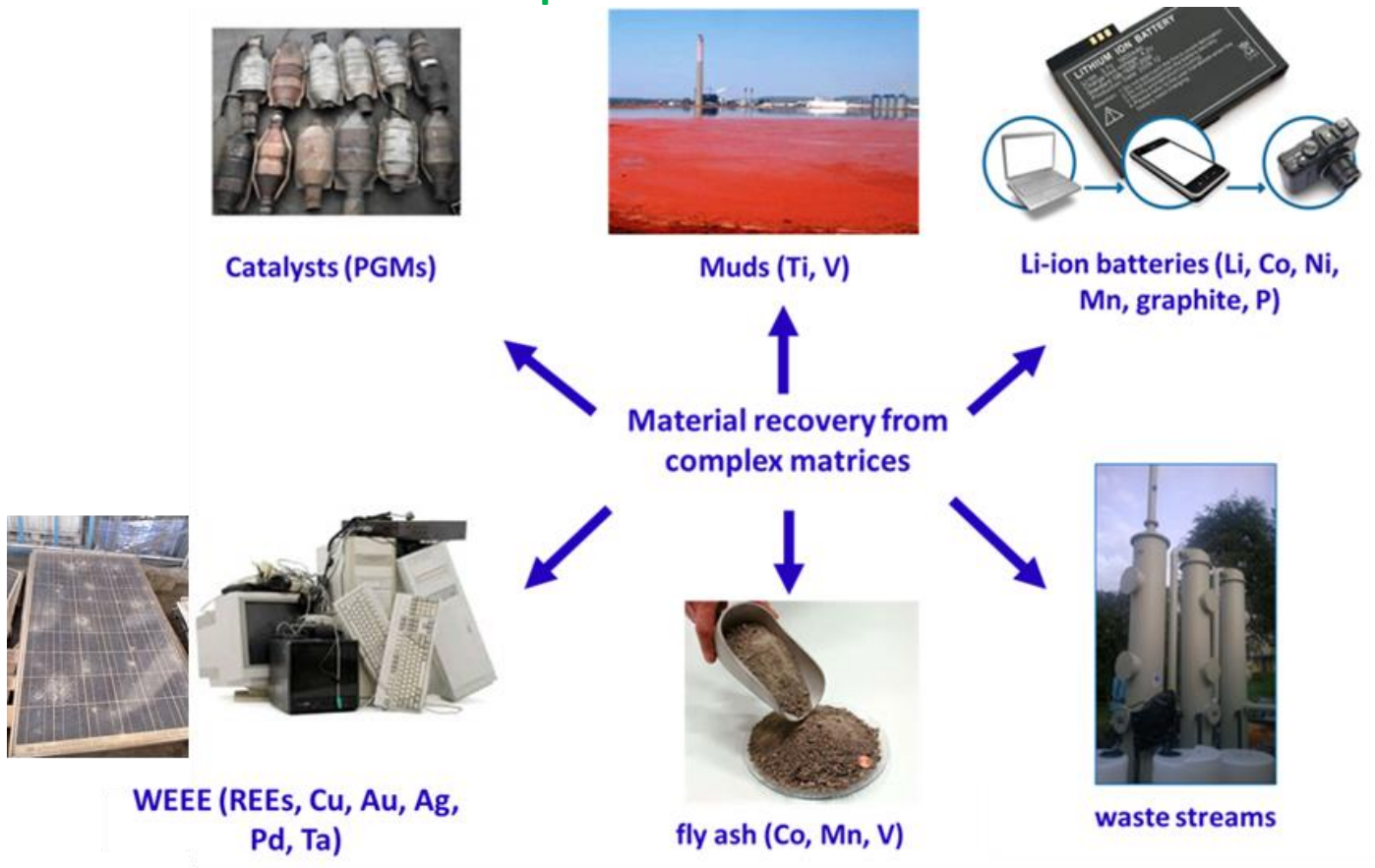
4 Departments

- **Department for Sustainability**
- Energy Technologies and Renewable Sources Department
- Fusion and Technology for Nuclear Safety and Security Department
- Energy Efficiency Unit Department

Something about ENEA

- Department for Sustainability (SSPT)
  - Division Resource Efficiency (USER)
    - Laboratory Technologies for the Reuse, Recycling, Recovery and valorisation of Waste and Materials (T4RM)

Development of technologies for the valorization of complex matrices



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Something about ENEA

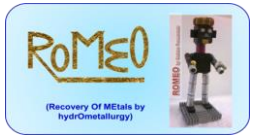
- **Department for Sustainability (SSPT)**
  - **Division Resource Efficiency (USER)**
    - **Laboratory Technologies for the Reuse, Recycling, Recovery and valorisation of Waste and Materials (T4RM)**

T4RM facilities

Laboratories

- Atomic absorption spectrophotometer (AAS)
- Microwave Plasma Atomic Emission spectrophotometer (MP-AES)
- Handheld XRF analyzer
- UV-VIS spectrophotometer
- FTIR-ATR spectrophotometer
- Ionic chromatograph (IC)
- Total Organic Carbon (TOC) analyzer
- TGA/DSC analyzer
- Microwave mineralizer
- Mills
- High-performance centrifuge
- Lyophilizer
- Muffle furnace

Technological Hall



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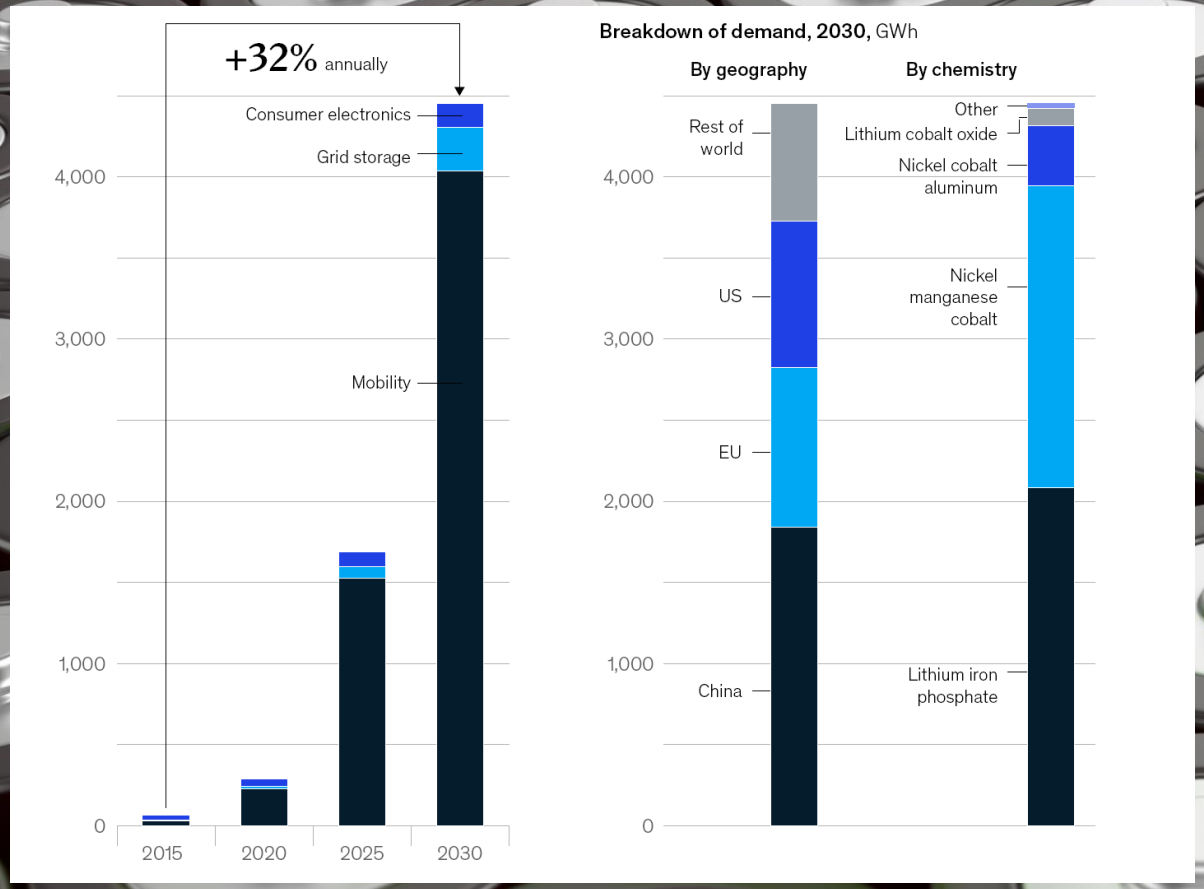
LFP batteries

Olivine-type LFP batteries have gained a considerable share within the lithium-ion battery (LIB) market.

They combine excellent electrochemical performance and long lifespan with intrinsic safety and low cost, which is ideal for use in electric vehicles and energy storage solutions.



Source: McKinsey & Company, 2022

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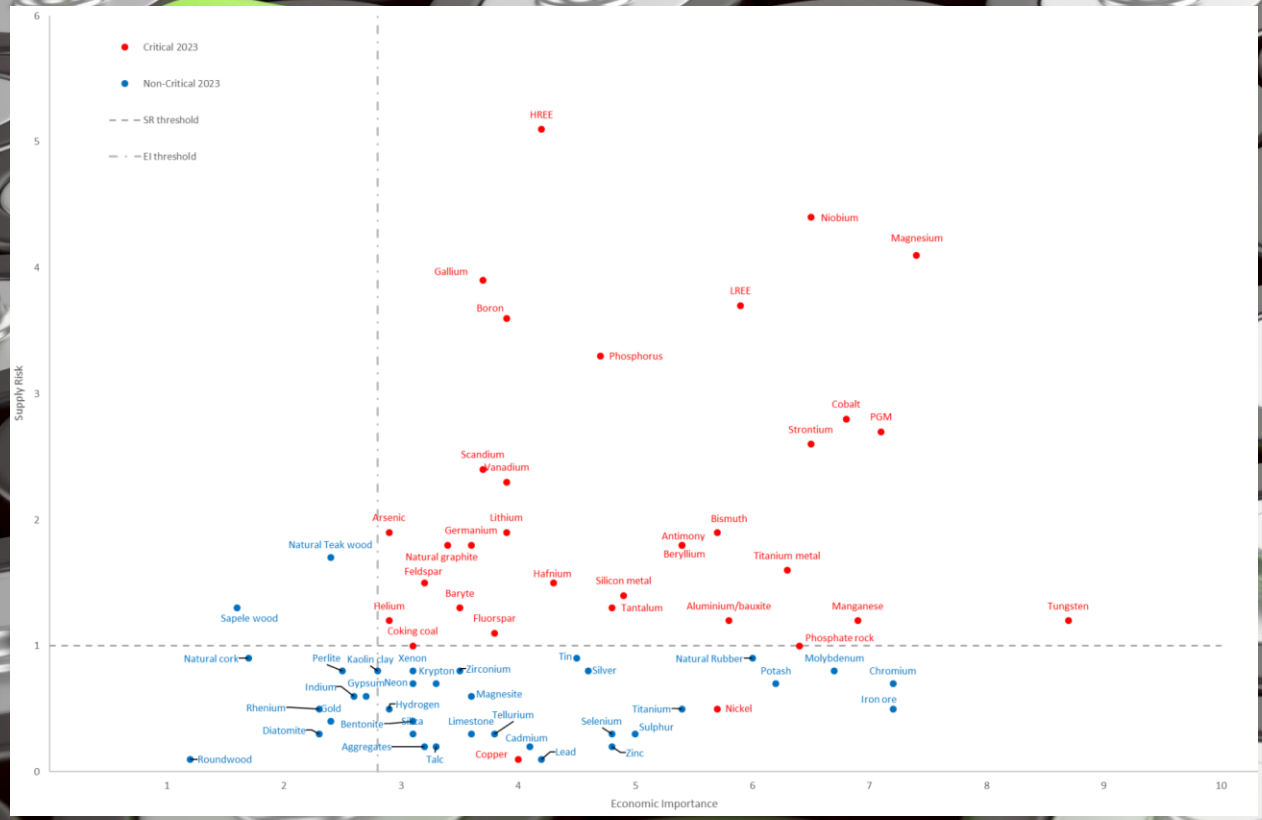
LFP batteries

LFP batteries contain three critical raw materials (CRMs):

- Lithium
- Phosphorus
- Graphite



Source: European Commission, 2023

LFP batteries

Currently, no dedicated, economically-viable, industrial-scale recycling process exists for LFP-type LIBs in Europe or elsewhere.

Necessity of an integrated strategy, aimed at the valorization of the entire matrix
(Li, P, graphite, electrolyte)

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Advanced CRMs Recycling from spent LFP Batteries

Project partners

vito

Fraunhofer ILT

KU LEUVEN SIM2

ACCUREC® RECYCLING GMBH

ENEA
Italian National Agency for New Technologies, Energy and Sustainable Economic Development

Project funding

ERA-MIN 3

fwo Opening new horizons

ptj Projektträger Jülich Forschungszentrum Jülich

Ministero dell'Università e della Ricerca

Duration: 01/08/2022 – 31/07/2024

Budget: 1.4 M€

Acrobat objectives

The project aim is to **develop innovative and environmentally-friendly recycling technologies dedicated to spent LFP batteries**.

The **specific objectives** are to develop and test:

- dedicated dismantling and pre-treatment (ACCUREC)
- extractive recovery of electrolyte materials (ENEA)
- in-line characterisation of black mass (Fraunhofer ILT)
- recovery of graphite (SIM2 and VITO)
- hydrometallurgical lithium recovery and conversion into battery-grade lithium hydroxide monohydrate (SIM2)
- direct recycling of spent LFP cathode material into virgin LFP (VITO)

Acrobat consortium

The ACROBAT consortium will have close interactions with its Industrial Advisory Board (IAB).
The IAB is composed of relevant industrial stakeholders active along the EU battery recycling value chain:

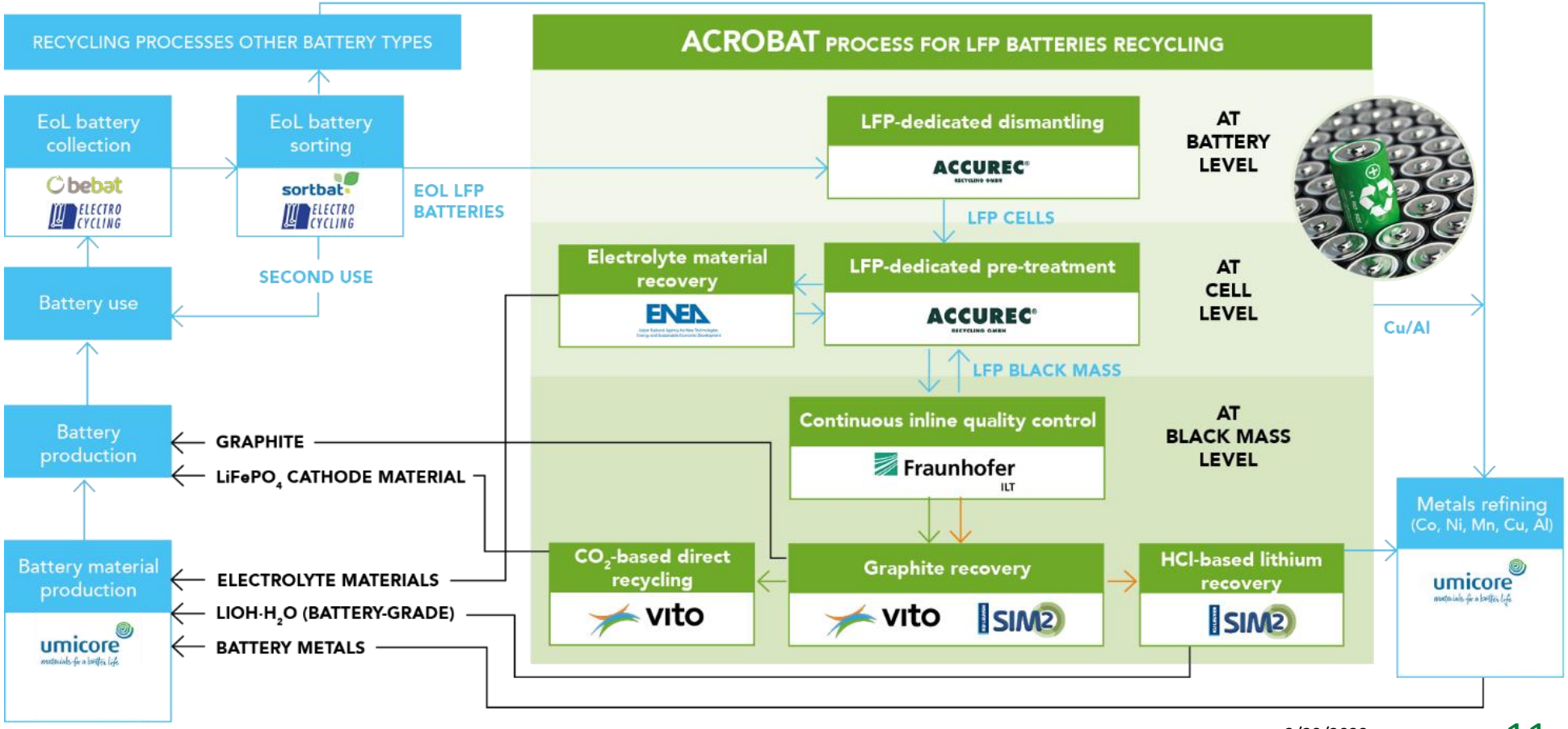
sortbat

bebat

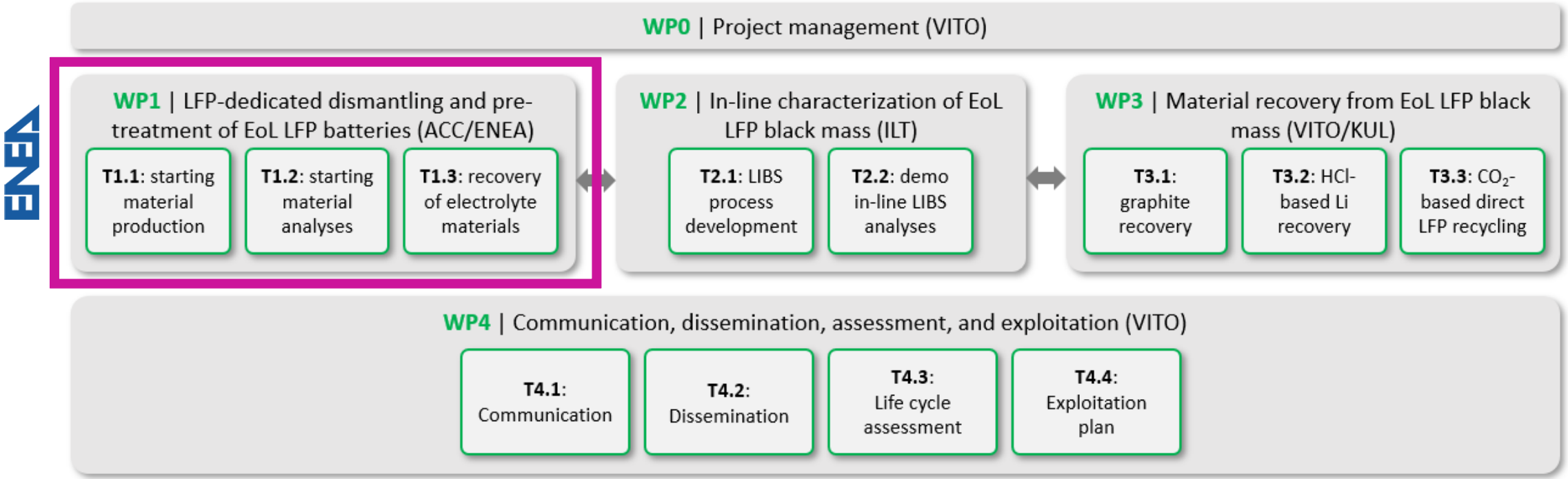
umicore
materials for a better life

ELECTRO CYCLING

Acrobat structure



Acrobat structure



Acrobat aims

Overall, the ACROBAT consortium (VITO, ENEA, Fraunhofer ILT, KU Leuven, Accurec) aims to:

- recover **90% of the EU-CRMs** (Li, P and graphite) from waste LFP batteries
- recycle LFP **cathode** material, **graphite** and **electrolyte**, respectively up to 5.4, 6.2 and 4.4 kt/y by 2030 in EU

If you are interested, please visit the project website:

https://acrobat-project.eu/en

Contacts:

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Thank you for your attention!

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