BATRAW

Funded by the European Union

CLUSTERING EVENT

PRODUCTION OF RAW MATERIALS FOR BATTERIES FROM EUROPEAN RESOURCES

CROCODILE LICORNE RHINOCEROS BATRAW eNiCoN FREE4LOB RELIEF

BATRAW

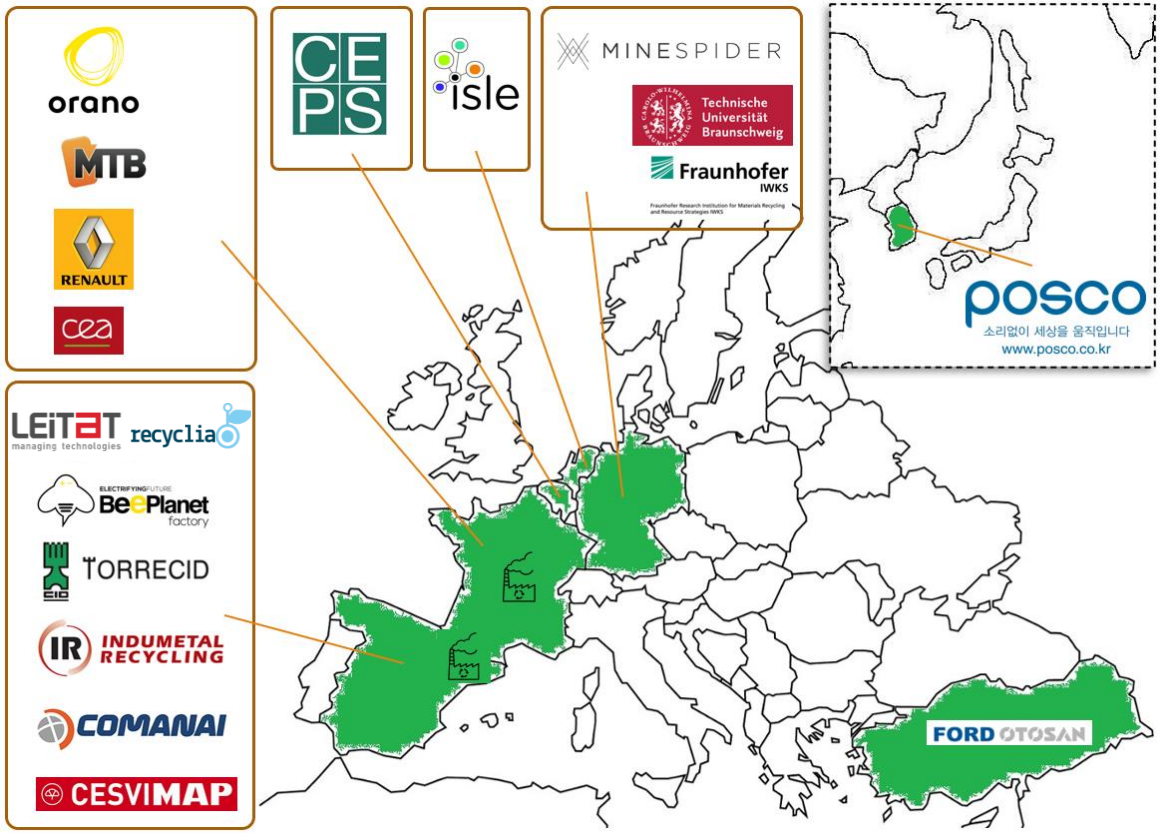
Recycling of end-of-life battery packs for domestic raw material supply chains and enhanced circular economy

14/11/2022

BATRAW overall introduction

HORIZON-CL4-2021-RESILIENCE-01-04 (IA)
European Health and Digital Executive Agency (HADEA)
Grant Agreement: 101058359
EU contribution: 10,236,986€
Total cost: 13,212,811€
Duration: May 2022 – April 2026
Months: 7/48

1. **LEITAT - ACONDICIONAMIENTO TARRASENSE ASSOCIACION ES (Coordinador)**
2. INDUMETAL RECYCLING SA
3. CESVIMAP - CENTRO DE EXPERIMENTACION Y SEGURIDAD VIAL MAPFRE S.A
4. BEEPLANET FACTORY SL
5. COMANAI S.L.
6. RECYCLIA - SIG DE RAEE Y PILAS SOCIEDAD LIMITADA
7. CEA - COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES
8. Orano Mining
9. RENAULT SAS
10. MTB Manufacturing
11. IWKS - FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.
12. TECHNISCHE UNIVERSITAET BRAUNSCHWEIG
13. ISLE UTILITIES BV
14. MINESPIDER GERMANY GMBH
15. POSCO (Korea)
16. FORD OTOMOTIV SANAYI ANONIM SIRKETI
17. TORRECID SA
18. CEPS - CENTRE FOR EUROPEAN POLICY STUDIES



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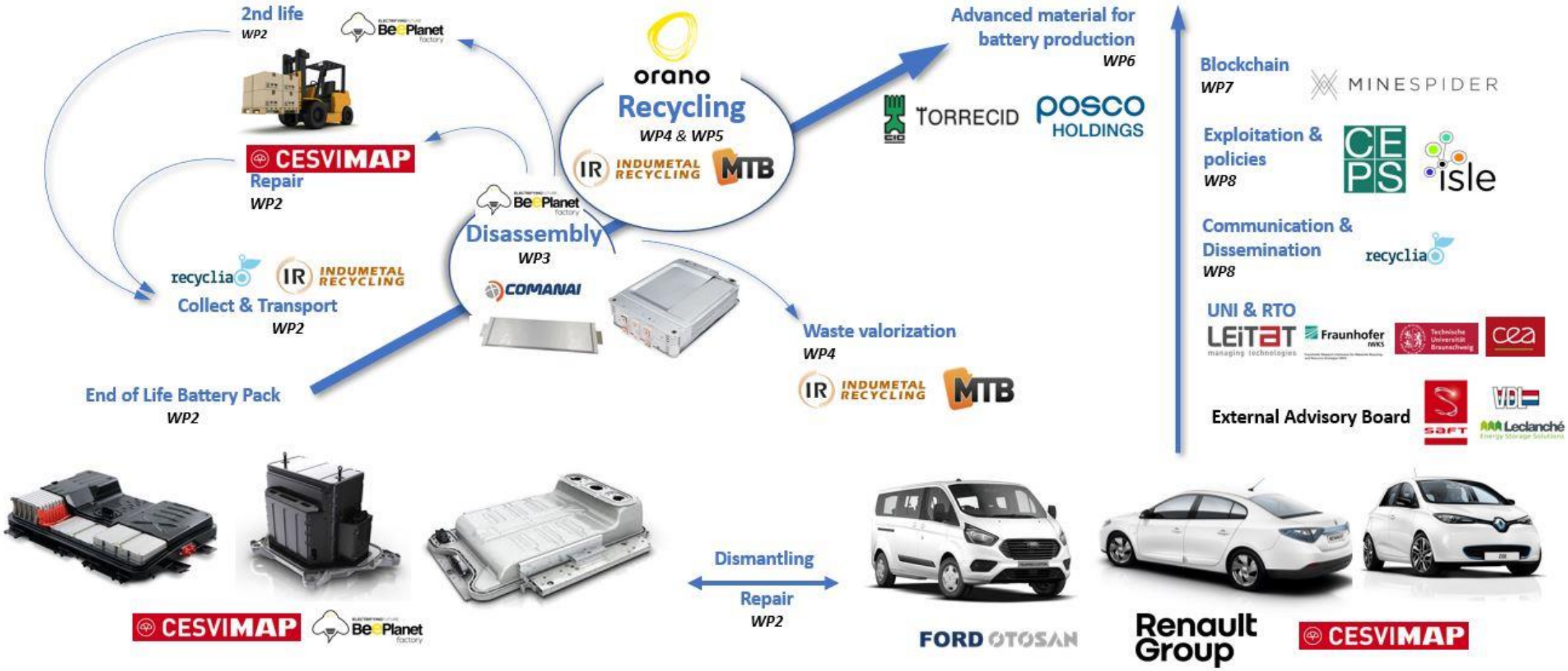
BATRAW overall concept



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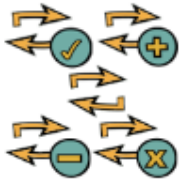
BATRAW general objectives

To **deliver battery grade secondary Co, Ni, Mn, Li, C-graphite and benchmark recovered RMs** in NMC811, MMC9½½ and LMNO cathodes versus cathodes containing primary RMs. Cost of the battery grade cathode material will be < 30 €/kWh and performance reported in a scientific publication.



To build a **prototype of second life battery** from BATRAW sample and a tool for repair of battery packs and modules.

To develop and deliver **eco-design guidelines** on pack manufacturing supporting better repair and dismantling of large battery packs.

To develop and deliver guidelines and best practices for **safe handling and transport of end-of-life battery waste.**

To develop and demonstrate a **blockchain platform for RM, product, and supply chain** tracking within the scope of ongoing EC efforts and legislations on supply chain transparency and Battery Passport.

To feed the EC's Raw Materials Information System (RMIS) by the IMS; **to contribute to policies and standardisation** in battery raw materials, processing, recycling, and waste in line with EU initiatives such as the Batteries Directive, Waste Framework Directive (2008/98/EC), and Circular Economy Action Plan, all met in 2-3 policy briefs and associated dossier.

To fully substantiate an **exploitation and business plan** that takes a broad EU-wide focus, including Circular Business models, for the successful implementation of BATRAW innovative dismantling and recycling processes.

To quantify **environmental and socio-economic impacts and benefits** of BATRAW results by following a life cycle approach and to engage stakeholders and EU citizens in the BATRAW results.

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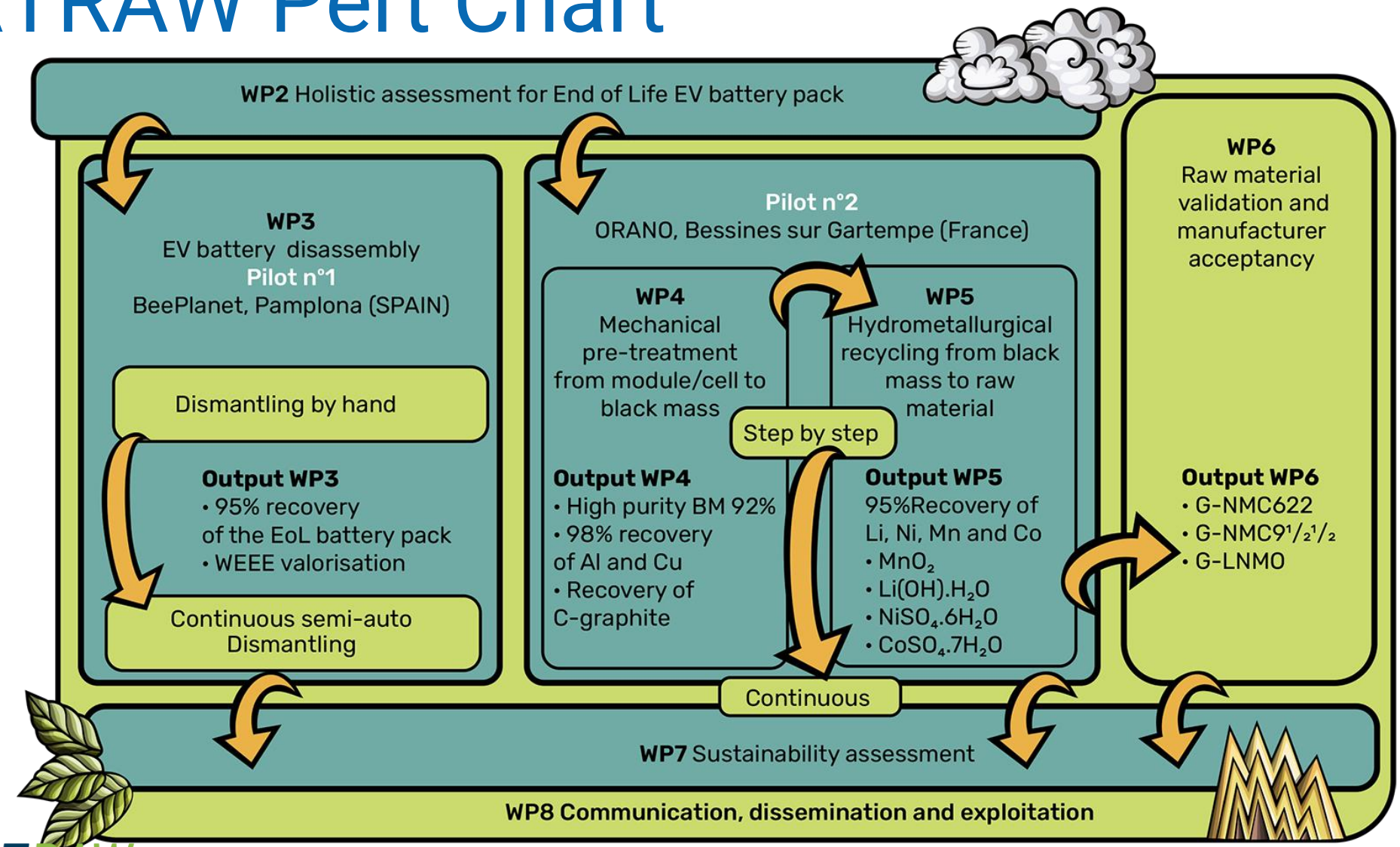
BATRAW Pert Chart



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BATRAW Pilots

Pamplona, SPAIN

First Pilot on semi-automatic EV battery pack disassembly

- Tool **for rapid characterization** [SoH estimation in < 30 minutes]
- To develop and demonstrate **semi-automated and intelligent robotic processes** (AI) for battery pack and module dismantling [1 ton/8 hours]
- To **recover battery pack components for recycling** (modules, cells, WEEE, plastics) [95% in weight]
- To demonstrate technologies and processes in an **innovative and scalable pilot line** [1 ton/8 hours]

Bessines sur Gartempe, France

Second Pilot on pre-treatment and hydrometallurgical recycling

- To upscale innovative **cell deactivation process** [50 KWh with no hazards]
- To upscale and demonstrate an innovative **mechanical pre-treatment**, for EV battery, achieving recovery of Al, Cu, and C-graphite and black mass [Black Mass >92% Co, Ni, Mn, Li]
- To upscale and demonstrate innovative pre-treatment of domestic batteries
- To upscale and demonstrate a flexible and **green hydrometallurgical process** [efficiency > 95% and purity > 99%]
- To upscale and demonstrate **Mn extraction in HM process** [250L/h]
- To upscale and demonstrate **electrochemical Li recovery** [250L/h]
- To demonstrate **continuous recycling process in a scalable pilot line and demonstrate the process flexibility to treat BM** from different battery waste (EV/domestic batteries, scraps) [300kg BM/day]

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BATRAW partners contribution

Vehicles to pack → Pack to module/cell → 2nd life → Pre-treatment → HM recycling → New RM

Blockchain, supply chain, business model, LCA, Policies, ecosystem

Communication, Dissemination, Exploitation

BeePlanet factory

- Second life prototype manufacturing and methodology (WP2)
- Development of a rapid SoH characterization tool for NMC (WP2)
- Participation on the design of the battery disassembly chain (WP3)
- **Pack identification tool for workstation on Pilot 1 (WP3)**
- **Exploitation of Pilot 1** (WP3)

CESVIMAP

- Supply of batteries to the other participants in the project. (WP2, WP3)
- **Development of methods and times for disassembling the vehicle's batteries. (WP2)**
- Preparation of the eco-design guide. (WP2)
- Elaboration of the informative video of the project. (WP8)
- Dissemination of the achievements and results of the project through the CESVIMAP magazine and other interest groups. (WP8)

COMANAI SMARTER ENGINEERING

- To test technologies to introduce in the Pilot Line (Laser, machine learning, traceability software etc…)
- To improve processes
- To design and manufacture the working stations (recycling and second life process)
- **To create and to operate a dismantling line for the battery packs. (WP3)**
- To exploit jointly with BEE the pilot line installed in their facilities so that an industrial upgrade can be driven after the project.

Technische Universität Braunschweig

- **Investigation of the dismantling process for battery modules (WP3)**
- Development of AI-supported dismantling processes (WP3)
- Collaboration in the development of a database for automated module recognition (WP3)
- Further development of human-robot collaboration in non-automatable process areas (WP3)

cea LEITAT managing technologies

- Manual deactivation and dismantling of first packs and modules, for analysis and advice for semi-automatization (CEA, WP3)
- Development of working station for battery pack dismantling (LEITAT, WP3)

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Communication, Dissemination, Exploitation

INDUMETAL RECYCLING

- Integration of the waste transport in the blockchain architecture (WP2)
- **Testing for the black mass mechanical treatment process (WP4)**
- **Valorisation of the different valuable fractions recovered in the mechanical treatment process (WP4)**
- Identification of policies, legislation and standards related to the collection, transport and recycling of batteries (WP7)

MTB MANUFACTURING

- Development, manufacturing and testing of micro-pilots (WP4)
- Provide areas of improvement for this equipment to develop the final pilot (WP4).
- Design, manufacture and installation of the final pilot at Orano site (WP4)
- **Optimization and pilot for the development of the commercial solution (WP4)**
- Development and implementation of downstream separation steps (WP4).
- Provide support for the development of the disassembly pilot (WP3).
- Provide support for the development of the hydrometallurgy solution (WP5).

orano

- Technical specifications required to develop the recycling process (WP 2)
- Pilot design / sizing of safe deactivation unit for batteries opening /shredding and pilot design/sizing for graphite recovery (WP4)
- Hydrometallurgy for Co, Ni and Li for their quantitative recovery (WP 5)
- **Piloting of full semi-industrial pilot,** which includes all the following steps: batteries safe deactivation, shredding, graphite recovery, Black Mass separation and metals purification with hydrometallurgical processes (WP 5)

Fraunhofer IWKS

- **Mechanical pre-treatment and separation (WP4)**
- Life Cycle Assessment (LCA) of BATRAW technology (WP7)

LEITAT managing technologies

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LEITAT managing technologies

- **Co-ordination of BATRAW project (WP1)**
- WP2 leader
- Development of working station for **battery pack dismantling** (WP3)
- **HM processes**, Leaching of the black mass through RTILs, DES and green solvent, Co and Ni separation and recovery through supported liquid membrane exchange, Li recovery through electrochemical process and flow continuous recovery process of solid product (WP5)
- **Material assessment** and electrochemical characterization of cells (WP6)
- **Life Cycle Assessment (LCA) and Social-LCA** (WP7)
- Communication (public media) and dissemination (platform specialist 2Zero, ETIP, EMIRI…) (WP8)

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- Manual deactivation and dismantling of first packs and modules, for analysis and advice for semi-automatization (WP3)
- **Development of pre-treatment methodologies for black mass** concentration: ultrasonic washing and Graphite recovery (WP4)
- **Hydrometallurgy treatments for selective Mn recovery** (WP5)
- **Development of micro-pilots for G recovery at TRL 5** (WP4)
- Synthesis of active materials (NMC) and manufacturing of electrodes. Materials characterization (WP6)

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Vehicles to pack > Pack to module/cell > 2nd life > Pre-treatment > HM recycling > New RM

Blockchain, supply chain, business model, LCA, Policies, ecosystem

Communication, Dissemination, Exploitation

TORRECID

- WP6 leader
- **Produce LNMO based on recycled material** using same processes and methods used to produce commercially available LNMO
- Assess the quality of the produced LNMO in terms of purity, morphology and electrochemical performance.
- Provide LNMO material to partners to evaluate the quality of LNMO produced based on recycled materials
- Provide input to requirements of raw material quality
- To perform an LCA of recycled raw materials in the synthesis of ceramic pigments

POSCO HOLDINGS

- Evaluation and feasibility test of recycled materials for NCM production (WP6)
- Analysis and evaluation of impurity effects in recycled materials on precursor production (WP6).
- **Development of large and small NCM9½½ particles using recycled materials** (WP6)
- Application and evaluation of bimodal type recycled battery materials for EV application (WP6)
- Application of doping and coating technique for recycled battery materials for long cycle life (WP6)

LEITAT managing technologies

cea Renault Group

Material assessment and electrochemical characterization of cells (WP6)

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Communication, Dissemination, Exploitation

isle

- **Coordination of work package Sustainability Assessment (WP7)**
- Techno-economic assessment (WP7)
- Circular Economy Business Models (WP7)

CEPS

- To lead the inventory of policies, legislations, and standards.
- To identify the optimal conditions for developing an EU industrial ecosystem of circularity applications for battery packs
- **To give policy recommendations for implementing circular economy approaches for battery packs**

FORD OTOSAN

- To deliver batteries pack from Turkey (WP2)
- To provide support and information on disassembly & teardown of battery packages, (WP2)
- **To run a LCA study to compare Turkey vs EU EV battery recycling options and support CEPS (WP7)**

MINESPIDER

- **Providing blockchain software infrastructure to track data along the value chain**
- Identifying, classifying and structuring the information needs of each project participant in all phases of the project.
- Identifying the existing workflows and criteria
- Identifying workflows for the implementation and use of the Minespider infrastructure
- Testing the Minespider infrastructure with relevant data sets
- Evaluating potentials to incentivise stakeholders and model supply chains to enhance the value of the supply chains in the EV battery business

LEITAT managing technologies

Leader for environmental and social assessment (WP7)

Renault Group

- Disassembly, recycling processes and validation specification (WP2)
- Holistic assessment of End of Life EV battery pack (WP2)
- System assessment and validation (WP6)
- Battery pack eco-design guide (WP7)
- **Environmental and social assessment (WP7)**
- Policies, legislation and standards (WP7)

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Communication, Dissemination, Exploitation

recyclia

- Battery-pack collection and transportation guideline (WP2)
- Identification of relevant policies, standards and regulations (WP7)
- **Leader for dissemination and communication activities of project results (WP8)**

isle

- **BATRAW innovation manager (WP8)**
- Coordination of work package Sustainability Assessment (WP7)
- Techno-economic assessment (WP7)
- Circular Economy Business Models (WP7)
- Communication, Dissemination and Exploitation Business Strategy Plans (WP8)
- Exploitation activities (WP8)
- IPR management (WP8)
- Targeted engagement (WP8)
- Business Models for exploitation (WP8)
- Contribution to project management (WP1)

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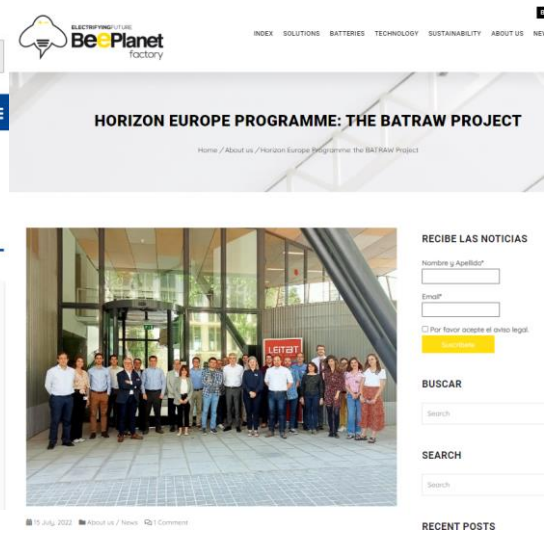
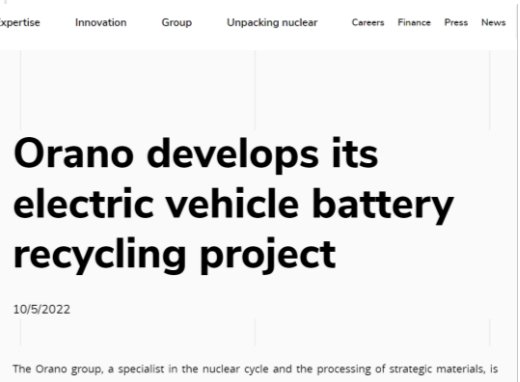
Dissemination and Communication





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Thank you for your attention!

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