



Funded by the  
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# BATRAW

## CLUSTERING EVENT

PRODUCTION OF RAW MATERIALS FOR BATTERIES  
FROM EUROPEAN RESOURCES



FREE4LOB



# 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

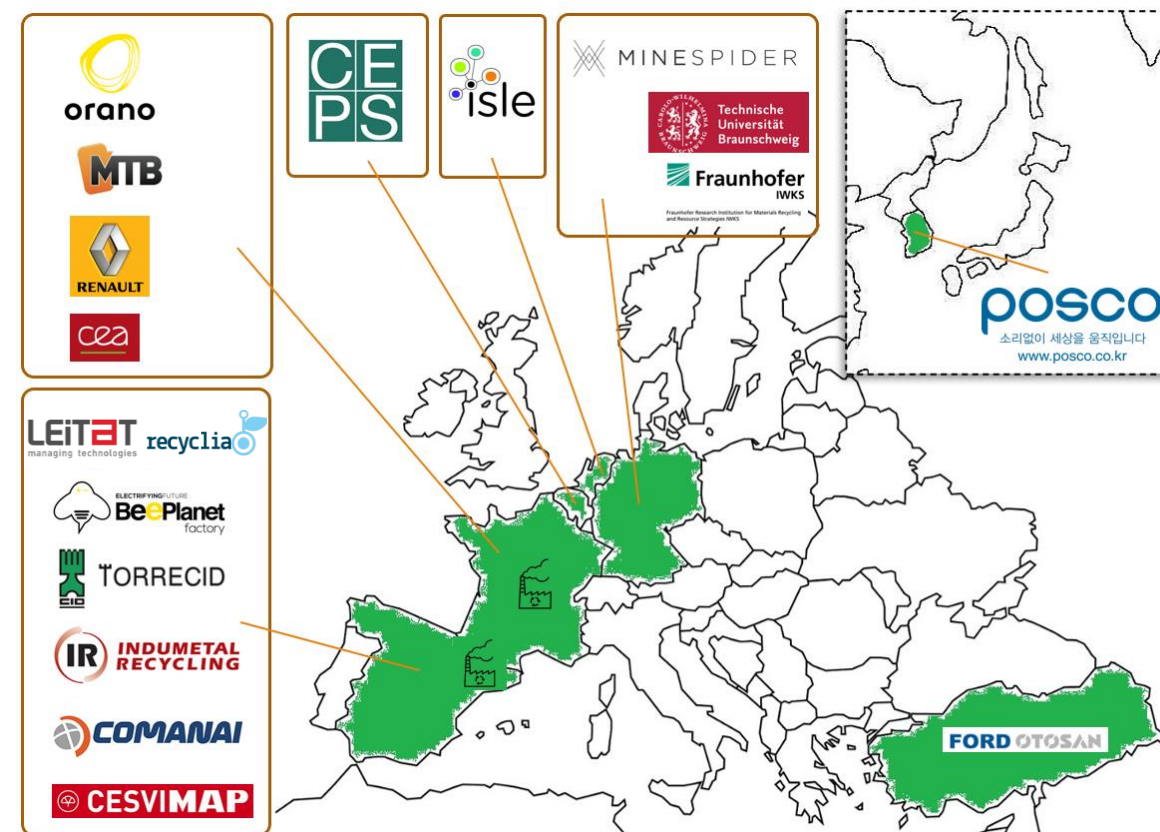
**EU contribution: 10,236,986€**

Total cost: 13,212,811€

Duration: May 2022 – April 2026

Months: 7/48

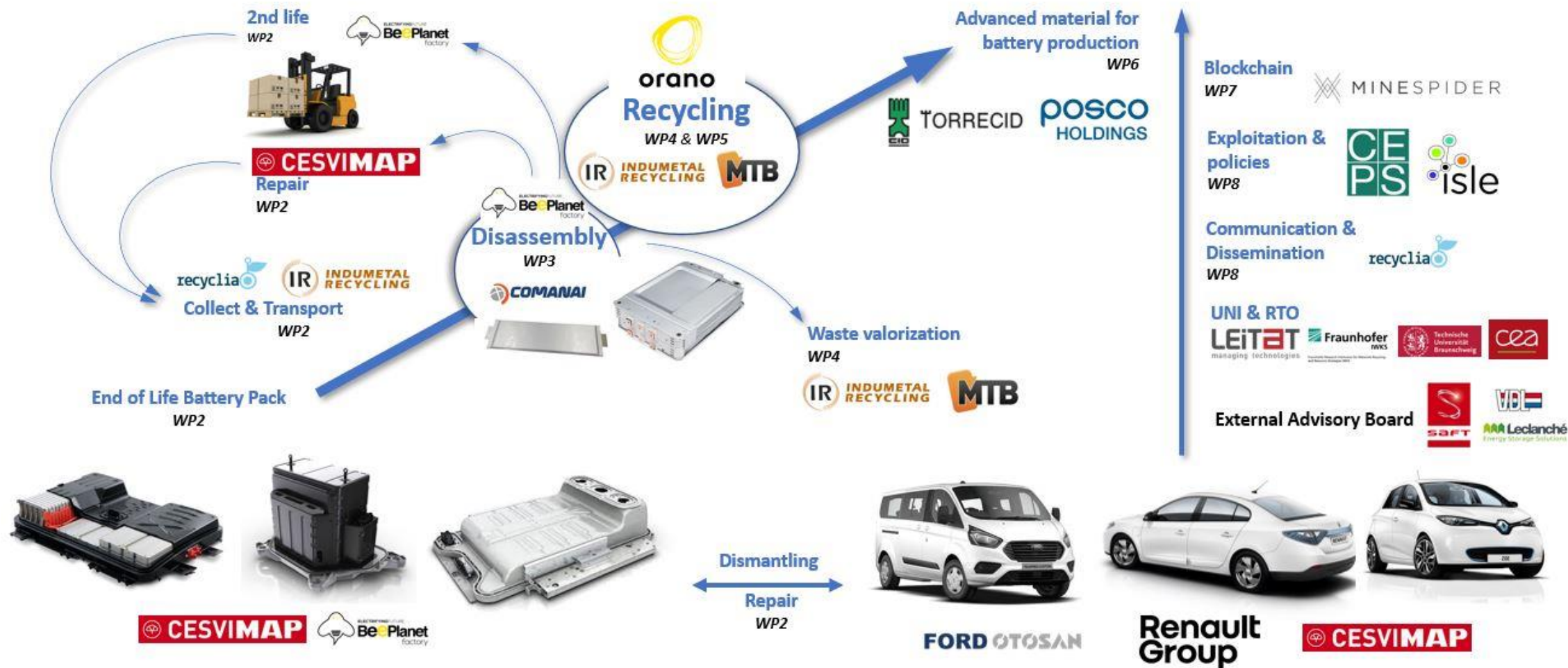
1. **LEITAT - ACONDICIONAMIENTO TARRASENSE ASSOCIACION ES (Coordinador)**
2. INDUMETAL RECYCLING SA
3. CESVIMAP - CENTRO DE EXPERIMENTACION Y SEGURIDAD VIAL MAPFRE S.A
4. BEEPLANET FACTORY SL
5. COMANAI S.L.
6. RECYCLIA - SIG DE RAEE Y PILAS SOCIEDAD LIMITADA
7. CEA - COMMISSARIAT A L ENERGIE ATOMIQUE 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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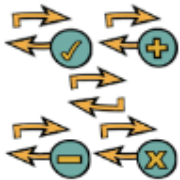
# BATRAW general objectives



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



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



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.



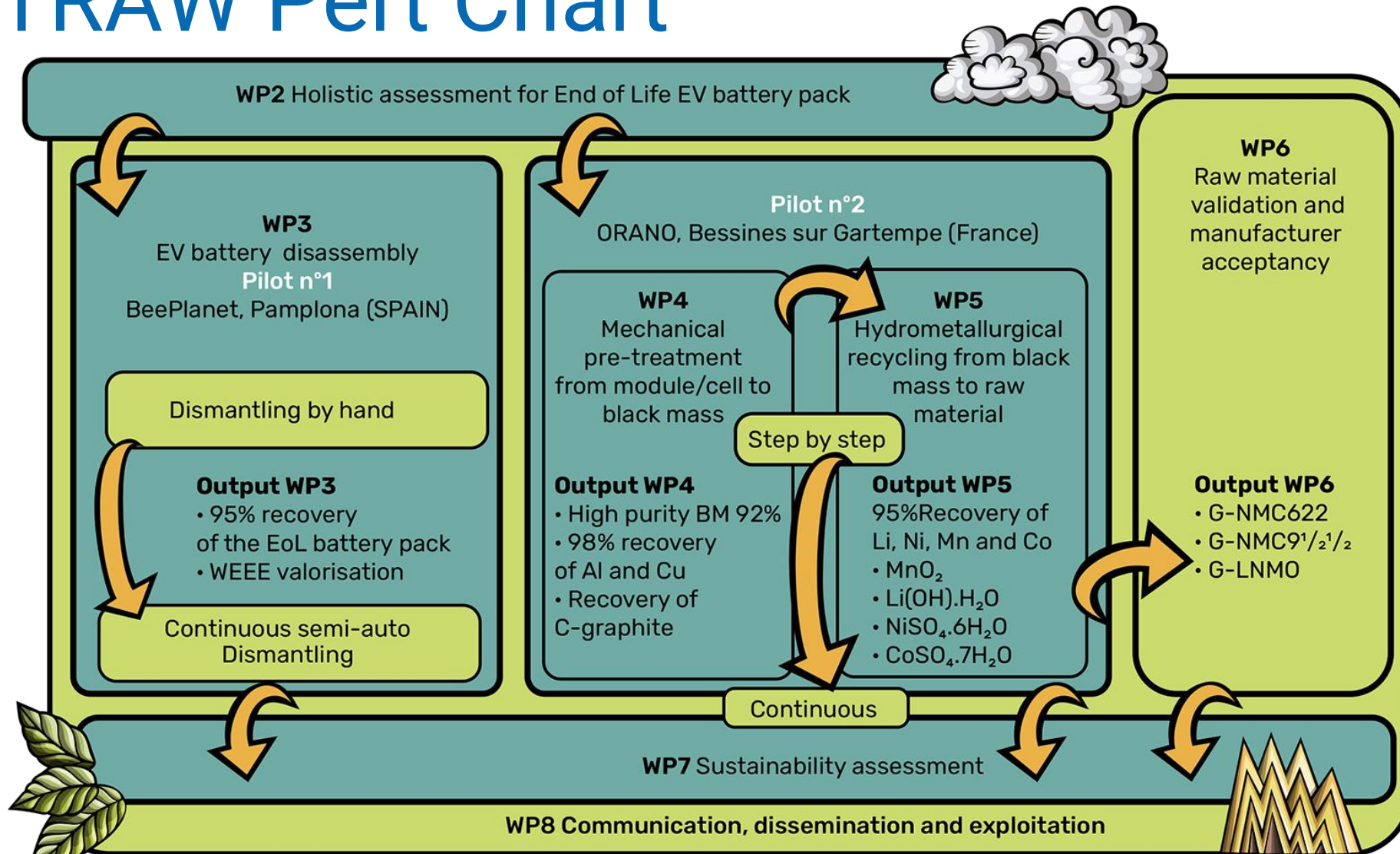
To develop and deliver guidelines and best practices for **safe handling and transport of end-of-life battery waste**.



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 > 2<sup>nd</sup> life > Pre-treatment > HM recycling > New RM

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

Communication, Dissemination, Exploitation



- 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)



- 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.



- **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)



- 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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- 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)



- 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).



- 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)**



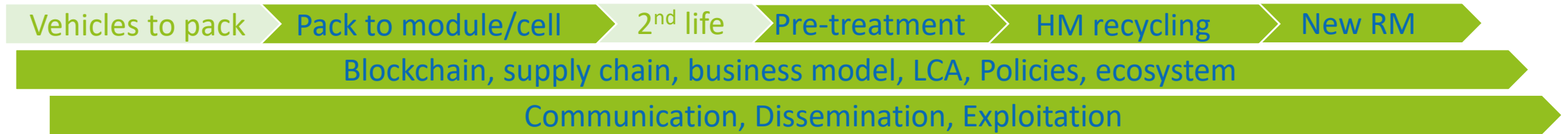
- **Mechanical pre-treatment and separation (WP4)**
- Life Cycle Assessment (LCA) of BATRAW technology (WP7)



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# BATRAW partners contribution



- **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)



- 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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- 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



- 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 NCM<sub>91/2/2</sub> 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)



**Material assessment** and electrochemical characterization of cells (WP6)

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Communication, Dissemination, Exploitation



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



- 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**



- 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)**



- **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



Leader for environmental and social assessment (WP7)



- 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)



[www.batraw.eu](http://www.batraw.eu)



# BATRAW partners contribution

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- 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)**



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

Fact Sheet

### Objective

BATRAW main objective is to develop and demonstrate two innovative pilot systems for sustainable recycling and end of life management of EV batteries, domestic batteries, and battery scraps contributing to the generation of secondary streams of strategically important CRMs and battery RMs. The first pilot will deliver innovative technologies and processes for dismantling of battery packs achieving recovery of 95% of battery pack components and separating waste streams including cells and modules by semi-automated processes for recycling. BATRAW's second pilot will scale and demonstrate efficient pre-treatment and continuous hydrometallurgical recycling of battery cells and modules including innovative steps for C-graphite, Al and Cu separation from black mass and Mn extraction, achieving a recovery of the full range of battery RMs (Co, Ni, Mn, Li, C-graphite, Al and Cu) at selectivity of 90-98%.

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## HORIZON EUROPE PROGRAMME: THE BATRAW PROJECT

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Inicio > Almacenamiento Energía > Arranca el proyecto europeo Batraw para recuperar baterías de vehículos eléctricos

## Arranca el proyecto europeo Batraw para recuperar baterías de vehículos eléctricos

Publicado: 29/07/2022

f t w e m +

El pasado 1 de mayo arrancó el proyecto Batraw, cuyo objetivo es reciclar baterías recuperadas de vehículos eléctricos, que ya no se pueden usar de nuevo, y aprovechar sus materiales. El consorcio está formado por 18 socios entre los que se encuentra la empresa de seguros **Mapfre** a través de su laboratorio de movilidad Cesiumap.

**Diario responsable**

## El Mobility Lab de MAPFRE busca reducir la huella de carbono asociada a la electromovilidad

28 Julio 2022

DIARIO\_RESPONSABLE

NOTICIAS EFICIENCIA ENERGÉTICA ACTUALIDAD HUELLA DE CARBONO

ELECTROMOVILIDAD MOBILITY LAB DE MAPFRE

El Laboratorio de Movilidad de la aseguradora, participa en el programa Horizon Europe a través del proyecto BATRAW. Esta iniciativa financiada con 10 millones de euros, tiene como objetivo reciclar baterías recuperadas de vehículos eléctricos, que ya no se pueden usar de nuevo, y aprovechar sus materiales. Así, reducirá la huella de carbono asociada a la electromovilidad, gracias a la actuación sobre la fabricación de baterías.

Expertise Innovation Group Unpacking nuclear Careers Finance Press News

## Orano develops its electric vehicle battery recycling project

10/5/2022

The Orano group, a specialist in the nuclear cycle and the processing of strategic materials, is

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## Project BATRAW – raw material recovery from EV batteries

Jonathan Spencer Jones  
7 July 2022

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The Horizon Europe funded BATRAW project has been launched to create new raw material processing from used electric vehicle (EV) batteries.

The four-year project, which has its roots in reducing Europe's dependence on mostly imported critical raw materials and

**SMART ENERGY INTERNATIONAL**

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Private broadband wireless ROI impact on offshore

**TORRECID**

Torrecid takes part in BATRAW project

Project started on 1st May and the KOM took place at Leitat. A consortium of 18 partners from seven countries develops this project, which is of strategic importance for the EU in reducing its dependence on imports of these critical raw materials, as well as being able to guarantee a stable supply chain in view of the expected growth of the electric mobility market in the coming years in Europe.

The project, focus on the development of eco-design guidelines that favour the repair and dismantling of batteries, as well as best practices for the safe handling, transport of these wastes and recovery of raw materials.

The BATRAW project has a total budget of 13,212,811 million euros of which 10,236,986 euros are financed by the European Commission in the Horizon Europe framework programme.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grants agreement No 101058359

## Project BATRAW – raw material recovery from EV batteries

By Jonathan Spencer Jones - Jul 7, 2022

The Horizon Europe funded BATRAW project has been launched to create new raw



www.batraw.eu

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreements N° 101058359. These results reflect the author's view and the Commission is not responsible for any use that may be made of the information it contains.



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# Thank you for your attention!

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