

# 2Boss

‘Toward sustainable batteries based on silicon, sulfur and bio-mass derived carbon’

## Sustainable batteries for a greener future



The 36-month project **Towards sustainable batteries based on silicon, sulfur and biomass-derived carbon** (2Boss) was completed in May 2025. It was funded under the ERA-MIN call and funded by the European Union's Horizon 2020 Research and Innovation Programme. The project was carried out in collaboration with the following partners:

- Institut de Recerca en Energia de Catalunya (IREC)
- Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
- Politecnico di Torino (PoliTO)
- Cleopa GmbH

### Problem to Solve

Electric vehicles have become increasingly common in recent times. However, the development of battery technology has progressed relatively slowly. Current batteries contain up to a hundred different materials, and most of them depend on critical raw materials (CRMs). Additionally, the durability and energy capacity of current Lithium-Ion Batteries (LIBs) are limited by the materials used in their electrodes. Recycling these CRMs is complex and costly, partly due to the presence

of several dispersed and intermixed metals. To facilitate a smooth and flexible transition to e-mobility, it was essential to develop solutions that promote circularity and sustainability.

## Goal and Solution

The goal of 2Boss was to create an innovative, durable, sustainable and high-performance battery technology that promotes circular use of materials, minimising the use of critical raw materials (CRMs) for a greener future. The researchers of the 2Boss project developed new advanced materials, technologies and solutions that are sustainable, energy efficient and recyclable and at the same time non-toxic and cost effective. The 2Boss contributes to the carbon-neutral transition by:

1. Ensuring the availability of raw materials for battery manufacturing
2. Reducing dependency on CRMs
3. Designing a cobalt-free cathode and a graphite-free anode
4. Offering circular designed components that are recyclable
5. Enhancing energy capacity, density, and battery durability
6. Optimising environmental and social impacts while promoting a more circular economy

## Project Progress

The project consisted of seven work packages (WP7 is project management), each with clear objectives, specific tasks, and defined deliverables that support the overall project goal.

### **WP1: Biomass-derived carbon and cathode assembly**

**Lead:** IREC

**Task:** Develop carbon materials from winery biomass waste to create high-performance sulfur cathodes. Design novel catalysts to enhance lithium-sulfur reactions, improving battery capacity and cycle life.

### **WP2: Silicon anode development**

**Lead:** CEA

**Task:** Synthesize approximately 40 silicon-rich anode materials using bio-waste carbon and recycled graphite. The process was scaled up tenfold, improving sustainability and energy efficiency.

### **WP3: Battery assembly and validation**

**Lead:** IREC

**Task:** Integrate the silicon anodes and sulfur cathodes into full cells. Solid sulfide electrolytes improved electrode stability, energy density, and cycle life.

### **WP4: Battery recycling**

**Lead:** CEA

**Task:** Design a recycling process for Li-S batteries, focusing on recovering lithium, sulfur, and trace metals to support the circular economy and reduce environmental impact.

### **WP5: Life cycle and environmental assessment**

**Lead:** PoliTO

**Task:** Conduct a prospective Life Cycle Assessment (LCA) and Social LCA (S-LCA) for the 2BoSS battery, identifying environmental and social hotspots and developing models for industrial-scale impact assessment.

### **WP6: Communication, dissemination & exploitation**

**Lead:** Cleopa GmbH

**Task:** Focus on co-innovative actions that ensured industrial players were involved in the product development phase from the beginning of the project through to the final go-to-market stage. The Living Lab process included active engagement of leading players in the automotive and mobile working machine companies, as well as two Living Lab events. Knowledge transfer

and communication activities supported the research project in achieving its goals and addressing the needs of various industries.



**Are you interested to hear more about 2Boss achievements and relevant research related to the topic? Please contact:**

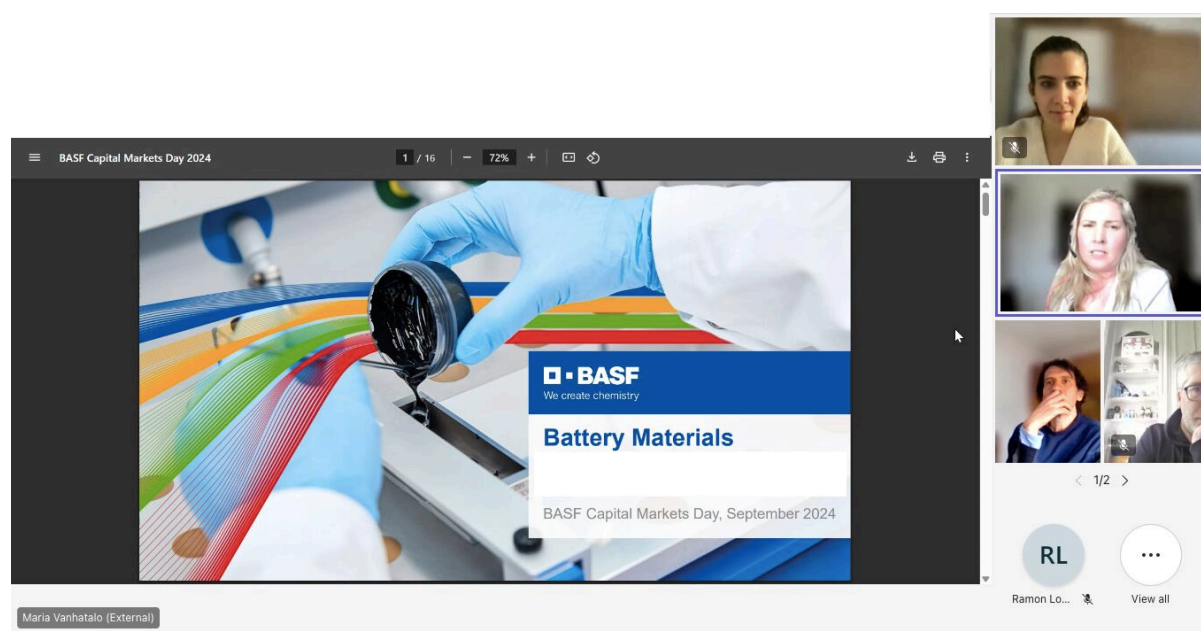
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## 2BoSS Project Drives Circular Innovation in Industry with Final Living Lab event

The 2Boss project brought together top European research labs and combined expertise from the fields of Advanced Materials, Renewable Energies, Recycling Processes, Industrial Innovation & Competitive Automation and Circularity, including Life Cycle Assessment (LCA) & Social LCA in the final Living lab event organised in March 2025.

The event's main goal was to co-innovate together with leading industrial players, such as BASF, TIALPI and RoboAI and present the final outcomes of the battery prototype project.

The key presentations and facilitation of co-innovative work for Living Lab meet were leading researchers Andreu Cabot (IREC), Elisa Accorsi (PoliTO), Giulia Pezzin (PoliTO), Michael Carboni (CEA), Pascale Chenevier (CEA), Timo Santa-Nokki (RoboAI), Pirta Ihamäki PhD., M.Sc. (Tampere University of Applied Sciences) and industrial and circular innovation experts Laura Martinez Garcia (Cleopa GmbH), Christiana Panteli (Cleopa GmbH), Pauliina Harrivaara (Cleopa GmbH) and leading industrial sector representatives Maria Vanhatalo from BASF and Lodovico Ramon from TIALPI - FRELP BY SUN.

The living lab process started in 2022, bringing together researchers, regulatory bodies & industry pioneers. We would like to show our gratitude also to those key experts like Dr. Alessandra Manzini, dr Meenu Sharma, Denis D. and many others who played a major role from the start and were bringing together latest academic research, sustainability and circular design.

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The **2BoSS project** aims at developing a battery technology based on silicon, sulfur, and biomass-derived carbon, supported on a cobalt-free Li<sub>2</sub>S based cathode and a graphite and lithium-dendrite-free silicon-based anode. It's being designed for a circular economy, minimizing the use of Critical Raw Materials (CRMs) while optimizing performance and incorporating effective recycling strategies, overall aiming to reduce negative environmental, health, and safety impacts.

For more information about the 2BoSS project, please visit our website

[The 2BoSS website](#)



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This newsletter is sent to you as a subscriber to the 2BoSS mailing list. It is intended for informative purposes only. We send it twice a year to keep you informed about upcoming events and developments related to the 2BoSS project that may be of interest to you. 2BoSS has received funding from the European Research & Innovation Program on raw materials to foster circular economy under ID:235

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